universität wien

DIPLOMARBEIT

Titel der Diplomarbeit

“Digital Games as Hypermedia Literature: An Examination of Structure and Visuals in Relation to Film”

Verfasser

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angestrebter akademischer Grad

Magister der Philosophie (Mag. phil)

Wien, 2008

Studienkennzahl lt. Studienblatt:	A 344 299
Studienrichtung lt. Studienblatt:	Anglistik und Amerikanistik (LA)
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Abstract

Digital games have long been a focus of research; recently there have been more and more discussions whether traditional methods of media studies can be applied to digital games, or if an entirely new frame of reference is needed. In stark contrast to these discussions are publications from within the field of game development which mainly focus on the production mechanical and aesthetic aspects of game development, often providing what may be regarded as works of normative poetics. This thesis attempts to put the structure of digital games into a frame of reference with other interactive and non-interactive hypermedia artefacts, showing which narrative structures exist and how they are generated. The narrative structures of the examined games, films and hypertexts are treated as node-based hypermedia. From this starting point, a number of strategies for the creation of dynamic narratives are examined that do not conform to the node-based approach. In the second part the visual side of digital games are examined with cinematic film as a comparison.

The structural analysis shows that the node-based approach is useful for examining many forms of hypermedia, including games. In this sense, digital games can be treated as any other form of media, without the element of interactivity disrupting the model. The dynamic and sometimes autonomous methods of creating narratives cannot be observed in mainstream game development yet, the current trends in the field point towards more linear, film-like presentation and layout of narratives. This analogy is confirmed on the visual side well, where digital games acquire more and more filmic traits.

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1 Introduction

Digital games are unique in many ways. Unlike any other form of media they turn the reader into a participant, offering the freedom and power to shape each instance of reading into an individual experience. Visually digital games have advanced a great deal from their beginnings in university basements, with current technology providing means to generate almost photorealistic images and provide film-like depictions of characters and actions.

On the other hand the genres and themes of digital games have remained largely static for the last decade, with no perceptible shift away from the domination of action games. Stories, it sometimes seems, are added as an afterthought or as decoration, with little possibility for the player to partake in any meaningful way. Despite mainstream gaming usually foregoing narratives in favour of pure action there are a number of instances where meaningful player interaction is possible. This thesis will attempt to provide a survey of the different methods used to convey interactive stories, starting out with pre-written narratives in digital games and various other hypermedia. The assumption is that digital games with pre-written narratives will conform to the same rules as other hypermedia systems. A node-based framework for examining branching stories will be applied to a variety of examples to illustrate the different strategies and techniques that can be used in conveying pre-written narratives in an interactive context.

As a second part the question of narratives without authors will be raised – several strategies for creating stories with the help of automated systems will be discussed, as well as their implications for the current perception of gameplay.

Finally the influence of cinema on digital games and the way games tell visual stories will be examined from a technological point of view, putting various visual effects of digital games into the framework of cinematic photography.

The main focus is to explain the current state from a technological and production-oriented point of view. Historical developments or cultural influences are not the primary concern.

2 Key Concepts

One of the biggest perceived differences between digital games and any other form of text is interactivity. In film for example, the recipient is by design a passive observer - each recipient gets the same stream of data. Games on the other hand do not allow passivity:

> While any text allows the reader to skip certain passages, or read the ending first, and some literary works even give the reader a choice of different endings (for example, John Fowles´ *The French Lieutenants Woman*), this form of participation is always voluntary. In Adventure there is no choice: in order to read, the reader must participate in constructing the text or vice versa. Still, the player´s progress in the game is dependent on literary conventions of plot development and description. (Kücklich, 97)

The key difference is that digital games react to the recipient - the recipient does not only shape his own media experience, but also the game world itself, according to the built-in rules of that world. The changes are visible and quantifiable. This may seem trivial, but the two-way communication that occurs when engaging in a digital game is defining for the key differences to the access of non-interactive media.

Leaving the recipient out of the equation for the moment digital games are left with two large parts - on the one hand the shared inventory of audiovisual media, images and sounds that are to a large extent predefined. On the other hand are the rules according to which these non-interactive media occurrences - building blocks of sorts, are assembled and recombined when interacted with by the player. These rules of interaction are generally referred to as game mechanics - they govern what happens when interaction takes place.

Thus digital games consist of content and game mechanics. The relative importance of either part differs depending on genre and context of the game. In the following chapters content will be regarded primarily as a vehicle for containing and delivering narrative, not as individual occurrences of audiovisual artefacts.

If one were to apply a more general media perspective "content" would describe everything that is at its core non-interactive and extrinsic. "Game mechanics" means rules by which the game world functions. A movie or book does not need mechanics since no interaction will occur - the author has already laid down anything that happens in the content, there is no need for further rules. Anything

not already in the content is irrelevant.

This spectrum can be applied to media in general - film and books would be at the "content" end of the scale while games like "tag" and "tennis" would be at the "mechanics" end of the spectrum. In-between is a large area of digital and non-digital artefacts.

The division between content and mechanics is a technical one, largely shaped by how game systems evolved from a production point of view.

When non-interactive media content is mixed with interactive passages, the player is required to change his role as a recipient very drastically and quickly. When watching a full motion video sequence it is necessary that the traditional traits of a movie-goer are adopted: lean back and watch. Then, as the level of interactivity rises to “gameplay” the recipient is required to become participant again, and vice versa. This creates a very inhomogeneous playing experience that is generally viewed as detrimental to the overall experience (cf. Adams and Rollings, 183ff).

How does this relate to narratives? Chatman (19) defines narrative “[...] as the means by which the content is communicated.” In digital games this can take many forms, ranging from fmv sequences to scrolling text to a monologue spoken by a character. Adams’ and Rollings’ (189) determining factor is that narrative within games is always noninteractive. This is can be applied to all instances of pre-written narrative in digital games in the widest sense but is not a useful distinction for any methods of story creation that does not require linear blocks of pre-generated content.

In general, most literary definitions of narrative are only applicable in digital games or hypermedia with restrictions. Ryan states that

> The inability of literary narratology to account for the experience of games does not mean that we should throw away the concept of narrative in ludology; it rather means that we need to expand the catalog of narrative modalities beyond the diegetic and the dramatic, by adding a phenomenological category tailor-made for games. (Ryan)

Since most digital games rely on the exchange between interactive sequences where the player deals with the game mechanics, and non-interactive sequences when the player receives chunks of narrative a system is necessary to relate how this array of narrative islands may be traversed.

In the following chapters a model of organising and structuring these heterogeneous sequences will be presented, which will then serve as a basis for further analysis and discussion of a number of examples, covering the most prominent phenotypes of hypermedia.

3 Node Trees as a base for structuring content-driven hypermedia

3.1 Definitions

In order to allow further structuring of the narrative stream of a nonlinear medium, certain units of specific content, interaction or meaning must be defined. These groupings of heterogeneous content will be referred to as nodes, which have predetermined relations and connections to each other and are largely self-contained[1]. Regardless of medium, a node will have certain contents: interactions, non-interactive material, relational information, variables and many more.

The analogy that is often used to explain nodal structures is that of beads on a string - each bead is connected to the next by the string, only that some beads may have more than one connection to other beads.

The node tree model is very similar to branching trees used in algorithm design, however since the main focus of branching trees is a different one these structures in relation to storytelling and content in digital games will be referred to as node trees. The term branching trees comes from computer sciences and refers to any kind of data structure that features parent and sibling nodes. Its common abbreviation is b-tree. The main application of b-trees is structuring data in such a way that it can be easily indexed and searched (cf. Neubauer, Semaphore). While this is not an issue for content management in hypermedia, the advantages of a node-based tree system are manifold.

Node trees can be viewed as a strictly hierarchical instance of traditional hypertexts[2]. This is an important distinction because hypermedia is not necessarily hierarchical or directed, as in the case of an html hypertext. The distinction between tree-analogous models and rhizomatic structures (cf. Yoo, 113ff) lies not only in the absence of hierarchy, but also in the unrestricted interconnectedness and decentralised structure, similar to the topography of ARPANET[3] (Yoo, 114).

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[1] Self-contained in this context means that each node can function as a segment of the narrative without relying on the content of other nodes and does not allow the traversing of node boundaries except in strictly defined instances.

[2] for a summary of nodes and linking in hypertext cf. Sturm, 27ff.

[3] Acronym for ”Advanced Research Projects Agency Network”, an information network implemented by the U.S. Department of Defense that would eventually grow into the internet

The approach to view narrative as nodes is not new; Chatman (53) describes narrative hierarchies and differentiates between kernels and satellites. In his model, kernels are nodes that are critical to the integrity of the narrative and provide the branching points for the structure. Satellites are minor plots that can be eliminated from the narrative without compromising the whole.

In the context of digital games nodes are tools for developers to control and structure the amount of interactivity the player can exercise in regards to the narrative. For critical analysis they provide the means to structure all kinds of hypermedial artefacts with a high degree of granularity and precision. The ideal subject for node-tree based analysis are games of progression[4] (cf. Juul, 72), although most hypermedia and digital games with progressive elements can be examined as node trees (cf. Juul, 82f).

The notation of node tree structures is from the top down, i.e. the first node called root is at the top of the graph, all other nodes branch downward and outward from there. Downwards generally corresponds to the temporal dimension in story time. Adams and Rollings (197) refer to these structures as “branching story structure” (cf. Adams and Rollings, 197).

The advantage of the node based approach is that it is very flexible as to the kinds of media it can be applied to. From interactive film to hyperfiction and digital games all instances of interactive media can be examined as node based networks. As a special case it can even be applied to non-interactive artefacts such as films.

The following chapters will explore the different traits and possibilities of the node tree model, specific examples illustrating these traits will be discussed separately.

3.1.1 Restrictions

So far there is no standardised definition or nomenclature for this kind of hypermedial structure. In some cases turns, similar to turns taken in non-digital

(Hauben, I-II).

[4] Juul (67ff) describes games of progression as games that present consecutive, mandatory challenges to the player. The proposed test of progression and emergence consists of finding a game guide on the internet – if the game guide is a walkthrough, i.e. a linear description of the individual steps required to succeed then it is a game of progression; if the guide provides tips on how to play the game in question is most likely a game of emergence.

games are used as a method of organising the narrative, in other cases where the implied interruption between turns is not wanted a different method of organisation is used. The interactive drama Facade which occurs in a real-time environment uses “beats” as the unit of organisation (Mateas, *Interactive Drama*, 43ff). The hypermedia creation software Storyspace[5] which does not include a temporal dimension organises content into “writing spaces”. These can be filled with interactions and content, as well as placed within a web of hyperlink relations, with connections leading to and from different areas within a writing space.

The node tree model however can be applied regardless of the intended chronology or granularity of the individual units, it is a method of organising the building blocks of the narration, how in a specific instance of experiencing the narrated (cf. Prince, 26ff) plays out is up to the player and how he interacts with the pathways between individual nodes. It must also be noted that the application of a node-based system may become pointless for hypermedia that is not based on authored narrative content, with narrative understood as “[recounting] a certain number of situations and events occurring in a certain world.” (Prince, 61). While the node tree model may be applicable to some digital games that are largely free of authored narrative content, the definition of individual nodes will in these cases often coincide with structures based in game mechanics, e.g. level partitioning or objective-based gameplay. In either case, the underlying gameplay system will pervade many of the nodes, making the node boundaries diffuse and thus largely useless for analysis. These games are more suitable for analysis within the phenomenon of emergence (Juul, 73).

3.1.2 Traits

Nodes, both as narrative units and data structures have certain common traits that apply regardless of the medium they occur in. In the following sections some of these traits will be examined more closely.

3.1.2.1 Dimension

A node will always have a certain dimension – either temporal or spatial. This

[5] (20.07.2008) <www.eastgate.com/storyspace>

means that they have clearly defined boundaries that include start- and endpoints. In the perspective of the recipient a node will usually exhibit temporal characteristics, although the flow rate of time within a node is dependent on both the author and the reader. The specific dimension of a node depends on the application of the node tree model – a node can encompass anything from an entire scene to a single gameplay interaction. As long as the node is self-contained the model will remain useful. Self-contained in this context means that all actions or interactions within the node only lead to the specified outcomes of that node, and do not interact with any part of any other node directly.

3.1.2.2 Relations

Nodes are always arranged in a hierarchal structure - a node may have parents, children and siblings. The pathways between nodes are usually one-directional, and the relationship causal, i.e. once a certain outcome has been reached it is not possible to go back to a previous node and access the contents of that node again. Pathways between sibling nodes rarely occur, since siblings usually represent different outcomes of one choice (cf. Adams and Rollings, 197-198).

This hierarchy represents the temporal flow of the story, however it must be stressed that the difference between telling time and told time is crucial here - child nodes are always related, narrated, told or transmitted after their parents, this however does not mean that they may not contain bits of narrative which have their own temporal frame of reference (cf. Juul, 147ff).

There are exceptions to this rule of course, but allowing child nodes to link back to a parental level creates a number of problems. The main problem with linking back is that the flow of the narrative is disrupted, either the children of the node that is linked back to are invalidated by the trackback or certain variables have to be transmitted back to the parent node, which presumes the existence of another, underlying structure that crosses node boundaries.

3.1.3 Content

In their most abstract form nodes are containers. They contain everything that will eventually make up the combination of authored contend and gameplay that the player or recipient experiences. A node may contain any of the following:

3.1.3.1 Plotlets

Since each node must carry the narrative forward a node usually contains some form of author-intended content that is pre-generated and to a large degree immutable. This content can range from traditional linear media content such as text, audio or video to non-interactive content of higher granularity that is meaningful only in the context of the interactions that are available. These small bits of narrative usually serve a specific function, either advancing the plot in a certain direction, or revealing back-story about the characters or the world. Typically the sum of these plotlets in the primary path – the path that leads through all nodes from the beginning to the primary conclusion - conforms to the traditional layout of Aristotelian drama.

3.1.3.2 Interactions / Gameplay

In digital games a node must offer some form of interaction, either through game mechanics or narrative choices. In most cases these interactions are not very rich or varied, but in order to serve the purpose of the node they don't need to be.

It is important to differentiate between the narrative structure and gameplay. In node-based systems they coexist within the same network, but do not interact except in the most superficial way.

The differentiation between narrative interactions and gameplay is best described in terms of impact on the narrative whole. A narrative interaction typically has high impact on the outcomes of the node, but comparatively little interactivity. Typically this would come in the form of accepting a task, choosing a path or eliciting a certain dialogue outcome. A gameplay interaction however offers a very high degree of interactivity, but little impact on the outcomes of the node. Typical gameplay-based interactions are puzzles and combat. The objects of the interaction are only marginally interesting to the story of a whole, and generally of little more consequence than expendable or replaceable tokens. For the outcome of the narrative, it does not really matter what the player interacts

with. To exemplify, for the outcome of *Star Wars* it is of little consequence how many Storm Troopers are shot by Luke and Han Solo during their daring escape; in the context of the narrative they provide a generic, replaceable challenge that needs to be overcome. As props for gameplay however they provide complex and challenging micro-interactions for the player.

3.1.3.3 Outcomes

A node can have one or more outcomes. Nodes without outcomes are dead ends, which may be acceptable for narratives that are intended to terminate at different points. The selection of the outcomes must always lie with the player; however this does not always mean that the player can actively select how the story goes on. The outcome can depend on many different factors, such as player performance during a preceding gameplay-based sequence, or certain variables that were modified by player action - or inaction - at an earlier point.

3.1.3.4 Supernodes: Nodes containing nodes

Since the use of node structures is only a means to an end, it is entirely possible to have nodes enveloped within nodes. A specific game challenge might be encompassed within a node, but several available strategies to solve the challenge may each spawn their own branching trees. From a development point of view this has the advantage of tightly constraining the outcome choices while offering a perceivably high degree of interactivity within the supernode.

3.1.4 Variables

Since the basic node structure only offers limited one-way relationships between nodes directly above or below the current level of hierarchy the introduction of an additional element is necessary in order to allow the more holistic tracking of user choices on the game world. Of course it would be possible to simply add another branch to every possible user action that may influence the narrative later on, but since a lot of the nodes in-between may be the same a system with no redundancy will be less resource intensive and much more elegant to handle.
This is primarily done through the use of variables - variables are of certain types[6] and have values in the format of their type. Usually variables are global, that

[6] E.g. Boolean for yes/no choices, integers to store numbers and strings to store text

means that all nodes potentially have access to them.

A node may also access a number of global or local variables. Usually the player may interact with the values of these variables in some way. A node may also use values of variables that have been set previously. The impact that the introduction of variables to a node structure has is quite profound and discussed below, since the use of variables changes the overall workings of the structure.

3.2 Different Types of Node Tree Structures

With this non-specific model of organising narrative and gameplay structures, a number of different styles and combinations emerge. All of the below are possibilities of applying the node model, and have their counterpart in the present and past landscape of digital gaming. Typically however, a combination of the models listed here is used.

3.2.1 Immediate Branching

In this model of node relationship each node spawns pathways to child nodes for each possible outcome of the parent node (Adams and Rollings, 196). This can be used to represent a variety of content with relatively straightforward interactions. Most adventure books used this kind of branching. Typical examples are binary outcome choices[7], or mutually exclusive outcome choices. Immediate branching is the most basic structure that can be found at the core of all node-based decision tracking engines. Chatman (56-57) calls texts with multiple outcomes "antinarratives" since they dissolve one of the main foundations of narrative logic, namely that one thing must

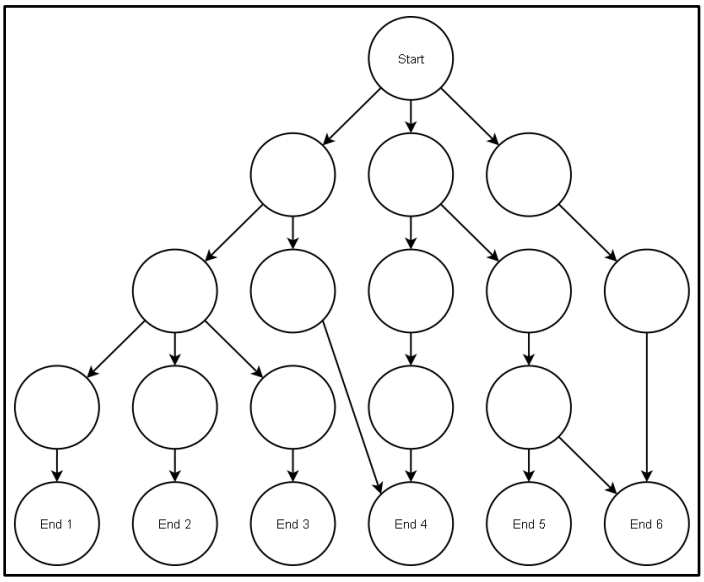

Fig. 3-1 Branching Tree

[7] i.e. a choice between outcome a and NOTa

follow another (cf. Fig. 3-1).

Since the simplest form of author-intended narrative is a single strand of actions that leads to an outcome, the earliest forms of interactive multimedia relied on very linear systems. There are two special variants of immediate branching structures that were implemented in various media at different times in the development of interactive entertainment:

3.2.1.1 Trunk Only

This type of node structure has only one choice at the end of each node. This means that the narrative can only move in one direction, there are no true choices to be made. Within the nodes there are usually puzzles, they have no effect on the author-intended narrative and have to be solved in order to move the story forward. Typically this type of structure was used in early CD-Rom based games which relied heavily on pre-generated movie sequences, and puzzle-based adventure games ranging from the late eighties up to the present. Crafword (*Interactive Storytelling,* 130) calls this kind of structure a "constipated story"(cf. Fig. 3-2).

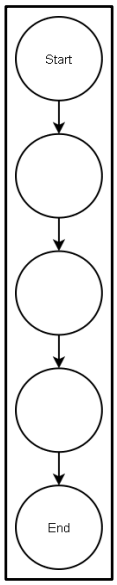

Fig. 3-2 Trunk Only

3.2.1.2 One Path

In contrast to the trunk-based structures that allow for some interaction within the nodes, one-path systems offer choices at the end of each node, but only one choice will lead the player forward.

Most notable and high-profile example of this strategy was *Dragon's Lair.* It consisted of an animated film by Don Bluth that allowed player interaction at certain intervals, prompting the push of the right button. Each node consisted of a short video sequence and the choice of several button pushes at the end. Any key press that was not the correct one led to the demise of the protagonist and would require the node to be replayed. While Dragons Lair was commercially successful it is argued that this was only due to the novelty effect of quasi

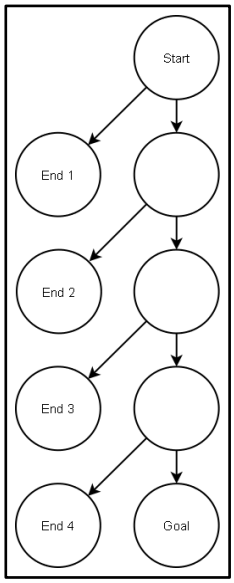

Fig. 3-3 One Path

interactive full motion video. The subsequent mass of follow up projects failed commercially as well as critically (Crawford, *Interactive Storytelling,* 98f, 130f). Similar structures were used in digital games for years to come, however they utilised many of the strategies discussed below in order to alleviate the negative effects on the player created by the "push the right button or fail" methodology (cf. Fig. 3-3).

3.2.2 Deferred Influence - Flags

This kind of branching occurs when a choice made by the player has an effect in one or more nodes that are not directly linked to the current node. The effects of the current choice or action become apparent further down the narrative stream (Adams and Rollings 196). Generally this is handled by tying the player's actions to "flags". A flag is usually a Boolean state variable and thus can have either 1 or zero as a value. Flags can be used to track all kinds of developments throughout the game world. Whenever a node is encountered that needs to "check back" if an event or action has occurred previously, the relevant flag is checked. The most basic example in hypermedia is that of the key - if the player picks up the key in one node, which is without immediate visible effect - only the variable "key" is set to active, he may open a door and thus create a different outcome in another node further along the game.

Deferred influence choices add a layer of complexity to the underlying hypermedial structure since from each point where a deferred influence marker can be activated, all nodes must check against that, and all other potential markers. However, due to the fact that a single array of variables can be used for tracing flaggable actions, the underlying data structure is simple and fairly easy to handle. Theoretically every possible pre-determinable, i.e. author-created player choice can be flagged, thus tracking the player's movement through the narrative with a very high degree of accuracy. The only limiting factor is that a flag without a resulting impact on a later node is pointless, so enough opportunities have to be created to let the players know that his actions were remembered by the game world.

The most common usage of this in digital games and hyperfiction is the inventory. The user may pick up items within the game world and use them at a later time. A

node further down the narrative path will allow the usage of an inventory only if the flag has been set, i.e. If the object has been acquired before.

Apart from the inventory which usually has little to no impact on the narrative, there are other uses of flags that enhance the perceived responsiveness of the game world. In digital games this kind of delayed impact action is commonly used to surprise the player and strengthen the feeling that the game "remembers". To achieve this effect only very few, non-consequential flags have to be set and acted on. It is not necessary to influence the outcome of the narrative or the actual choices the player can make, only to occasionally remind him that there is some entity in the background actually watching what he does, thus reinforcing the image of a fully responsive game world. Some games do use this technique to influence the eventual outcome of the game, but since every flag that has an effect on the node structure of the game reinforces the exponential effort problem inherent to node structures, it is generally not used to a large extent (cf. Fig. 3-4).

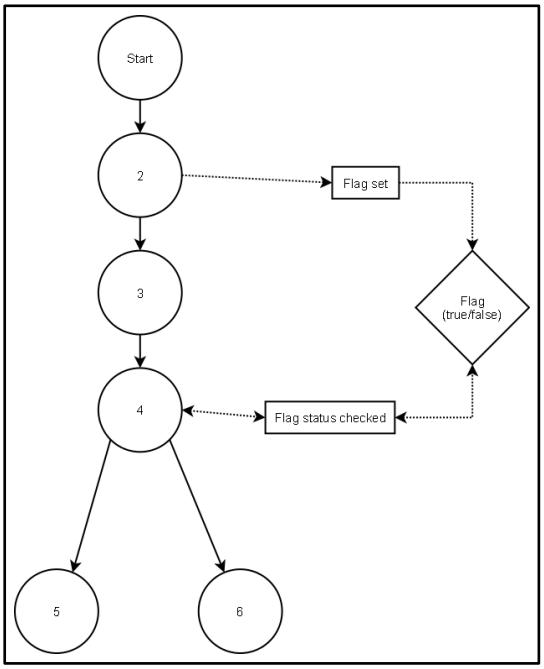

Fig. 3-4 Flag Structure

The following posts illustrate how strong an impression this creates, even if the effects are completely irrelevant to the outcome of the game.

A very complex and powerful example can be found in the game *Deus Ex*, a first person shooter with rpg-elements and strong emphasis on multiple solutions to puzzles.

> Right near the beginning, just as soon as you enter the UNATCO base for the first time after your mission. First time through, because I'm the sort of person that likes to explore his games...I went straight into the ladies toilet. Inside there is this woman who suddenly turns around and glares at me and says "How unprofessional. Expecting a show?". Completely threw me by suprise [sic], I laughed so hard. This is furthered when in the briefing for your second mission, your boss will actually tell you off for this incident.[...] It gets better too. The woman you walk in on appears in subsequent visits to the base, and she will either scold you or just express apathy depending on whether or not you went in there. (user Aventine, (28.09.2007) <http://forums.somethingawful.com>)

User Wilikai retells his experiences:

> In Chrono Trigger, there's one point where your character is put on trial, and suddenly all these little things you've been doing the whole game catch up to you and bite you in the ass. For example, some guy at the local fair has a meal on a table. If you eat it, he gets mad and runs off. You don't think twice about it until that guy shows up during the trial to testify against you and your thieving ways. ((28.09.2007) <http://forums.somethingawful.com>)

In Bioware's 2008 game *Mass Effect* this a similar effect is created by allowing the user to select a handful of back stories for his character, more or less archetypal traits such as "sole survivor", "war hero" or "ruthless commander" which are then referred to by various characters throughout the game.

3.2.3 Cumulative Influence - stats economy

In this case of branching the players actions have an effect on certain variables that, once a certain threshold is reached may trigger a specific path in the current node (Adams and Rollings, 196). A typical case of cumulative influencing are gateway nodes tied to level achievements or character stats.

In the realm of adventure books this would simply mean that the player keeps track of his characters hitpoints or wealth of gold coins. Losing a hitpoint in barroom brawl may not make a difference now, but if two fights down the road hitpoints are exhausted a different outcome is generated (Adams and Rollings, 521f).

In digital games this often comes in the form of a certain number-based overall goal that must be reached, either for the completion of the game or the completion of a segment of the game. Since this strategy has been used since the beginning of digital entertainment it is relatively well accepted by players. Typically a certain percentage of tokens must be found or earned in order to successfully continue. While a bare-bones system of token collection may work well within the context of action/arcade games with only a very light author-intended narrative, games with deeper and more complex stories would probably be adversely affected by a simple collection task that is not integrated into the story (cf. Fig. 3-5).

Here, in some cases NPC stats are used instead of tokens. This is usually done by tying certain outcome choices to the relationship a player character has with an NPC. In its most simple for this is represented by a slider along the dimensions of "I like you" and "I don't like you". If the player does things that "please" the NPC in question the slider moves more to the positive side. These actions usually consist of puzzles or specific tasks, but can also contain purely gameplay based interactions like killing enemies. As soon as a certain level is reached, additional choices (typically in the form of quests) are unlocked.

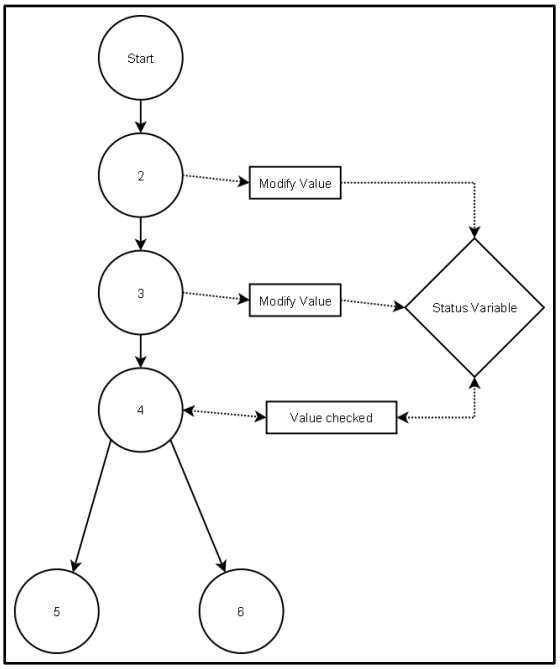

Fig. 3-5 Stats Structure

The Game Writers Special Interest Group provides a different example using a similar variable based system for character interactions:

> Initial State:Affinity (Han, Luke) = 0
> Luke and Han bond:+ 5 Affinity (Han, Luke)
> *Each time* Luke rescues Han:+ 10 Affinity (Han, Luke)
> *Each time* Luke accidentally hits Han in the foot with his light sabre:-3 Affinity (Han, Luke)
>
> A possible condition to test whether or not Han acts the hero in the finale might be:
> If Affinity (Han, Luke) > 5 Then
> Saves Luke

As the above example shows affinity systems are fairly easy to implement and can provide a great deal of additional depth because they will take previous actions of the player into account.

There are several games that used character affinity variables to lightly influence gameplay. Current examples would be *Oblivion,* where each NPC had a certain attitude[8] towards the player and would not divulge certain information and quests if the value was too low and *Star Wars: Knights of the Old Republic*, in which the attitude variable was centred on the player character[9]. NPCs would react

[8] The attitude was represented as a 100 point scale along the axis of like/dislike.
[9] The player character had a single scale ranging from "light side" to "dark side".

differently according to their preference.

3.2.4 Threaded Branches

Threaded systems are different to the node tree structures discussed so far. In this structure the player can access several branches in parallel, experiencing different narrative strands according to his preferences and the structure of the story. The major advantage is that similar to films and novels, multiple narrative threads can be combined to result in an engaging story.

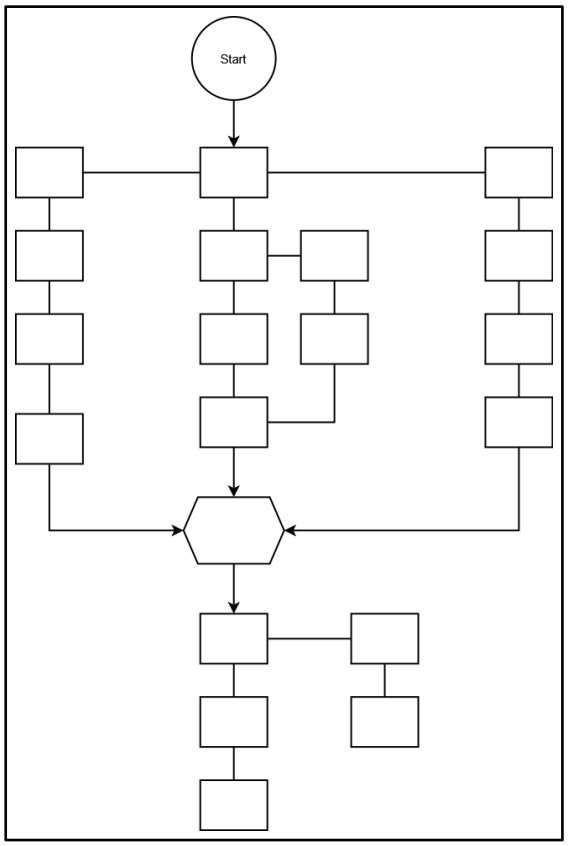

Fig. 3-6 Threaded Branch Structure

For this system to work, a number of additional requirements are necessary. Fist, the player can access the threads at will, each thread may lead to a conclusion, and there may be several threads that lead to a single outcome[10].

Outcomes of a single node are not solely dependent on the interactions within the node, but may draw on outcomes of other nodes. This means that there may be requirements for the story to proceed that can be expressed as AND and XOR relationships. For example, in a detective game one of two key witnesses has to be found for the next pathway, in the form of a clue leading to a new location to be opened. Game Writers Special Interest Group describes these relationships as mandatory and non-mandatory plot events.

It is necessary to note that just because it is possible to access multiple threads at a time it is not possible to go back to past nodes (cf. Fig. Fig. 3-6).

This system has been used extensively in adventure games such as *Diskworld Noir* or *Blade Runner*. The advantages of these systems are high freedom of movement for the player and low frustration level since there are usually several

[10] cf. inevitable events

challenges to overcome at a time. If the player gets stuck in one thread he can simply continue with another one. The main problem of threaded node structures is that the high degree of interconnectivity makes change tracking during development very difficult. This in turn leads to much higher QA efforts, since it is nearly impossible to exhaustively test a system that allows such a large number of different possible playthroughs (Game Writers Special Interest Group).

3.3 Problems of Node Trees

Node trees, as largely predetermined and self-contained entities create a number of specific problems when applied to a narrative environment. This does not mean that they are inherently unsuited as structuring mechanisms for interactive narrative, but that the application of this specific form of content-driven structuring requires specific attention to certain problematic areas.

3.3.1 Combinatorial Explosion

Using branching tree structures in digital games carries a huge advantage in the amount of apparent flexibility that can be offered in contrast to linear media such as text and film. However, this flexibility comes at a steep price. Since each real choice that is offered to the player creates a new branch in the network of nodes the amount of content required tends to rise exponentially as the number of choices increases (Adams and Rollings, 199).

From a production point of view this is incredibly problematic for two reasons: On the one hand it cannot be expected that a player will replay the narrative over and over again until he has exhausted all the possibilities, this means that most of the content that has been created will not be seen in a single playing of the game. On the other hand the continuing technological advancements in computer graphics make content the one area that is most rapidly increasing in complexity - with each generation of hardware content creation becomes more and more expensive.

This means that branching trees are only viable if ways can be found to curb their tendency to complexify themselves into unfeasibility.

The amount of content required is easily calculated. Assuming a hypothetical hypermedia story with an amount of n true choices before the story reaches its

conclusion, and each node containing an amount of k outcomes.
The amount of true choices until the conclusion is reached is the depth of the tree – each true choice adds another layer of children to the network. The amount of outcomes each node contains is equal to the amount of new nodes that are spawned in the next level in the hierarchy.
The start is always a single node.

This means that with depth=n, branches per node=k, amount of nodes per depth level = A

$A(n)=k^n$

and the total amount of nodes for a tree of n depth and k branches per node is

$\text{Sum } A(1..n)=k^1+..+k^n$

This means that for a b-tree 10 levels deep – nine true choices to be made by the user before the conclusion is reached (the initial node at the first level has no „in“-path attached, i.e. It is the default starting point) – with three possible outcomes for each choice the total amount of nodes is 29524. If the amount of choices per node doubles, the total sum of nodes rises to 12093235, more than 400 times the amount of nodes with only 3 choices.
Even with only three choices this is an unmanageably large amount even if only a fraction of the content for each node must be original.
This shows that the depth of the tree is the main factor in deciding the amount of required nodes, the amount of choices per node a secondary factor. However, since the overall length of the game or work of hyperfiction is usually a set requirement, simply reducing the depth is usually not an option. Several other strategies are employed in order to keep growth in check. The most common of these is applying foldback schemes, which are discussed below.

3.3.2 Limited freedom of interaction

While the level of interaction and sheer number of individual choices presented in node-based models may be impressive at first, it soon becomes apparent that the amount of outcomes is always limited. In the example above, the total amount of choices seems staggering; however only allowing three possible outcomes in any choice or scene that occurs in a digital game cannot by any means be called freedom of choice. This, in combination with the fact that the three available choices are constructed by an author with a specific narrative intention in mind means that a branching tree based model must always have very carefully chosen outcomes. When applying this to digital games, where most of the nodes contain challenges or problems for the player to solve, solving the given tasks don't really require real-world problem solving skills. Since all the possible outcomes and thereby the actions that lead to those outcomes are predefined by a designer, it is necessary to get into the mindset of the person who made the narrative, and not to immerse oneself in the narrative itself. A good designer will be able to mask this to a great extent, but the single fact remains that in a narrative-based digital game every available option is available only through the active choice of the designer to put it there. However large the number of options that are provided, the core of the problem remains that the player cannot find his own solutions to a problem. In this respect these games are more like a riddles and less like a puzzles, in the sense that they require one "true" solution to be found and not a solution that works in terms of the game world that is presented. The larger this rift between the designers mind and the game world is, the more infuriating will the dead ends be perceived to be. In early adventures there would be a large number of possible interactions and a low number of actual solutions, the typical system response was "that does not work".

3.3.3 True Choice Problem

One major requirement of any useful node tree is that the amount of effort required to craft content for the individual nodes is limited in some way. This means on the one hand the sheer amount of input needed and on the other hand the amount of choices significantly altering the plot. As books and movies have

repeatedly shown, creating an engaging, believable plot in a linear medium is difficult enough to achieve. When burdening the writers with multiple paths, choices, possibilities for character development and multiple endings, the complexity soon reaches a point where it cannot be guaranteed that each path that leads to a conclusion is also a path that still works as an engaging plot.

The plot of digital games can usually be summarised, even those with a strong interactive narrative component. This means that even though there are a lot of choices the player can make, there is still mainly one direction the narrative will go.

Within the choices that are available, those that do not have a significant impact on the narrative work better[11] towards the overall goal of providing an exciting and engaging narrative. This can be seen as the primary symptom of the opposing forces of interaction and narrative - the less the player can engage with the story, the less likely he is to break it. The more interaction is possible, the less likely the outcome will be produced that was intended by the author.

This means that paradoxically the node-based model works better the less interaction it tries to offer. This has been discussed as the primary reasons why node-based structures are not really useful for the long-term goals of interactive storytelling.

[11] since they create less or weaker branches.

3.4 Foldback Structures

The single most useful tool in controlling node trees is the use of foldback structures. This means that instead of each choice generating more choices at a certain point a reduction in choices sets in, reducing and combining pathways thereby limiting the available strands of narrative. Foldback structures can be applied in variety of severities, with the effects on the player being more pronounced the sooner after a node with multiple outcomes the foldback occurs. The strongest manifestation of foldback structures is the inescapable event. It occurs when all outcome pathways from sibling nodes merge into one node - no matter what choice is taken, the outcome is always the same (Adams and Rollings, 200f). While this does provide a clean slate for all further pathways, and drastically reduces the associated effort, it is also the most visible and immersion-breaking symptom for players. Whenever a player encounters a visible foldback all of the player's previous choices are voided in terms of the player's involvement in the story-making process. It could be argued that by subjecting the player to a foldback event (provided that the player is aware of the foldback) the contract between player and designer is broken, since the game was up to this point played under the impression that the choices the player took were real ones. A game will "break" when too many foldbacks become apparent since there is no reason for the player to have any form of investment into the game experience - active participation becomes secondary since no matter how big the effort is the player is effectively relegated to the position of passive recipient (Crawford, *Interactive Storytelling,* 126ff).

However, since no narrative-based game can currently afford to do without foldback structures, the inescapable event is and has been for twenty years one of the most visible symptoms of games failing at narratives[12]. Adams and Rollings (202) however "[...] think it´s reasonable to use inevitable events to establish plot-critical situations that the player cannot reasonably expect to prevent or change."

[12] Cf. Bates *Storytelling Panel*.

3.4.1 Inevitable Events

The typical foldback consists of several pathways being recombined into one, i.e. multiple strands leading into one node further down the stream. The node that all paths lead back to is referred to as inevitable events (Adams and Rollings, 200ff). Game Writers Special Interest Group calls this phenomenon “parallel paths” and describes it as a special case of a fully recombined branching structure. While in Adams’ and Rollings’ model there are connections between the main parallel paths, in the Game Writers Special Interest Group model the pathways are independent of each other until the inevitable event. These parallel paths can be applied as equal choices or hierarchical options depending on player skill. This means that if the player fails one challenge, the story keeps going through an easier, alternate route. A tertiary “catch-all” path provides a safety net to keep the story intact even if the player does not overcome any of the gameplay challenges.

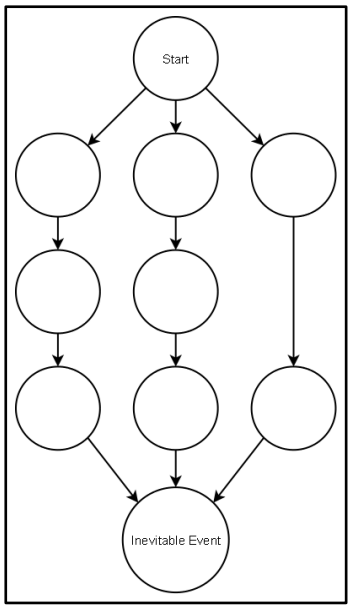

Fig. 3-7 Inevitable Event Structure

Inevitable events have the advantage of allowing seemingly true choices for the player without the extreme authorial load that come with branching tree structures. Despite this the overall effort in parallel path structures is still a multiple of that of a linear flow. In addition to that, extra effort has to be taken to control all references to previous player choices, this means that after a foldback each reference to events that occurred before the foldback must either happen in such a way that they do not include the specific player choice, or draw upon variables in order to let the story engine “know” what the player did (cf. Fig. 3-7).

Of all the nonlinear interactive narrative structures, this has been the most widely applied in commercial game development, mainly due to the additional effort for content creation being fairly low, as well as the fact that the tracking of all the possible outcomes is easy (Adams and Rollings, 202).

3.4.2 Loopbacks

In a loopback a player choice is effectively revoked by restoring the state before the decision was made. This kind of foldback was frequently used in early console RPGs, where the "other" choice was often only cosmetic.

As an extreme example Nintendo´s *The Legend of Zelda* included dialogue, but only in a as means to convey back-story and instructions to the player. While there were some choices, they usually resulted in immediate loopback to before the choice, eg. „Will you save the princess“ yielded two possible answers (Yes and No), however selecting „No“ would cause the NPC to simply pose the question again.

Increased loopback distance will make the fact that a loopback occurred less apparent, however it is almost impossible to mask a loopback so that the player does not notice.

In current examples loopbacks are mainly found in parts of multiple choice dialogues that are not critical to the development of the story. In these cases the player can usually pose questions again and access the same paths multiple times. A good example of this can be found in almost any dialogue of *Mass Effect,* which will be further examined later on (cf. Fig. 3-8).

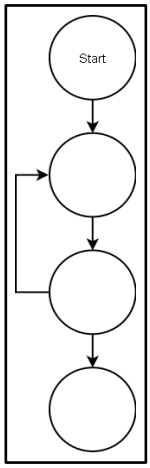

Fig. 3-8 Loopback Structure

3.5 Limiting the negative effects of foldback structures

In order to cushion the negative effects of foldback structures they are usually employed with great care and in such a way that they are not overly apparent to the player. Crawford (*Interactive Storytelling,* 126f) argues against using foldback schemes at all since they give the impression to the player that there are meaningful choices to be made when in fact there are none. Since the discovery and the resulting feeling of being cheated is inevitable once the storyworld is replayed, foldbacks should not be used at all (Crawford, *Interactive Storytelling,* 129). Since there is a distinct lack of alternatives, especially when applying node tree structures to commercial game development, many strategies have been devised to mask foldback events and give the impression that there are true choices to be taken.

3.5.1 Increasing foldback distance

The most visible foldback is one occurring immediately - the player might either guess or try out the other path, and realise that the choice he just made had no effect whatsoever at the outcome of the game.

Increasing foldback distance, i.e. distance from the first branch that is effectively rendered meaningless by the foldback does require more content in between but makes it much harder for the player to determine where the narrative path first turned towards the inescapable event.

3.5.2 Masking through variables

Linearity can also be masked by using variables as flags for future events which seem causal, but do not carry a real significance for the development of the narrative pathways. Typically this is done by flagging certain game events (i.e. the game "remembers" certain occurrences, certain places the player visited, persons he talked to, things he did by simply setting a yes/no flag) and referring back to these events in nodes farther down the pathway. The outcome in the node further downstream must be independent of the possible outcomes of that node - otherwise complexity creep will set back in.

These self-reference events make the narrative seem more homogenous than it really is. The main challenge is incorporating these events well enough into the game world so that the fact that no mention will ever be made again of the act of remembrance does not seem suspicious in itself.

Crawford (*Interactive Storytelling,* 126-127) argues that by using variables that connote meaningful choices the inherently fraudulent foldback scheme can be positively applied. He gives an example using inventory variables to give meaning to the foldback (*Interactive Storytelling*, 127). This example is flawed in terms of a node based system of narrative since the nodes in Crawford's model are based on location, not narrative content. In terms of interactions, his example would consist of different pathways: If the acquisition of the potion is the only way to reach the goal the structure would be completely linear, if not then it would result in parallel paths and no foldback would take place at all.

3.5.3 Foldback by similar solutions

Another increasingly popular method of creating apparent diversity is to shift the focus of the choices the player can make away from the narrative. This means that while the foldback occurs very soon after the initial choice, the alternatives are not complementary, but synonymous. This means that the effect on the narrative is marginal, and that the how of the pathway that led to the outcome ceases to be important as soon as the sub-goal of the current node has been reached.

For example, a player might be presented with several possibilities of crossing a river - each presenting distinct challenges (challenges that will reside in the area of gameplay, not content) and requiring distinct solutions. However, as soon as the task is completed the effects on the following nodes are nonexistent, a foldback has occurred but without devaluing the players choice.

It must be noted that while this strategy is seemingly ideal because it limits the amount of options that have to be presented to a very small, controllable arc and does not create any kind of dissonance in the player if the foldback is noticed it does so only because any effect on the narrative was excluded beforehand. In the example above, the player would never have had any option of not crossing the river.

3.5.4 Focusing on Gameplay

The most effective way to work around the problems of node-based narratives is to make them secondary to gameplay in the sense of interaction with the game mechanics. This may seem like a very drastic step, but it has been argued that games are simply not good at presenting deep and engaging stories, and that games consistently fail at creating emotions outside of rage, exhilaration and frustration (Cf. Bates, *Storytelling Panel*). It has been proposed multiple times that digital games should in their primary role as entertainment focus on game mechanics, since gameplay based interactions invariably offer much more interactions of finer granularity[13].

[13] cf. Rolston (*Vast Narratives*) who gives powerlevelling and powerharvesting as examples of an area that works well in digital games. He states in his presentation that games should not use deep and complex stories because they will invariably fail at presenting them. Instead, a simple

This approach invariably reduces the importance of the node based narrative network, leading to an experience that has more emergent than progressive properties [14]. These types of narratives will be discussed in the chapter "Environmental Approach".

3.6 Examples

The use and structuring of nodes is of course largely driven by the technical processes that are necessary for developing any form of hypermedia - the sheer amount of data that is invariably necessary to fill a node-based web requires tight control of the underlying assets and interactions. Since this kind of structuring has been used since the early era of digital games, there are a variety of examples that help illustrate how different instances of node trees work.

3.6.1 Adventure Books

As hardcopy instances of basic hypertext documents adventure books gained popularity in the mid-eighties, building on the previous success of pen and paper gaming systems such as *Dungeons and Dragons* (cf. David Cook). The idea was to provide the "choose your own adventure" functionality of pen and paper gaming without the need for other players. Most adventure books of that period were intended for children and young adults, drawing heavily on the themes already established in fantasy gaming.

An adventure book was at its core a large collection of numbered chapters, each of which directed the reader towards the next chapter. Some chapters gave the reader limited choice about where to continue reading, e.g. "In the *Ice Dome* the cave forks. Do you want to continue your treasure hunt in the left branch (continue at **145**) or in the right (continue at **97**)?" (Sklenitzka, chapter 33, own translation). This allowed the reader to generate the reading experience by making choices as he went along - when it comes to narrative modern digital games offer exactly the same functionality.

Some adventure books tried to introduce variables as a secondary layer - players would have inventory lists or track hitpoints across chapters, causing different

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premise like "The bad guys have your stuff – they must die" works best

[14] Cf. Juul 72ff

outcomes depending on their stats or inventory. Some books also added a rudimentary game mechanic in the form of dice throws for certain challenges, in essence a simplified version of the combat and skill systems available in pen and paper gaming from the late seventies onward (cf. David Cook). A good example of this can be found in *The Golem of Brick Lane*, which allows the reader to create a player character with a number of different attributes and skills. These numerically represented attributes serve as a basis for the combat system while the skill selection is dependent on attribute values[15] and provides options for the combat system, as well as alternate paths during the reading of the adventure.
While adventure books have almost disappeared from the modern media landscape, their role as precursors of modern hyperfiction and nodal narrative structures is undeniable.
The core features of adventure books were

- Well-defined nodes with non-interactive content and interactive content.
- Hierarchical structures with one-way choices
- Branching of node trees
- Randomised events as a gameplay layer
- foldback structures
- tracking of variables

All of the above are traits shared by digital hyperfiction as well as digital games.

The following excerpts, taken from *Der Schatz im Ötscher* will be used to illustrate the different traits of node structures present in this literary hypertext. In this adventure book from the mid-eighties the player takes on the role of a spelunker trying to find a fabled treasure in the Ötscher-massif. He or she navigates the tunnels inside the mountain and encounters various challenges, usually in the form of mystical creatures from local folklore. Apart from the typical multiple choices and chapter-numbering this book also features a random element in the form of a dice throw, which is included in the book as die faces at

[15] All skills have a corresponding attribute, if the attribute is higher than a fixed threshold value, one of the corresponding skills can be selected. Attributes are set by distributing a fixed number of points on all attributes.

the corner of each page. The player can substitute a die throw by flipping through pages and stopping at random. The chapter numbering is arbitrary apart from chapter one, chapters that follow one another in the narrative are rarely within five pages of each other.

The first example occurs when the player has reached the lake, and chooses to throw rocks at the water sprite that lives there (Appendix, Der Schatz im Ötscher, Excerpt 1).

Here several things can be observed. First, the nodes – corresponding to chapters, are well-defined and have interactive content (the dice throw) and non-interactive content (the narrative text). The text structure is hierarchical; the player can only go forward at the end of each node. The randomised event of determining whether the player hit the water sprite or not are determined by dice throw, although the random element is weakened by providing the consequence within the same chapter. Other books only provide links, thereby further limiting the player's choice of which path to take. Finally, a foldback can be observed at the end of chapter 39, where each dice throw leads to the same outcome, thereby invalidating the dice throw.

The same book also features very limited variable tracking in the form of inventory items. In Fig. 10-1 the entire structure of the first section of the adventure is illustrated. The first section roughly compares to the departure of the hero according to Campbell (49ff), with chapter 144 providing the supernatural helper when the player has the option of buying sunglasses from a little old lady, and the crossing of the first threshold (Campbell, 77) after chapter 5. The event in chapter 144 which is optional has repercussions much later in chapter 71 which is not depicted here. In this chapter there are two possible outcomes depending on which model the player bought. Regardless of the choice, a foldback occurs two steps further on.

The most notable features that can be observed here are several loopbacks to previous nodes, as well as an inevitable event in chapter 88, which provides the gateway to the next section of the adventure. There is one node with a randomised element (73), depending on the outcome the narrative continues with the inevitable event or further invalid paths. The loopback from chapter 73 to one and from 85 to 5 can be considered game over events since the loopback carries the reader back to the beginning and effectively forces a restart of the adventure.

3.6.2 Literary Hyperfiction

The area of literary hyperfiction is currently the one field where node-based structures are most apparently used. Eastgate's hypermedia construction program *Storyspace* uses a node based system as a basis for content creation. Aimed not solely at authors of literary hypertexts, *Storyspace* offers possibilities for creating scientific, educational and game-like hypertext. With this broad range of usage in mind, *Storyspace* fulfils all of the requirements for creating node tree based hypermedia. Each node can be filled with content and interactions, pathways between nodes can be defined and a fairly complex variable management system allows using both flags and stats for deferred or cumulative influence on nodes. Since *Storyspace* has a number of export options, as well as being a viewing tool as well as a creation tool it can also be utilised for structuring or planning of more complexly layered hypermedial artefacts.
Hypermedia created with *Storyspace* can have the following traits:

- Well-defined nodes with non-interactive content and interactive content
- Hierarchical structures with uni- or bidirectional choices
- Branching of node trees
- tracking of variables

3.6.3 Film

Yoo (199ff) uses the broad term hyperfilm for filmic entities in a hypermedial context, but does not differentiate between interactive and non-interactive occurrences. His examples range from linear films with non-linear stories to films that are organised along interactive principles, i.e. hypermedia with film as content.
This means that it is possible to treat traditional film as a special case of node-based hypermedia. The node boundaries are not as clearly cut since there is no interactive element to impose divisions – hence another unit of organisation must be chosen. Dependent on the type of analysis this may be a scene, a paragraph of dialogue or a location. The usability of the model becomes apparent

when applied to films with multiple storylines which behave similar to threaded branches, but with a fixed viewpoint and no viewer interaction.

When an interactive element is added to film, or film sequences incorporated into some sort of gameplay structure, the node-based model can be applied without restrictions. The field of interactive movies however seems quite diverse, ranging from puzzle-based games padded with movies, to movies that allow choices every now and then that can be played on a DVD player. Their rise began in the early 1990s with the CD-ROM becoming more common, thus providing the technological foundation for film to be incorporated in PC games. Apart from a few notable exceptions the production value of the filmic sequences was criticised as being very low, especially the integration of live-action footage with computer generated backgrounds was very problematic (Perron, 237-238).

For this discussion interactive movies will be defined as any kind of interactive narrative structure that incorporates non-interactive fmv sequences that can either be live action, animated or computer generated.

In regards to narratives the granularity was invariably high since movie sequences inherently have a certain minimum length; the amount of player choice was low due to the fact that each additional branch would require additional film material to be produced. This is true for both ends of the spectrum, ranging from the *7th guest* on the side of puzzle game interspersed with fmv sequences to *Dragon's Lair,* which featured fmv throughout, but did not allow the player to deviate from the predetermined path. Created by Don Bluth, a Hollywood animator and producer known for films such as *American Tail*, *Land before Time* and *Titan A.E*[16]. *Dragon's Lair* was based on full motion animated videos of quality similar to Disney animation films of that period. Originally released as an arcade machine in 1983 it was re-released in 2002 on a DVD-player compatible format (Perron, 244). It was based on a one-path structure, allowing only for linear progression or game over. The outcome selection occurred depending on user inputs, the player had to press the correct button at the correct time or the main character would meet a usually gruesome end.

Since DVD player menu structures offer only very simplistic interactions, the

[16] Internet Movie Database. (20.07.2008) <http://www.imdb.com /name/nm0089940/>

interactive movies of that period featured only very rigid structures with no additional variables or stats carried from node to node.
As hybrids between games and film they were operating under the restrictions of both - which left the end-result often unsatisfactory both as a film and a game.
The core traits that can be observed in almost all examples of interactive movies are:

- Well-defined nodes with non-interactive content and interactive content.
- Hierarchical structure with one-way choices
- One-path or branching node tree structure

Depending on the type of interactions that occur between the movie sequences the list can be extended to include further features of node-based systems. In some instances complex gameplay layers were available between the filmic sequences[17].
From the boom of interactive film caused by the success of Dragon's Lair emerged many other examples, most of which would extend the range of interactions by providing true choices at the end of each node, the structure that was most commonly used was that of the inevitable event through parallel paths. Due to the much higher authorial load of fmv over text the amount of nodes and thus the amount of content-hours was much less than in current or past hypertexts.
At the end of the 1990s the interactive film genre had faded from the market, being surpassed by the rapidly growing graphical performance of 3d engines and the more responsive interactive environments created with them. In terms of reception interactive movies were always received with mixed reviews, even in instances where high-profile actors were involved (Perron, 283, 255).

3.6.4 Digital Games

Digital games have almost always relied on some sort of node structure to track narrative. However, since here the narrative is often mixed with gameplay, the

[17] in the *Myst* series puzzles needed to be solved, in *Wing Commander 3* the gameplay consisted of a 3d space combat simulator.

differentiation is not as easy as with other hypermedia instances.
To exemplify this, one chapter of the Action-RPG *Mass Effect* will be examined in detail.
In *Mass Effect* the main gameplay elements are moving through the environment and shooting enemies. These are set in an extensive framework of node tree driven narrative that is related mainly through cinematic dialogue. In addition to this, there are several mechanisms of flag and stats tracking that influence multiple interaction layers.
In order to understand the node-based system, all layers including the gameplay layer have to be examined. The individual layers sorted from highest to lowest level are:

- Main story segments as supernodes containing
- Non-interactive cinematic sequences
- Node tree based dialogue
- Gameplay sequences with linear outcome
- Underlying stats and variable system that influences all layers but the topmost

3.6.4.1 Superstructure

The superstructure is fairly simple (cf. Fig. 10-2). The game progresses from one location to the next, in some cases allowing player input as to the order in which the individual locations are played.
The initial progression is linear: Normandy, Eden Prime, Citadel. Each of these has clearly defined conditions for the next chapter to become accessible. After the final subtask in the Citadel has been mastered, the player may choose from three new locations: Feros, Noveria and Dig Site. Once two of these three have been completed, a fourth location, Virmire becomes available. These branches are effectively threaded to a degree, this means that the player may visit them in any order, or in some circumstances leave one and continue the story at another. During this segment of the game the player may also visit secondary locations, that are heavy in gameplay challenges, but do not influence the main story.
Once all four locations have been completed, the progression becomes linear again, linking Citadel, Ilos and Citadel Tower.

All locations are linked by the player's ship, which serves as a location of its own, housing characters and dialogue interactions.

3.6.4.2 Variables

Permeating almost all layers of presentation is a complex system of stats and variables. Several different components exist that influence specific areas of interaction.

Flags: Before the game starts, the player creates a "background" for the avatar, choosing from three predefined histories and three psychological traits, called "origin" and "reputation". These are referred to by various other characters during the game, as well as each background having a specific sub-plot that occurs during a certain segment of the game.

Stats - Abilities: The player character and the controllable NPCs each have a set of values describing their abilities. Most of these abilities provide numeric boni to combat such as accuracy and damage, other govern special attacks. This means that the stats primarily influence the gameplay portion of Mass Effect.

Stats – Traits: The player character also has two additional values which each link to an ability. These are Paragon and Renegade points which are rewarded for good and bad deeds respectively. Once these reach certain thresholds, the player has access to two additional abilities called charm and intimidate, these open up additional dialogue options. Through this a feedback loop has been created that reinforces playing within the boundaries of morality as dictated by the game.

3.6.4.3 Node based analysis

The Eden Prime supernode (Appendix: Mass Effect, Eden Prime, Structure 1) will be examined in detail, listing all components and their relationships. In this case the node boundaries have been set to coincide with the kind of interaction that is possible:

Cutscenes offer no interaction, Dialogues are visually similar to cutscenes but allow dialogue interaction and gameplay segments consist of moving the player character through a 3d environment, usually fighting enemies but also solving minor puzzles, such as finding switches).

Playing through this segment takes approximately 20-40 Minutes, including all spoken dialogue.

The notation is [Type (description) trigger, outcome]. Type specifies the kind of interaction that is possible, description provides a brief summary of the contents, trigger describes on what condition the segment is activated and outcome specifies the impact on the following nodes. If no outcome is listed then the next node is called up without additional parameters. Nodes that are tagged optional can be accessed from within the preceding gameplay segment, if they are not accessed gameplay continues with the next gameplay segment. It is necessary to note that gameplay is listed as several nodes because the primary factor is interactions, not location within the 3d environment. In most gameplay nodes it is possible to walk the avatar back to the location of the previous gameplay segment, however the interactions are usually not repeatable.

The example shows clearly that the structure of the resulting narrative is completely linear. The player's interactions have effects only on the level of gameplay, even though these choices are cleverly disguised as having narrative significance. Through the fast pace of the developing story and the density of dialogue the player is actively discouraged to try out alternative paths. The result is a subjectively engaging game world that offers a seemingly high degree of interactivity.

3.6.4.4 Dialogue

The dialogue depicted in Fig. 10-3 is a typical dialogue in Mass Effect and illustrates several strategies used to keep the effort required for content low while providing a large number of possible ways this dialogue can play out. There are a number of immediate foldbacks, as well as several inevitable events. Since in Mass Effect the dialogue that will be spoken by the player character is not written out in full, but paraphrased this offers another opportunity to reduce content without giving the player the impression that his choices are meaningless. There are also two instances of loopbacks, which are there to allow the player to review critical background information. In these cases the loopback is obvious and there has been no attempt to mask it.

Four of the dialogue options leading to further information are accessible only if the player character has high enough charm or intimidate scores; the outcomes are the same for both.

3.6.4.5 Gameplay

The gameplay sequences are in themselves linear, in the term of Crawfords constipated stories (Crawford, *Interactive Storytelling,* 130), the only possible outcomes, apart from activating optional dialogues are moving the narrative forward to the next node, or player character death.

3.6.5 Dialogue as Branching Trees

Dialogue is one of the most interactive forms of communication possible. Paradoxically in digital games dialogue is what is most problematic in terms of interactive depth. The main problem lies in the fact that dialogue as a very high time/choices ratio - in no other area is it possible to encounter so many story-critical decisions per unit of time. This of course drastically accelerates the rate at which the range of possible outcomes expands in relation to playing time (Rolston, *Vast Narratives*, 2007).

If one relies on author-intended, pre-scripted text for dialogue, the number of choices and outcomes must be limited in some way, for this the strategies for limiting complexity within node trees are fully applicable.

The use of node based structures for multiple choice dialogue has been largely unchanged in the last two decades. This can be attributed to the fact that the technical requirements for interactive dialogue haven't changed at all, and that so far there hasn't been a commercially viable alternative available (Adams and Rollings, 210ff).

In the screenshot in Fig. 3-9 a typical dialogue screen from Sierra Entertainments 1993 release *Gabriel Knight: The sins of the fathers* is shown. Notable is that the dialogue occurred in a different view than the typical game environment in which scenes were always shown from a perspective similar to a wide shot. Since due to low resolutions characters faces were only five pixels high the depiction of character faces during dialogue

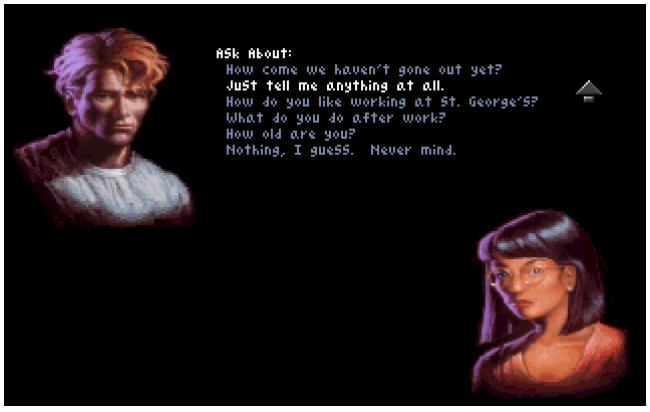

Fig. 3-9 Gabriel Knight Dialogue

provided a practical way of adding visual detail to the characters. In *Gabriel Knight* the player selects one of several choices via mouse cursor; each choice will yield a response and either link to a sibling node, or display the information and link back to the main node. This commonly used strategy in dialogue ensured that there would only be one possible outcome of the dialogue, thus greatly limiting the effort required for content.

In the second example in Fig. 3-10 the dialogue system of *Mass Effect* is shown. Here, dialogue interactions take place in a slightly closer framing than the in-game view, although the break is much less visible than in the previous example. The number of choices in this screen is typical, and illustrates the general trend of reducing dialogue options in favour of other content. The dialogue choices shown on screen also do not correspond exactly to the spoken dialogue, but are paraphrased and shortened versions of the text the character speaks when selected. This allows for much quicker assessment of the available options, and avoids the problem of repeating in spoken text what the player has just read and selected. It also introduces another obscuring layer between player input and game output, thus allowing different dialogue choices to lead to the same outcomes. Since *Mass Effect* usually features three main characters, the player character and two AI-controlled NPCs that fight alongside the player, the dialogues are to a large degree independent of the characters that are present. This is necessary due to the fact that these sidekicks can be selected from a pool of up to six available characters. This distribution of dialogue occurs whenever the secondary characters have non-specific lines of text. This means that the lines for each dialogue remains the same (with the exception of character-specific sub-plots) merely the character that speaks them changes. This still causes a lot of extra effort due to the fact that all dialogue from secondary characters has to be recorded for each of the characters, but is preferable to scripting individual dialogues for each situation and character combination.

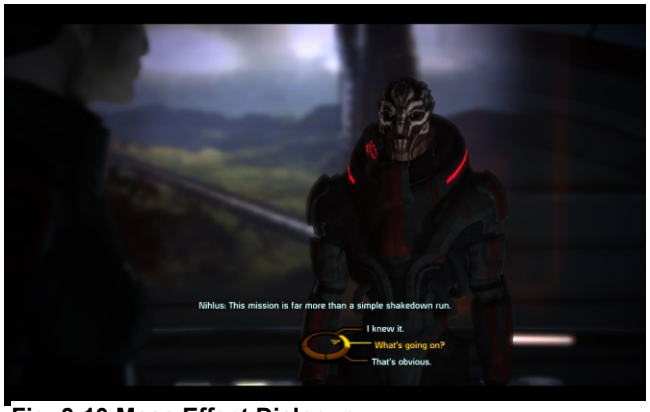

Fig. 3-10 Mass Effect Dialogue

3.7 Summary

It can be concluded that while the mix of non-interactive narrative elements and interactive, gameplay mechanics based elements is a problematic one, it is still the most viable solution for the digital games of today. Without prewritten narratives, no engaging story can take place - while this is not a problem for some genres, other genres must still rely heavily on pre-scripted content.

In the next section strategies will be explored that attempt to circumvent the problem of authored vs. player created content.

4 Automated Story Creation

Stories created entirely without the need for writers have long been in the focus of artificial intelligence researchers. The range of topics in this field is broad and ranges from human language interfaces to drama generators. For the realm of digital gaming this area is very promising, because it may offer ways around the limitations that author-generated narratives pose, as discussed in the previous chapters. There are several different approaches, ranging from the phenomenon of emergence [18] to data-driven story engines and attempts at procedural generation of narratives.

Emergence is a phenomenon that occurs only through player interaction with the game rules, there are no external components or planned story structures (Adams and Rollings, 202). Data-driven systems assemble stories by combining pre-created components according to a specified set of connectivity rules. These are usually specific to the individual components, such as what component may follow a certain event (Crawford, *Interactive Storytelling,* 146f). Procedural generation shifts the emphasis from data to rules. Here the focus is to create a set of algorithms that can govern a large variety of interactions. While procedural systems will always require some sort of data as a basis, the rules are not tied to the individual components, and the result is more like a simulation than a linear narrative.

Most applications in this field are combinations of the approaches listed below and cannot be clearly slotted into any one category. Some of the more recent or noteworthy examples will be looked at in combination with their theoretical background.

[18] To this date the debate to what constitutes emergence in the context of digital gaming is still going on, for an overview cf. Juul 80-82

4.1 Emergent Narratives

In some cases narratives occur where there is no predefined, author-generated content or intended mechanism of story creation at all. The phenomenon of emergence in a broader sense can be observed when a set of usually very basic rules allows the creation or formation of phenomena that were not explicitly included or intended in the initial creation of the rule set. Juul (73) notes a “basic asymmetry between the relative simplicity of the game rules and the relative complexity of the actual playing of the game”. In the case of narrative, emergence "[...] refers to storytelling produced entirely by player actions and in-game events and without any narrative blocks created by a writer" (Adams and Rollings 202, LeBlanc). This means that whatever narrative-like structure occurs, it does so only through the interaction of the player with the ruleset of the game world. This may seem self-evident but is notable because it means that the emerging narrative is implicitly player-driven. This means that the player has a large degree of influence over when and how the narrative progresses. Adams and Rollings (202) state that the main advantage of emergent narrative "[...] is that the sequence of events is not fixed by a linear or branching structure, so that the player enjoys more dramatic freedom. He can bring about any situation that the core mechanics will let him create."

It is important to note that narratives that are created in this way are generated by the act of playing, i.e. they can be told after the fact. The process is similar to the retelling of children’s games, especially games with freeform rules such as "Cowboys and Indians". In this example the game itself is an opportunity for the creation of a story that can be told and retold after the game has ended. A similar occurrence has been noted by Riedl when conducting target audience interviews with young girls - a key factor of play was the discussion of previous games, the discourse of events and not the playing of the game itself.

It may be argued that this is applicable to every kind of game, even games with very strict rules such as chess. The same holds true for most digital games, however some games rely on this more than others.

One of the earliest examples of non-narrative emergence is *The game of life*, a simulation of cellular automata, i.e. an array of intelligent cells each of which was behaving according to a very simple rule set. After several simulation cycles larger organised structures of these sim-cells were observed, which exhibited

cyclical movement patterns (Juul, 78-79). In combination with input from complexity theory the concept of emergent phenomena was born: "the idea that sufficiently complex systems can generate even more complex phenomena that the systems ɪs original creators never expected" (Crawford, *Interactive Storytelling,* 136). LeBlanc terms this a "complex system", meaning that the rules are inadequate to describe the behaviour of the system. In non-digital games, the same would apply to chess or go - the rule set is fairly limited and simple, however the patterns that emerge during player interaction with the rule set are complex, meaning by his definition a system exhibiting emergent properties, such as gambits[19] and knight forks[20] (LeBlanc).

Emergent narratives are problematic for several reasons. One of the main problems is that the underlying mechanisms of dramatically meaningful stories have to be translated into machine-readable algorithms. At the Game Developer Conference 2000 Marc LeBlanc talked about the difficulties in getting computers to create emotionally engaging stories, without too much repetition, randomness or contradictions (LeBlanc). Another major point of criticism is that the narratives generated in this way are very limited. While they may technically fulfil the definition of narrative according to Price, they are severely lacking when it comes to providing drama (Crawford, *Interactive Storytelling,* 142-144). While there are usually obstacles to overcome, these narratives provide little in terms of characterisation and character development. Most of these games are played out as journeys, the distance covered is only geographical or temporal and the hero is, apart from a few statistics immutable in the sense of the hero's journey (cf. Campbell).

The following chapters will illustrate two of the main approaches in trying to create, or rather cause the phenomenon of emergence.

4.1.1 The Gameplay Approach

This broad category of games is purely based on its game mechanics, they may have a beginning and an end, but between the individual game segments there

[19] A gambit is a move where a piece is sacrificed in order to bring his opponent into a disadvantageous position, or gain a tactical advantage himself. For an explanation and a listing of commonly used gambits see (20.07.2007) <http://chess.about.com/library/weekly/aa04g10.htm>

[20] A fork occurs when one piece threatens two opposing pieces simultaneously.

are no noticeable distinctions[21]. Some of them are truly perpetual, as in having no goal or end condition. These games can be found at the very beginning of digital gaming history, as well as today. Typical examples are *Space Invaders*, *PacMan* or any game with orthogonal unit design[22]. Most of these games do not feature anything resembling a narrative, thus any discussion regarding them would lead to the area of gameplay design where emergence is a possible and wanted phenomenon, but has very little to do with stories. There are however some examples where this approach leads to narratives, primarily the Sims series and various by-products thereof. As one of the most successful digital games today *The Sims* are notable not only for their commercial success, but also for the source of their audience appeal. In *The Sims* the player becomes the managing agent in a quasi-living household of virtual characters, they sleep, eat, relax and interact with each other. The player's tasks are exclusively micromanagement of everyday tasks such as telling a Sim to do the dishes, to take a shower or to talk to his spouse. The Sims has no explicit goal and no predetermined end. In this respect it may be more appropriate to speak of a simulation or sandbox than a game. Due to the open ended nature there is also no predetermined story. Crawford (*Interactive Storytelling* , 142) notes that "this [game] is not drama; this is a housekeeping simulation. Alfred Hitchcock once described drama as "life with the dull bits cut out." The Sims is life with the dramatic bits removed." Yet still it has captured the hearts of millions of gamers who have spent tens of millions of hours interacting with their puppet-house creations. Each of these players is capable of retelling the story of the life of his or her Sims in great detail, even if there is no actual story in the product. Arguing from the side of emergent phenomena the fact that a story can be told post-hoc is enough[23], but in terms of interactive storytelling it is still lacking since the type of story that emerges is little more than an account of household occurrences. They are lists of things that happened, completely detached from characters and personalities.

Thus one must come to the conclusion that these products may provide engaging worlds and interactions, even stimulate the users imagination but that they do not provide stories of the necessary depth to warrant the name.

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[21] These are the games of emergence as defined by Juul (72)

[22] Cf. Juul 107. Orthogonal unit design means that game entities are designed along the rock-paper-scissors principle, i.e. that no single unit is more powerful than all the others.

[23] Chatman (166) states that "[...] showing can only be an act of telling".

4.1.2 The Environmental approach

An approach that is more in keeping with dramatic narratives is to cause emergence by providing an interaction-rich environment to complement the gameplay elements. The environmental approach has in some instances been used synonymously with the attempt to create emergent stories in games in general (Crawford *Interactive Storytelling,* 137ff; LeBlanc), however in this case the label will be used explicitly for games that feature a predetermined environment that can be accessed through interactions provided by the game rules. This means that complexity and depth is added to a gaming experience by adding elements to the game world the player can interact with. These elements are usually placed in an environment that is open to exploration and experimentation (LeBlanc). It is up to the player to find out what he can do within and with the game world that is presented.

It must be noted however that while there are a number of commercial games that utilise the environmental approach to sustain their gameplay, it does not seem possible to go entirely without an authored narrative[24]. These chunks of narrative are usually embedded in the environmental experience, and usually conform to traditional node-based rule sets. The main difference in application is that the environment provides a framework for all the narrative nodes, either to interact with or simply as a frame of reference. Several multilinear node-bases structures are nested within an environment that offers no direct interaction with the progression of the story, but gameplay challenges of very fine granularity that can be accessed by the player at will.

The method of delivering these units of narrative can vary and seems to be a question of taste, rather than design necessity. One the one hand there are those who argue that storytelling and narrative must rely on certain dramatic conventions, i.e. characters that undergo transformations during the course of the story (Crawford, *Interactive Storytelling,* 140). This requires that the granularity of authored narrative content be fairly low, and that the decisions the player can make within the progression of the story be true decisions. The underlying problems of integrating freedom in exploring and interacting with the world with navigating tightly constrained narrative paths remain the same as in

[24] Cf. *Oblivion, Morrowind* or *S.T.A.L.K.E.R*

traditional node tree models, with no practical solutions in sight. The current strategy is still to allow a limited number of character-defining moments, i.e. true choices as to how the story progresses, but apply the workarounds mentioned above to mitigate the negative effects. Bates (*Storytelling Panel*) not only confirms the necessity for these workarounds but states on the subject of smooth integration of authored narrative and gameplay that "[game developers] have failed for years and years to do that."

The opposing approach is to accept that "linear media are a lot better at story" (Rolston, *Vast Narratives*) due to the fact that they offer "crafted intensity" during every step of the progression of the narrative. This means abandoning the unattainable goal of providing rich, engaging and interactive narratives in favour of components that have been proven to work well in games. This also extends to dialogue, which in this context is sometimes seen as a necessary evil due to the fact that its node-based nature (not only on the dialogue progression but also on the outcomes of the game world) is "incredibly problematic from a player point of view" (Bates, *Storytelling Panel*). Rolston (*ibid*) points out that in most computer games interactive dialogue is the least interactive segment of the player experience and that once "[you, the player] exit dialogue and you're inputting the living shit out of things".

Abandoning linear, pre-generated narrative as far as possible in favour of interaction with the game environment has a number of repercussions. Theme and setting become primary factors over characters and story, freeform gameplay dominates over quest or task-based structures and the position of the player within the world becomes that of an observer, rather than an active participant. Rolston (*Vast Narratives*) terms this as the dominance of the player as a "mute witness" over having interactive dialogue. This has been heavily criticised by Bates (*Storytelling Panel*) due to the fact that "story does not equal revealed back-story"[25].

[25] This remark was in reference to *Oblivion*, of which Ken Rolston was the lead designer. A typical occurrence in *Oblivion* would be that the player enters a dungeon through one of the many entrances throughout the game world, battles various foes and defeats a mage as the final opponent. All this occurs without extrinsic motivation. In the belongings of the mage the player finds a letter, in which the background and motivations of the mage as well as his activities in the dungeon are detailed. These details provide only background and have no effect on gameplay or the structure of the narrative. A lot of the back-story is relayed through such texts which by Chatman's (171-172) definition would be called "unmediated texts".

The kinds of narratives that emerge from these structures are focused on fairly simple, interaction-rich tasks that can be repeated at a high frequency with slight variations. Within the genre of digital RPGs these typically include looting, powerharvesting and exploration (Rolston, *Vast Narratives).* A very typical example of this would be *Diablo,* a very action-heavy RPG in which the player character has to explore a multi-tiered dungeon full of monsters, while solving certain tasks that usually coincide with the exploratory flow of the game, i.e. the quests provide rewards for things that occur during the exploration process. Main game elements are the killing of monsters, acquisition of better equipment from dead monsters, called "looting" and the improvement of the characters skills through gaining experience by killing monsters. The only external narrative elements are short bits of non-interactive dialogue that occur outside of the dungeon and provide non-critical back-story and quests.

The environmental approach has been extensively criticised, as it does not provide any true dramatic content, nor any significant influence of the player on the dramatic narrative. Chris Crawford (141) in *on Interactive Storytelling* deconstructs several environmental approaches that may lead to emergent narratives. He lists a number of possible strategies, some of which are relevant to present day commercial game development. The first of these is adding to the size of the three-dimensional world. Arguably, providing more room for the player to explore will enhance the narrative experience. Extending the world sizes is also a marketing factor, as has been observed in the series of *Grand Theft Auto III*, *Vice City* and *San Andreas*, each successive instance in the series providing a larger, explorable city as a backdrop to the arcade adventures that are the main focus of the game. Crawford (*Interactive Storytelling*, 138-140) compares this to the total of locations of star wars, which according to his list number no more than 35. Thus, the amount of backdrops is largely irrelevant to the narrative that is played out before them. He then proceeds to list other strategies, all of which rely on extending the contents of the world the player can interact with. This ranges from props, such as items, objects, vehicles, etc. to agents, simplistic computer-controlled entities that can interact with the player in a rudimentary way and puzzles. While all of the above may add to the volume of possible interactions and thereby to the time that can be spent interacting before repetition occurs, none of these strategies influences storytelling in any way.

The only other noteworthy approach is the application of the "journey structure" (Crawford, *Interactive Storytelling*, 141) to an environmental base. The progression of the narrative is imagined as a journey which puts the player in charge of the rate of progression. While this has been used in many games that combine environmental gameplay with fixed-structure narrative[26] Crawford argues that ultimately the journey does nothing by itself to provide drama. All it does is providing a framework for the individual components of the story that are already in place, thus shifting the problem of interactivity to the components themselves (Crawford, *Interactive Storytelling,* 142). The application of the journey structure leads to games of exploration, discussed in the next chapter.

4.1.2.1 Exploration and Landscape

One variant of the environmental approach is to understand the environment as the physical game world. Exploration is the main gameplay element, thus limiting the need for authored narrative content. Through this the player can chose both the pace and direction, as well as experiencing detailed interaction with the game world that does not cause options in the sense of branching tree structures. The narratives that emerge from these kinds of games are typically travelogues, a character going from place to place, seeing and experiencing, but not interacting with the game world in a way that will leave permanent marks or demand involvement with a predefined story.

Of course exploration without a surrounding framework will not capture an audience's attention forever, so games that have a strong explorative element usually rely on other methods of delivering story as well. However, by embedding the relevant pre-scripted bits in the landscape, the player still has the feeling of freedom that explorative gameplay provides, with the added bonus of always having a storyline to go back to. Typical games that use landscape as a basis for the environmental approach are *Oblivion*, *S.T.A.L.K.E.R* or *Two Worlds*. *Oblivion* will be discussed in more detail, since it is both a current and prominent example of this approach.

Like most of the examples used so far *Oblivion* employs a mix of techniques ranging from sophisticated gameplay to pre-generated dialogue to create a

[26] Most recent example would be *Oblivion*, which allows the player to engage in an unlimited amount of gameplay action in-between pursuing the main plot or side plots.

uniquely immersive experience. It is noteworthy in the context of exploration mainly because it makes all other game elements secondary to the freedom of exploration. While *Oblivion* bears all the hallmarks of a traditional fantasy RPG, including the main storyline to save the world from otherworldly evil, it continually states that this is merely an option and not the required playing experience.

In order to better illustrate this it is useful to compare the story structure of *Oblivion* to that of previously discussed *Mass Effect*. Apart from the introductory chapter, the player is completely free to choose which steps to pursue next. The available options are nested within the environment, a freely explorable world several square kilometres in size. Using the environment as a base there are a number of narrative branches available to the player, including the main storyline. In contrast to *Mass Effect*, the player can choose to do something different at almost every step – this means that the player can abandon the pursuit of the main quest for as long as he would like, go down other paths and return when he feels like it. This offers an incredible range of viable options in terms of a dramatic travelogue, but creates a number of unique problems. First the dramatic cohesion of the individual narrative branches is in danger each time the player reaches an escape point. It is perfectly possible to abandon the assault on the castle while the attackers are cowering behind a wall, waiting for the player character to open the gates for them – the player may go explore a cave somewhere and return two months later only to find the attackers still dutifully behind their wall. Second, since almost all of the locations are accessible a lot of the challenges are initially without dramatic context. Monsters are killed and dungeons are looted simply because they are there. While this is in keeping with designer Ken Rolston's paradigm of allowing the player to do whatever he feels like and then rewarding him for it (cf. Rolston, *Vast Narratives*) it does not make for an engaging story. The third problematic point is that of pure gameplay challenges. Since, as in most RPGs the player character's skills improve during the game the challenges have to scale along with that. In more linear games enemies of different difficulty levels are placed so that they automatically create a quasi-linear progression. In Oblivion, the opponents are always a good match for the player. This always guarantees a fair challenge but takes away all motivation for improving the character since he will never be more powerful than his adversaries.

4.1.3 Effects of Emergence in Games

Despite the drawbacks, relying on some degree of emergence in digital games has a number of advantages. The most crucial element for the suspension of disbelief is a credible, consistent game world. When the player reaches the edges of the game world, either metaphorical in terms of narrative or in a physical analogue 3d representation, he encounters areas that are either not defined, or explicit no-go zones. This means that the higher the desired degree of interaction the larger the game world has to be. And even if emergent narratives in gameplay are mainly based on rules, not content the effort still increases almost exponentially with each type of interaction that is added to the experience. This is due to the fact that each facet of the game world must react to the interactive arsenal of the player - a dilemma not entirely dissimilar to the choice problem of node-based narratives.

Again, the easiest strategy is to simply limit the players' means of interaction. In regards to consistency this is much less intrusive and obvious to the player than arbitrarily limiting choices later on since the rules of the game are easier to understand and implicitly accepted by the player (cf. Caillois, 13f). This is due to the fact that "the game has its meaning only in itself. This is why its rules are so powerful and unconditional; above all discussion. There is no reason given why they are as they are and not any different" (Caillois, 13-14, own translation).

Chess is an excellent example for consistent gameplay, the rules are easily understood and there are no exceptions or areas where the player would expect the boundaries of the game world to be different (cf. Juul, 105f). In games which mimic real-world analogue worlds this kind of consistency is impossible because real-world interactional rules are carried into the virtual world. As soon as there are people-analogous entities, one automatically expects to interact with them as with real people. Any dissonance between these expectations and the offered interactions reduces the consistency of the game world, forcing the player to acknowledge that he is in fact trapped in a very limited world that only pretends to be real[27].

[27] This dissonance is similar to the uncanny valley phenomenon that was observed by roboticist Mashahiro Mori (Digital Worlds, *Uncanny Valley*) when observing emotional responses to artificial representations of human or humanoid beings.

4.1.3.1 Spatial Consistency

Since unlike the real world, 3d-worlds cannot be limitless in terms of spatial expansion there must be limits to where the avatar can go. There have been games that tried to do without world boundaries, such as *Elite*[28] and *Battlecruiser 3000ad*, but all they succeeded in was creating vast, repetitive landscapes devoid of anything interesting to interact with. The only other option is to limit the amount of digital real estate that has to be created so that the areas that are open to the player are filled with objects and interactional entities. However, the spatial limitations can be easily masked - locked doors, walls and high cliffs are standard tool in the repertoire of today's level designers[29]. Other games did offer the virtual freedom to go anywhere, but either punish the player by going to out-of-bounds areas, or take over the controls until he´s pointing in the right direction again. One notable example would be *Star Wars: Rogue Squadron II* on the Nintendo GameCube, where the player controlling Luke Skywalkers Starfighter in the Death Star Trench has the ability to turn around or leave the trench - just to get shot down within a fraction of a second. The result is the same - the universe of avatarised Luke consists of the death star trench, and nothing else.

Especially in games with a strong exploratory element a smooth integration of the world boundaries with the interactional vocabulary of the player is very important. Since the environmental approach is based on freely exploring the game world, its boundaries must not feel constraining to the player. When the player finds a method of circumventing these boundaries, which is always a possibility since the emergent properties of the game cannot be fully predicted, the consistency of the world is destroyed.

[28] Planets in *Elite* were created procedurally, based on randomly generated values. Cf. Boyes.

[29] In *Oblivion* the game world is a large valley, surrounded by mountains. At the edges of the game world the mountains become so steep that the player character cannot climb them – a perfectly credible explanation for the boundary. It must be noted however that in this game the boundary is not complete – in some areas the player can reach the edge of the game world which cannot be traversed. The player simply receives a "You cannot go there" text message as an explanation.

This problem is inherent to all game types that allow or encourage emergent gameplay, even if there is no emergent interaction with the narrative. In this context Smith differentiates between desirable emergence, where the player interaction with the provided ruleset causes a richer and more interesting playing experience and undesirable emergence, where the ruleset is exploited in ways that are detrimental to the experience and contrary to the intention of the author. He cites an example from *Deus Ex* where attaching proximity mines to walls would allow the player to use the mines as a ladder. Since many walls also serve as world boundaries, i.e. they have no content behind them this was a way for the player to act within the possible, but break immersion by looking at the metaphorical non-world behind the stage decoration. A typical game world can be seen from the outside in Fig. 4-1, a screenshot from a level design tool.

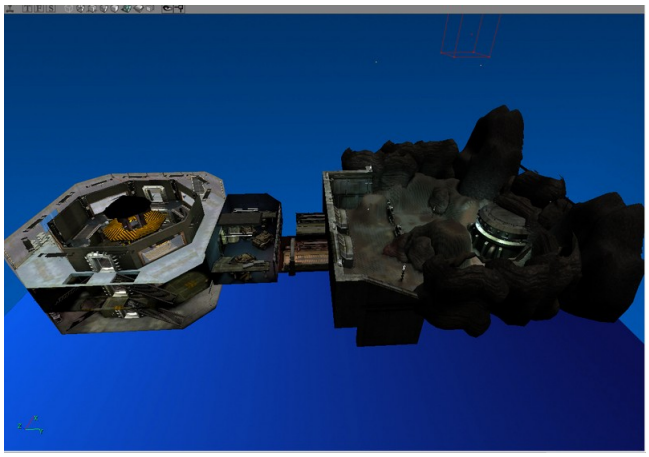

Fig. 4-1 UnrealEd

4.1.3.2 Interactional Consistency

Interactional consistency refers to how game world entities react to the interactive options of the player. A typical example of high interactional consistency would be first person shooters, a prominent example being *Quake* in which player to world interactions were limited to two dimensions: walk and shoot. It would seem that this would make for an incredibly dull experience, both in terms of narrative and gameplay. However, the opposite could be observed. Shooter games have far less problems with maintaining credibility than adventure genre due to the fact that adventure games, especially the generations of text parser based adventures offered a large amount of interactive options[30], but failed to provide interactions with most of the game world for these options.

This means that in the case of games with a low amount of interactive options the degree and granularity of interactions is very high, e.g. the player doesn't have a

[30] The dictionaries of these games consisted of several hundred interaction items, cf. Scheyen.

lot he can do with the game word, but by controlling timing and placement of these interactions the interaction between game world and player is perceived as being very homogenous. This cements Rolston's (*Storytelling Panel*) claim that interaction with an environment, even if only slightly responsive is much more rewarding that character interaction, which carries with it expectations about real-world human interactions that are invariably disappointed.

4.1.4 Conclusions

While the phenomenon of emergence is relatively well understood in the area of gameplay, the creation of emergent narratives is still largely experimental and placed in the wider field of automated storytelling research. Since emergent gameplay has been codified to some extent and can be tested for and thus at least controlled by trial and error (cf. Shelley), while emergent narratives remain elusive. Crawford (*Interactive Storytelling* , 137) points out a major misconception in the application of emergence:

> Although the academics who advance this field of research have developed and refined it considerably, a bastard form of the concept has trickled down to the programmer community as a fervent belief that big complicated systems can be made to produce almost any desired result, if only programmers make them big enough and complicated enough and give them enough time. From this belief the concept of emergent story has arisen, the hopeful fantasy that somehow, if programmers diddle around with complicated systems long enough, they´ll eventually get a story to emerge.

He then goes on to compare the belief in emergent stories with the belief in medieval alchemy, stating that a non-directed assemblage of components cannot reasonably be expected to produce a specific result as desired by an author.
Emergent narratives offer a number of possibilities for game developers, however this approach does not address the needs of interactive narratives (Crawford, *Interactive Storytelling,* 144). Nonetheless, for commercial games the environmental approach offers several methods of creating believable back stories and providing gameplay experience that does not require authored content on a 1:1 ratio. Since games utilising this approach have fared well in the past years, both commercially and critically it can be expected that the trend of supplementing authored content with environment-based gameplay will continue.

4.2 Data driven systems

Some systems rely on large corpora of data as a basis for their storytelling engines. The data may contain subplots, story components or utterances. Data-driven design has been used to a great extent in algorithm design where the development of a hard-coded algorithm-based simulation is not feasible or possible. Instead of a sophisticated algorithm, tables of data are substituted (Crawford, *Interactive Storytelling,* 145-146). The key to data driven design is to externalise as much of the data as possible. This means that the data and the connecting information make up the simulation. The data itself will encompass many different areas such as configuration information, variables that affect game behaviour and gameplay as well as scripts that govern the behaviour of ingame entities (Wöß, 60-61).

In digital game development this method carries a lot of advantages, such as allowing content producers such as designers and artists more direct access to the current working build, as well as providing large portions of reusable code (cf. Wilson), lower overall production risk and the ability of earlier testing but carry with them a number of drawbacks such as high costs in the area of content production, low differentiation between products and a high gameplay burnout rate. This refers to the fact that all gameplay rewards are of the same, usually visceral nature which players may quickly recognise as being repetitive. Gameplay itself changes very limited in data driven game development, this means that while the content, such as visuals and story changes, the underlying mechanisms do not. (Dan Cook; Gilgenbach).

As a method for creating interactive stories the data driven approach is very appealing, because a number of large corpora, some of them already provided with rudimentary connectivity information are available. Connectivity data provides information on how individual components can be assembled into a whole story, and what rules govern the selection and handling of individual components. Since connectivity data for data driven models is descriptive rather than intrinsic large amounts of data are necessary for a more complex system. The basic model of connectivity is a two-dimensional table showing how each component links up with the other components in the data corpus. Simply assembling such data seems like a daunting task, but the real challenge lies in defining the actual nature of the connections, and with them the nature of the

original data sets (Crawford, *Interactive Storytelling,* 146).

Crawford (*Interactive Storytelling*, 146ff) mentions several possibilities, among them verb type connectors for noun-based data or story components based on events. Regardless of the model that is used, each connection possibility has to be specifically designed which means that the effort of creating suitable connecting data increases exponentially with the size of the corpus.

4.2.1 Applicability for Interactive Story Creation

Even if the validity in general algorithm design is questionable, for the creation of stories data-driven models may seem inevitable since raw data is available in abundance. Ever since C.G. Jung's classification of archetypes (Jung et al) extensive data is available about stories, providing a large amount of data that only needs a connectivity model in order to be used for story creation. The spectrum of available data is broad, ranging from drama to folk tales. There have been many later models trying to break down the corpus of folk tales into archetypical components that theoretically encompass the entirety of tales in existence. The most notable of these will be discussed in their applicability to serve as a basis for a data-driven model of story creation.

4.2.2 Annti Aarne and Stith Thompson

Published as *The types of the folktale* this index initially constructed by Antti Aarne at the beginning of the last century and expanded by Stith Thompson in the 1950s provides a vast array of categories for folk tales. The catalogue consists of approximately 2500 first-level entries, some of which contain a number of subcategories. Intended as a base of reference, Types of the folktale is concerned with whole tales, in contrast to the *Motif-Index of Folk-Literature* which tries to list individual motifs, not entire stories. A typical entry in *The types of the folktale* looks like this:

850** *A Girl is carried off to an Island by Robbers*. She kills them with poisoned grass and is taken back home by a young man.
Lappish 1.
(Aarne and Thompson, 285)

Since there is no information about connectivity provided, the data alone is not usable for automated story creation. Crawford (*Interactive Storytelling,* 152) proposes two methods of establishing connectivity between the individual entries. The first and more direct approach is to create a matrix of Boolean variables, with one column and one row for each entry in the catalogue of motifs. Then the author would have to check each individual entry and set the relevant value to "true" if the two motifs are compatible, i.e. if one motif can precede the other. This would only provide the most rudimentary connectivity and does not take into account any preceding conditions. The amount of effort required would still be gigantic, as each entry would have to be correlated with all other entries.
The second approach would be to provide each motif with flags, describing conditions that must be present for the current motif to be applicable. Each of the preceding motifs would be taken into account for the selection of the next motif. While this approach would probably yield more convincing results, the amount of connectivity data needed is much greater than in a simple Boolean matrix and would require in-depth situational analysis of each motif.
So far no attempts have been made to turn the Aarne-Thompson Catalogue into a basis for an automated story creation engine (Crawford, *Interactive Storytelling,* 159).

4.2.3 Georges Polti

In *Thirty-Six Dramatic Situations* Polti, a French writer born in the mid-19th century provides a list of archetypical dramatical situations which he claims encompass all possible dramatic situations. In the preface he alleges that his work is a continuation of Carlo Gozzi who initially stated that there are only 36 situations. The situations are described in detail, each containing a number of variants of a particular situation. In contrast to the Aarne-Thompson catalogue Polti's work includes a brief header outlining the elements necessary for a

situation, followed by a description of the situation. These elements occur only as necessary preconditions for the existence of a situation, i.e. there is no additional information on relation and formation. E.g. *Third Situation - Crime Pursued by Vengeance (Elements: an Avenger and a Criminal)* (Polti 19), or *Twenty-Fifth Situation - Adultery (A Deceived Husband or Wife; Two Adulterers)* (Polti, 81).
While this description of elements may provide a useful basis for a data-driven model of interactive drama, the low granularity of the situations and the lack of connectivity data make Polti's catalogue rather inflexible. Crawford states that *Thirty-Six Dramatic Situations* could become a useful basis for an interactive storytelling engine, but offers no concrete suggestions (Crawford, *Interactive Storytelling,* 159).

4.2.4 Joseph Campbell

As one of the most referred to books in both game design and scriptwriting Joseph Campbell´s *The Hero with a thousand Faces,* (cf. Bates, *Into the Woods*) originally published in 1949 is worth mentioning because it provides a very detailed account of the archetypal structure of any mythological story. Originally intended as a means of analysing myth and legends it has since its first publication been successfully applied to the analysis of a wide range of media, ranging from novels to sci-fi movies. Since then it has often been mistaken for a work of normative poetics (cf. Bates, *Into the Woods*) and applied to character design as a template (Adam, *Storywriting*), rather than a post-hoc means of determining whether a story is well-formed. Still, its uses for structuring and developing linear stories as well as level design are undeniable (Dunniway). So far no attempts have been made to use Campbell's work as a basis for a data-driven system of automated story creation.

4.2.5 Vladimir Propp

In *The Morphology of the Folk Tale* (1932) first published in 1928 Propp analyzed Russian folk tales and came to the conclusion that these contained many similar elements which he called "universal functions". In addition to listing and describing these elements he also provided a method of notation, as well as

some rules describing how individual functions can be linked together. Since of the discussed catalogues Propp´s is the one with the most detailed connectivity data, there have been several attempts to create story engines based on this model which will be explored below.

Propp's grammar is fairly abstract and not complete enough to allow direct translation to a computerised system. Additionally there are a number of exceptions that require special treatment, particularly at the lower levels of abstraction. (Crawford, *Interactive Storytelling,* 153ff) In total, Propp postulated 31 functions, such as "*11. Hero leaves home"* or "*31. Hero marries and ascends the throne (is rewarded/promoted)"*. In addition to these functions Propp states that there are only 7 character types. These do not correspond directly to characters, but rather to roles or Jungian archetypes within the approximately 100 stories that were analyzed. These roles can also be distributed among different dramatic characters, or be transferred between characters. A typical function is described as follows:

II. The hero receives an interdiction. Definition: *Interdiction*; Symbol b.
I. "Into this chamber you must not look" (159). "Watch your brother and do not leave the farm" (113). [...]
Propp (32)

The rules governing the relations between these functions are complex and usually noted explicitly, as in the case of *Sch* (Donation) and Z (Acquisition of the magical potion) that can occur in a number of different variants, with all possible combinations between Sch1 and Sch10 and Z1 to Z9 being individually addressed (Propp, 49). A typical notation for an "acquisition of the magical potion" subplot would be:

Sch1 H1 Z1: The witch forces the hero to watch a herd of mares. A second task follows, the hero succeeds and receives the horse (160).
(Propp, 51)

In the example above H is the function describing the reaction of the hero to the actions of the donor, H1 being "The hero succeeds or fails the test" (46).

Two implementations will be examined in more detail, a mixed-reality application by Grasbon and Braun, and a more complex variant by Fairclough and Cunningham. Others such as Peinado and Gervás show similar approaches or utilise only some components of Propp's classifications such as Prada, Machado and Paiva in their TEATRIX story creation environment for children.
There are also a number of more limited, web-based proppian story generators available. These only assemble stories based on Propp's rules and initial user selections without interactivity and are good examples of the limitations of Propp's ruleset for story creation. Lim et al. have created an applet that assembles story elements according to user selection. The stories that emerge work only insofar as they contain all the specified elements, however there are no dependencies between the individual components, which can lead to repetitions or logical faults, such as characters reappearing in the wrong places. The story generator released by Stone Dragon Press does without narrative content and only assembles the individual functions in a well-formed sequence according to Propp's formative rules.

Grasbon and Braun have created a model based on Propp's morphology with the intention of implementing a storytelling engine for a mixed-reality application where the user can traverse physical space while interacting with a virtual reality. The system chooses "... which scenes to show according to the age and preferences of the user." (Grasbon and Braun, 2) Interestingly, their main motivation is to provide an experience that is not offensive to the user. They state that "By not offending the tastes of the audience, we believe that emotional immersion can be improved" (Grasbon and Braun, 2). The system itself builds stories from predefined scenes each of which is assigned to a proppian function. The selection of scenes is based on certain variables that come with the scene, such as duration and story context (Tomaszewski and Binsted, 1). Additionally, there are functions which are polymorphic, this means that in contrast to the other functions they can be changed after their beginning. The outcome of these functions is determined by the interactions of the player. This does not mean that there is a large degree of freedom within the scene that is played out, but that the function in Propp´s terms may vary. If a specific outcome is required for the story

to move forward, the function is repeated within a different scene, or a non-polymorphic function is selected (Grasbon and Braun, 2ff).

Fairclough and Cunningham have adapted a slightly different model called OPIATE (open-ended proppian interactive adaptive tale engine). It uses a dual layer system, with the one layer using agent-based technology to govern the behaviour of computer-controlled actors with different behavioural modes such as attitudes, objectives and gossip, while the second layer is a case-based reasoning system founded on Propp´s rule set. Case-based reasoning in applied AI means that solutions to previous problems are examined and applied to current challenges. Approximately 80 cases are stored in the database, which is searched each time a new "move", as defined by Propp, is executed. (Fairclough and Cunningham, *Story Engine*, 3-4) The roles defined by Propp are used to provide the actors with goals - the roles are assigned depending on their relationships towards the player character. The player character is always cast as the hero. Similar to Grasbon and Braun's storytelling engine, OPIATE also features polymorphic functions (Crawford, *Interactive Storytelling,* 156ff; Tomasziewski and Binsted, 1f; Fairclough and Cunningham, *Story Engine,* 1ff; Fairclough and Cunningham, *AI Structuralist Storytelling*).

Propp-based interactive drama generators have a number of drawbacks that are largely caused by the underlying system. Since Propp's system was never intended for interactivity, but rather for descriptive purposes the availability of true choice situations is limited. The conventions laid down through the description of the individual functions state what must happen, and when. In the instances where a choice is offered, e.g. within polymorphic functions as used by Fairclough and Cunningham as well as Grasbon and Braun, the type of choice is usually binary. Even in these cases the player must choose the affirmative answer in order to go along with the pre-generated narrative, otherwise the system will halt. OPIATE has dealt with this problem by simply generating a completely new narrative once the player has input three negative choices. Tomaszewski and Binsted's proposed Eudaemon engine allows time-outs if challenges are not taken up by the player and simply cancels the previous function. This occurs at the expense of the well-formedness of the story.

The individual functions provide fairly large chunks of narrative and do not allow the players world interaction to become part of the story, the players actions may only influence which function is called on next. Tomaszewski and Binsted argue that in most of these cases it would make no difference for the user if the next function would be selected randomly. The probably most critical limitation in regards to commercial application is the high authorial load, i.e. that each functions requires several possible corresponding scenes which have to be created by an author. This, coupled with the fact that most of the content must be re-usable in different stories makes a proppian system very demanding on the content producers.

Finally, proppian systems do not scale well. The classification was intended for folk-tales and as such is best applied for short, simple stories. Adapting the system for longer, more complex stories would require the creation of more functions, which in turn would greatly increase the overall effort (Tomaszewski and Binsted, 5ff).

4.2.6 Conclusion

Data-Driven systems of interactive story generation have so far been largely based on existing sets of data which were not originally intended to be used as a base for generating stories. The results so far are promising; however it is apparent that the low granularity, i.e. the smallest unit being a single scene, and high authorial load makes these applications problematic from a production point of view. The main area of use for data-driven systems currently lies in the area of graphical content, where it has been successfully applied in commercial applications (cf. Woodard).

4.3 Procedural Generation of Narratives

4.3.1 Technical Concepts

In emergence the main concept is that simple rules may create complex systems, in the data-driven approach a story is assembled from a number of pre-made components along with a construction manual. Procedural generation of narratives goes a step beyond and tries to simulate storyworlds by formulating rules that govern the behaviour of the individual elements. The emphasis is on behaviour, which means that these storyworlds have the potential to be truly dynamic. In contrast to the methods discussed previously the storyworld is not inert anymore until the user provides input, some of these storyworlds can indeed run on their own, with or without user interaction. The interactions these systems provide are usually very rich and multifaceted. In general, the player can influence almost all the game variables at any given time, exerting much greater control over the development of the story than in any of the other methods presented.

Procedurally generated narratives are a relatively young field compared to interactive fiction as a whole. The core concepts are strongly influenced by the developments in computer programming, in contrast to the graphical evolution of games that has been largely driven by innovations in hardware design.

Procedurally generated narratives are best exemplified in contrast to other occurrences of narrative in various media. In traditional media narratives are linear. The story begins somewhere, with characters and events, progresses through several stages during which the characters change in some ways and finally reach a conclusion, i.e. the classic Aristotelian drama. When an element of interactivity is added[31] one finds oneself in the realm of hyperfiction. While the way the story unfolds is now at least partially in the hands of the recipient, hyperfiction still relies on predefined elements - this means that while the player/reader may choose how the story progresses, he may only choose which of several predefined elements he wishes to access. While this was viewed as a great step in terms of interactive storytelling, the underlying structure was still heavily influenced by traditional, "offline" media. The evolution from linear literature to hypertextual literature invariably means that even the most complex

[31] i.e. there are certain external inputs that interact with the story in some way

and cunningly crafted hypertexts are at their hearts linear - with all the drawbacks and advantages of linear media.

Procedural generation has its roots not in literature but in programming. The assumption is that stories have underlying mechanisms, that certain governing principles of how stories work can be formulated and expressed in mathematical terms. The main constituents of stories are defined as characters and events. Both are defined as data structures with variables and mechanisms. A character for example will have a number of variables describing its state, while an event will require a number of requisites before it can occur. Since these systems must to some extent model interpersonal relationships and in a broader sense human interaction in general, they cannot be reduced to simple interactions or straightforward sets of data. Developing a working character model alone is a daunting task, but character interaction is not enough for an engaging story. For this a program termed by Crawford drama manager (*Interactive Storytelling*, 201ff) is necessary which would control the flow of the story by observing the personality states of the actors, guiding the characters motivations and running the development of the story by assigning goals and events to the storyworld. For a detailed rundown of the requirements of a proposed procedural drama management system cf. Crawford (*Interactive Storytelling,* IV).

If one were to use an Agatha Christie mystery as simplified example, one of the core events would be the murder. From a programmer's point of view a murder has certain requirements that need to be fulfilled before it occurs:

Murder (murderer, victim, motive)

In this case, the event requires a murderer, a victim and a motive. This could of course be expanded by adding various props (weapon, location) or supporting characters (accomplice, witness) to the equation, but as a basic mechanism this will do. The murderer and the victim must be characters within the game world, for a motive a one-dimensional numeric scale will be assumed, with the polar opposites love and hate. Once, either through predefined starting conditions or in-game interactions a character has acquired enough hate for another character he becomes eligible for being the murderer.

If a story is crafted like a clockwork mechanism winding down without outside

influence, how can any author still provide any semblance of an interesting narrative? The point of procedural generation is not to have a fully automated story taking place along to its internal rules, nor is it intended to be a sandbox of things happening haphazardly. A story generated with this kind of mechanism at its heart will still need certain cues to provide an engaging structure. The task of the author is not to write the details - these are now fully automated, but to provide the framework and rules in order to have things happen at the right time. For a good murder mystery neither the victim nor the type of the crime are particularly important - as long as the murder takes place at some time during the stormy night the story can move forward. The writer would specify that at some time the murder should occur - the program would then select the variables according to the plan.

The big advantage of a system like this is not only that it requires very little amounts of pre-scripted content, but also that player interaction is highly granular, that means that the player can interact with the game system at any time, and that he can effect meaningful changes of the underlying variables every time he interacts. In comparison with traditional, linear-based interactive narratives it is obvious that there are no intervals of forced passivity in procedurally generated stories.

4.3.2 Current Examples

So far several applications are in development that use a mixture of existing classifications or proprietary data. Since all of these models use procedural content, as well as large arrays of data with connectivity information their classification as procedural generation systems is to some degree arbitrary. However, since they are inarguably more than data-driven systems they will be discussed in the context of their procedural elements.

4.3.2.1 Erasmatron and Storytron

Chris Crawfords *Erasmatron* (Crawford, *Interactive Storytelling,* 298ff) relies on an engine that ties event-based story components together. Since its inception in 1991 the *Erasmatron* has grown in complexity and is now being implemented as a commercial application called *Storytron*. According to information published on the projects website (Crawford et al) the *Storytron* utilises a unique language called Deikto, a simplified English language. This is necessary because natural language interfaces are too complex and so far have relied on prefabricated content to some degree. By using an artificial English derivate the size of the vocabulary can be kept small enough to keep the number of possible interactions and dependencies manageable. The cost of a full, usable vocabulary for interaction is that "[...] it must communicate with the player in a simple language, unsuited to artistic embellishment." (Crawford et al, *FAQ*). The sentences that direct the characters actions are constructed using a simple interface that allows adding worlds from the storyworld's pre-defined vocabulary. An initial mockup of this interface suggests that not only is Deikto unsuitable for artistic embellishment, but that it may also be too cumbersome for the conveyance of the subtle nuances of drama, despite claims on the website (Crawford et al).

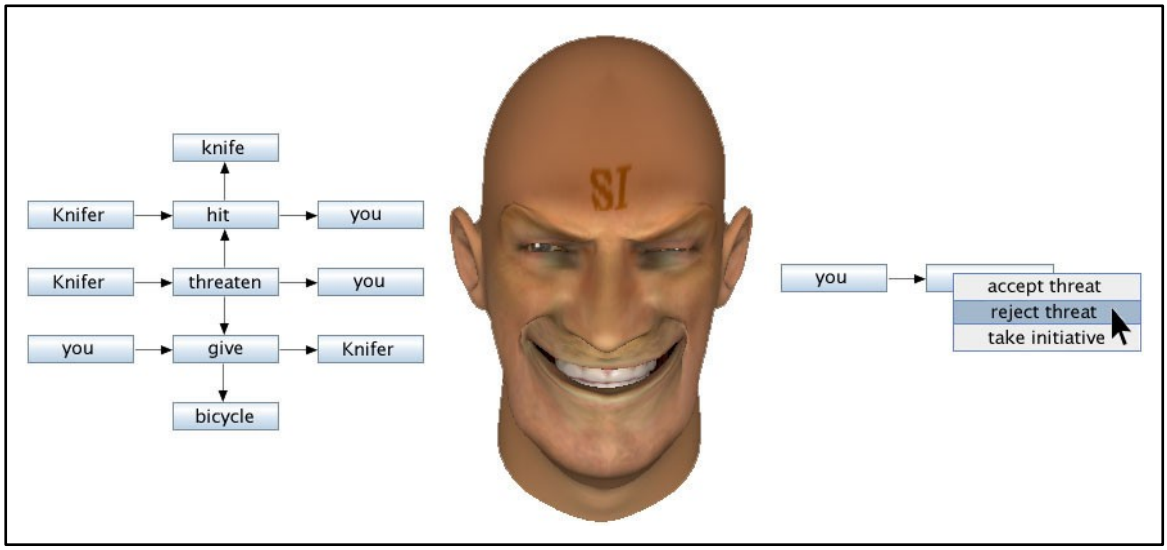

Fig. 4-2 Storytron Interface

Fig. 4-2 shows a mockup of the Deikto interface: The diagram on the left, which is how Deikto is related to the player, indicates that the player, addressed as "you" that the Knifer, in the centre of the argument has just issued a threat to the player,

stating that he will hit the player with a knife unless the player surrenders his bicycle. On the right are the player's possible responses, which are constructed through context menus.

While this schematic representation of dialogue is still recognisable to the audience, or at least open for decryption without too much effort it does not support any finer subtleties of dialogue. This is because "The basic structure is logical, not alphabetical, so it transcends cultures. It is for this reason, and the interactive quality of wholly procedural language, that you lose ambiguity and nuance." (Dugan)

This code-oriented approach has been heavily criticised for mainly this reason, as the article by Bond sums up nicely:

> All Deikto can do is describe the bare skeleton of a story, the bare facts of character interactions. I could imagine such a language being effective in certain limited areas -- stories where the communication between characters is severly [sic] constrained for some reason, such as a story set on a world of Deikto androids. [...] The very idea of using a machine-comprehensible language for general-purpose storytelling is misguided. Art, including the art of storytelling, is a human domain.

While this may be a somewhat polemic statement, the limitations of a system based on machine-readable language cannot be denied. On the other hand, a verb based system of story generation offers much finer granularity of interaction than the much more cumbersome corpus-based data-driven systems. The authorial load is presumed to be very high for the Storytron as well, since most dependencies and connections will have to be defined by an author, despite the apparent flexibility of the system.

No final statement can be made since the Storytron is still in development; however it is likely that it will be regarded as an important step in the development of true interactive storytelling, potentially with little commercial relevance. In order to turn the diagrammatic representation into marketable dialogue at least a real-language conversion for the computer-generated statements would be necessary, and even then the system by itself would most likely not sustain gameplay in itself for long.

4.3.2.2 Facade

Developed by Michael Mateas and Andrew Stern (*Interactive Drama, Procedural Authorship*) *Facade* [32] is an interactive, real-time one-act drama with two non-player characters. It features a first person 3d-view of the world in which the player can move around freely. The characters are flat-shaded and exhibit realistic body language and facial expressions. Player input is handled through keyboard input for movement and a real-text interface, similar to those of the early generation adventure games. However, the text interface is not a command input device to control the player character, but rather a dialogue tool which lets the other two characters react to input as if it were spoken conversation.

Real-time interaction is also noteworthy since most other storyworlds rely on turn-based sequences because they allow better control over the different variables the story engine has access to. Facade instead handles events organised into "beats", a beat is a single temporal unit that consists of a series of events or actions that belong together. The general organising principle of beats is that each succeeding beat should have more tension than the previous one, until a climax is reached. Then the system reverses until the conclusion of the story is reached. Beats can be interrupted by the player and will resume once the interruption has been dealt with, assuming that the beat that was on hold is still dramatically viable. For example, the sequence of Trip opening the front door and welcoming the player is a single beat. Typically a beat consists of 1 to 5 lines of dialogue and 20 to 400 lines of ABL code, acronym for "A behavioural language", custom developed for Facade. The organising entity that selects the contents of the individual beats is called the "Drama Manager" which performs according the ABL code script (Mateas and Stern, *Procedural Authorship,* 6ff).

In playing Facade the player takes on the role of a friend of a married couple that he or she hasn´t seen for a while. The game starts as the player arrives at the door of the apartment of Trip and Grace, and overhears an argument through the door. Trip then opens the door and invites the player in. Depending on the player's actions and reactions to the two characters the story will unfold in a different way, with a number of different possible outcomes.

It has been argued that Facade is the first truly interactive storyworld produced

[32] Facade is available as a free download at (20.07.2008) <http://www.interactivestory.net/download>

that actually works within specification (Adams, *Interactive Stories*). This is possible due to the fact that Mateas and Stern have created a tightly controlled and topically limited storyworld and have thereby created a playing field that is still vast, but controllable in terms of interactive possibilities.

The project has gotten mixed reviews, with some disappointment coming from the gaming community, as well as some critical acclaim from the development and academic communities[33].

Some known and documented shortcomings lie in the natural language systems capability of interpreting player input. In informal tests a failure rate of approximately 30 percent has been confirmed, however the effect on the player is less noticeable because the system tends to mask these failures fairly well (cf. Falstein). Mateas and Stern argue that this failure rate is acceptable, because it allows the exploration of a working natural language interface in the other 70% of cases (*Procedural Authorship*, 7). Since the playing experience of Facade has no clearly defined goal it invites the player to experiment and in some cases sound out the boundaries of the game world (Mateas and Stern, *Facade Website*).

4.3.3 Repercussions

Providing a completely new model of interaction changes some of the fundamental assumptions of gameplay. The traditional approach of supplying a very limited range of interactions along with a weakly responsive world brought with it the assumption that "anything that the player can do, he may do". Over the past decades this sort of player behaviour has been actively enforced by providing games with more and more limited pathways to success, games that either gently push the player back towards the one path to victory, or remorselessly punish any deviation (cf. Crawford, *Interactive Storytelling,* 124ff). The result of this is that the boundaries of a game have traditionally been very obvious, and that players expect a game world that is very limited in interaction,

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[33] For Facade reviews cf. (20.07.2008) <http://www.gametunnel.com/gamespace.php?id=165&tab=3>
(20.07.2008) <http://www.justadventure.com/reviews/Facade/Facade.shtm>
(20.07.2008) <http://www.gamespot.com/pc/adventure/facade/review.html>
(20.07.2008) <http://www.brasslantern.org/reviews/graphic/facademurray.html>
(20.07.2008) <http://www.gamefaqs.com/computer/doswin/review/919887.html>

but effectively unbreakable, especially in terms of narrative - the worst case scenario was to get stuck or choose not to move the story forward, a phenomenon Crawford (*Interactive Storytelling,* 130) calls "constipated stories".
In procedure-based systems this is radically different. Due to the fact that the player can change key variables at almost any point during the playing experience it is now also in the players hand to effectively sabotage the plot in such a way that a conclusion as intended by the author is not possible anymore. This problem is multiplied by the fact that many procedural systems rely on verb-based interaction models, i.e. that they have natural language interfaces which provide exponentially more possibilities of interaction than traditional button or choice-based interfaces.

4.3.3.1 Re-evaluation of the game mechanic

Through the possibility of influencing core game variables, the role of the player shifts from participant or active observer to that of a co-author. Suddenly not only game mechanics or mutually exclusive, pre-generated choices are available, but a much more wider array of available influences and outcomes. This creates an interesting bind - a co-author must have the ability to shape, not only influence a story but to break it. It means that in order for a player to participate in a game of this kind in a meaningful way he must abandon the way of playing that has been tradition for over twenty years. Instead, the game must been seen from the first moment on as a collaborative effort that will fail if one of the parties abandons it (Adams, *Interactive Stories*).
This may seem trivial, but both public and academic feedback from the first examples of procedural story engines have shown that the credo of "everything that is possible is allowed" is so ingrained in the current gamer demographic that a shift will be very difficult, at least for the first few generations of new games. In fact some of the responses have gone so far as to call the games "broken", which is understandable under the assumption that "anything that goes, may go" is inherent to all digital games.
Adams (*Interactive Stories*) has subsumed this as one of the traditional assumptions of game design, namely that "the player shouldn´t have to think about the rules".
An excellent example of this conflict is given by Fyfe in a script generated during

a playing of Facade. In this case the player acts within the possible, but breaks the unstated conventions of the storyworld and thus causes the narrative to dissolve. In the transcript by Fyfe the player, here with the name of Audrey chooses to act out a different role than intended (c.f. Appendix, Facade Transcript 1).

This means that if there is to be a collaboration both sides must be aware of the rules, both of the co-authored narrative they shape and the rules of interaction between player and author. Adams argues that assuming that both author and player actively take part in the story, they both spend the same resources by taking actions. The unit of cost in this case is credibility - if one side or both overextend the credibility budget, loss of immersion occurs. In regards to the cost of an interaction Ken Perlin (qtd. in Adams, *Interactive Stories*) has formulated the rule that "The cost of an event in an interactive story must be directly proportional to its improbability."

This creates an internal economy of the story, through which both participants - player and author - can interact with the game world.

The question of the laws which govern these transactions remains. Adams (*Interactive Stories*) states that some laws can be exacted on the player, due to the fact that by taking part in a certain story of a certain genre the player automatically assumes a specific role. This encompasses a wide array of genres, not only traditional role-playing games, which in Adams' words usually make the player take on the role of a second hand arms dealer.

Good roleplaying requires self-control, once the player exits the role he is bound to break the story. This, according to Adams is not a problem since most games require the player to stay within the role - a wargame for example does not allow the player to be a bad general and still win.

He then defines three major groups of laws that can be applied to procedurally generated or emergent narrative worlds: physical laws, social laws and dramatic laws.

The first two are self-explanatory, assuming that the player has access to the same cultural background as the intended audience. The dramatic laws are conventions that encompass "the role, as agreed to play" and reinforces the point above that if the player decides to leave the role at some point, a successful outcome must not be guaranteed or possible (Adams, *Interactive Stories*).

4.3.3.2 Non-narrative applications of procedural content generation

In commercial game development procedural generation of narratives has not yet been realised.

However, in a wider sense of content generation procedural mechanisms are becoming more and more widespread. The advantage of these mechanisms is that since digital games are becoming more and more content-intensive, as well as rising development costs through the technical acceleration, creating a working mechanism of automatically generated content can save a lot of effort in the long run.

There are several fields of application for this today. Chronologically, the oldest is level design. While most games of today still feature hand-crafted levels, some games have successfully presented semi-randomly generated environments. One of the most noteworthy of these is *Diablo*, in which the dungeons through which the player must battle are generated at the beginning of each game. Building blocks, such as archways, doors, passages and walls are arranged randomly, according to certain restrictions. In this case for example that each level must have an entrance and an exit, and that each room must be accessible. The second area of procedural content generation is animation - here the last year has seen rapid spread of new technologies that have made keyframe-animation obsolete in many areas. Traditionally in a 3d game, each characters movements are designed by an animator. The wireframe model is bound to an internal skeleton, which affects the geometry. The virtual bones are then moved into the desired position, and a "keyframe" is taken. The computer then interpolates the movements inbetween. This method of animation is still very similar to the way Disney films were animated - frame by frame, working forward and backward from keyframes. The next step in this evolution, applied widely in the first person shooter genre in the last few years was ragdoll animation. It provides semi-realistic animations, largely of humanoid creatures falling down by applying a crude physics model to limbs that are attached to each other with joints of limited movement ranges. The name sums up the quality of movement, it is reactive to the environment but the movements are doll-like and devoid of tension. A very good illustration is *Porrasturvat - Stair Dismount*[34], a ragdoll physics game in which a humanoid ragdoll must be pushed down a stair.

[34] Available for download at (20.07.2008) <http://secretexit.com/>

Currently, a new method of procedural animation has emerged in the form of the euphoria engine. It combines a physics simulation with a crudely simulated organism that has operational parameters of its own. Virtual characters are imbued with rudimentary muscular systems, as well as a handful of physical goals, such as to try and keep upright, react to hurt by protecting the hurt area, etc. The results are quite stunning, with wider implications for character design and animation, however so far the main area of application that has emerged is virtual characters getting shot, bludgeoned, thrown against each other or otherwise maimed in creative ways[35].

There have also been attempts to proceduralise other graphical content. A very striking experiment in this direction has been performed by the .theprodukkt demo group who have created a first person shooter game that takes up only 96k, an amount of data comparable to a word document of less than a hundred pages. Released in 2004 it relied on "creation histories", i.e. sets of machine readable instructions to create all content, especially textures stored in this way were only a fraction of the size had they been stored in bitmaps. The process is described by the developers:

> while using traditional painting programs, fiver2 noticed that he only needs a few simple primitives and filters to create very realistic looking textures. he defined a set of operations and asked chaos to write a user interface where the artist can specify, modify and store these operations. in the 64k program, these stored operations are executed and the image is generated. Just a few hundred bytes are needed to specify a texture, and there are no compression artifacts.
> (cf. Theprodukkt (20.07.2008) <http://www.theprodukkt.com/faqmaking>)

Since storage space for digital games has long ceased to be a problem most of the techniques used in kkrieger are irrelevant for present day game development, however they illustrate that procedural generation is a viable solution for almost any kind of content.

[35] cf. Natural Motion – Euphoria Demo (20.07.2008) <http://www.naturalmotion.com/euphoria.htm>

4.3.4 Conclusion

Procedurally generated narratives currently offer the highest degree of interactivity and come closest to the availability of true narrative choices for the player. However, there are a number of significant drawbacks that prevent these systems from being used in commercial applications. Foremost, procedural systems of story generation place a much larger responsibility on the player, allowing the player to shape or break the narrative. On the other hand there are high demands for pre-generated content, on the one hand by building a vocabulary, such as used by the *Storytron*, and on secondary content such as voice acting, as used in *Facade*.

5 History of Narrative in Digital Games

The following chapters will provide a brief overview of the evolution of digital games from a narrative point of view. Games that do not have a strong narrative element, or are based mainly on non-narrative mechanisms will not be included. Since many developments occurred simultaneously or over longer periods of time the list is not entirely chronological but sorted along the major trends in narrative presentation and development.

Digital games are a relatively new form of entertainment. With their roots in the first university mainframe computers of the 1960s they originally were a purely academic venture. Development was driven mainly by university researchers and graduate students who still had to compete for very limited time slots on very cumbersome and expensive computers the focus was mainly on simulations. The honour of the first digital game is contested, but likely candidates are a tennis simulation by William Higinbotham (1958) which ran on an oscilloscope, and *Spacewar* (1962) which was developed at MIT and pitched two players against each other in a physics simulation with two spaceships, the sun and a gravity component.

Not much later, when on-screen text interfaces became available, the arguably first digital game with a strong narrative component was made and the genre of text adventures was born (Kirriemuir, 23-24).

5.1 From Text Adventures to Graphical Puzzle Games

Developed in 1967, advent.bat, abbreviation for adventure in order to conform with the DEC-10 operating system which only supported file names of six characters. It heralded the genre of text adventures that enjoyed popularity until the mid-1990s. Advent, later released under several names including *Adventure*, *Colossal Cave Adventure* or *Classic Adventure* consisted of a verb-driven interface with text input. By presenting the user with a limited number of verb-driven choices advent is the first instance of a classical node-driven narrative structure (Kirriemuir, 23).

Text adventures continued to rise in popularity throughout the late seventies and early eighties, when computer prices dropped significantly, creating a larger hardware base for games. One of the immediate successors to *Colossal Cave*

Adventure is *Zork*.

The *Zork* series consists of almost twenty games, spanning almost two decades[36]. Initially, *Zork* was very similar to its predecessor, but later on evolved in accordance with the technology and expanded both in terms of verb counts, and in presentation. The first *Zork* game featured a vocabulary of 697 words that could be used on 60 objects (Scheyen). Later iterations of the *Zork* franchise featured graphics and a mouse-supported text parser (cf. Schönlein). While the presentation evolved along with microprocessor technology, the core game systems remained the same. The player could move from node to node, engaging in various interactions at each node.

While the *Zork* series came to the conclusion in 1997 with *Zork: Grand Inquisitor* it featured the mix between fmv sequences and graphical backgrounds that were continued in the popular *Myst* series that continued using a rigid node based model until the switch to fully interactive 3d environments with *Uru: Ages Beyond Myst.*

5.2 Role Playing Games

Branching from the early text adventures graphical exploration games appeared as soon as the technology permitted it. Traditionally set in fantasy worlds they pitted one or more player characters against a mythical world full of magic and monsters. It is noteworthy that in *Ultima*, founding father of the role-playing genre for the first time player and player character were not wholly synonymous anymore.

In order to understand this genre it is necessary to go back to its analogue roots in American university campuses of the 1970s. Here a genre emerged that gained notoriety as "pen and paper" gaming and role-playing. These games that have been constantly popular until today are a mixture of a set of core rules that are probability-governed, and a freeform part that could best be described as a mixture between cooperative storytelling and improvisational theatre. Thematically these games, most prominent and successful of them being *Dungeons and Dragons* which was released in 1974, used to be set in fantasy worlds heavily influenced by the Lord of the Rings and pulp fantasy of the 1960s.

[36] *Moby Games* (20.7.2008) <http://www.mobygames.com/game-group/zork-series>

In their evolution through the following decades the fantasy theme has remained a prominent item in role playing games, but other themes have also gained a foothold - currently there are themed worlds available covering anything from science fiction to mystery and crime stories.

The rule sets of these games are usually very complex and mainly data-driven; this means that there are a lot of descriptive rules for different play situations. Most of the core game rules are chance based, some utilising 6-sided die, others like Dungeons and Dragons using a wide array of dice from 4-sided to 20-sided. However complex and convoluted these rules may be, it is necessary to be aware that these games traditionally do not involve a competitive element. This is doubly misleading, since board gaming has been associated with competition ever since chess, and the fact that complex rules usually mean more complex challenges.

In pen and paper RPGs one player takes on the role of the "game master", who is tasked with governing and interpreting the rules, as well as providing challenges and a narrative for the players. The other participants each take on the role of one player character, with specific skills and abilities that can be developed and expanded during play and must cooperatively face challenges set for them by the game master. However, the players do not play "against" the game master; instead all participants cooperate to create a narrative together.

In fact, the narrative elements that are not directly based in gameplay or the ruleset make up a large portion of the game. The focus of these sequences is usually social interaction, the rest of the game time is usually spent battling various enemies and overcoming obstacles.

The widespread appeal of this genre to an audience that was in the late 70s the same demographic that helped create the first and second generation of digital games was undoubtedly a reason for the strong support this genre had in the following decades. In addition to this the probability-based rule sets were easily transferrable to the digital realm. The most problematic aspect of digitising this genre lay in the same component that created its unique appeal: the game master. Pen and Paper games are freeform, cooperative narratives, managed and directed by the game master. This allows for an almost infinite amount of choice when it comes to the directions these stories take - the only limit is the patience and creativity of those involved (cf. David Cook).

In digital games it was necessary to replace the game master with controlling agents, the natural result of this was that the focus shifted towards the rule-governed part of gameplay because this was easily transferrable, and worked even better in the digital version because calculations were quicker, more accurate and there was no need for sifting through various tomes of rulebooks in order to find the correct rule. The freeform narrative part on the other hand diminished, a fact that was criticised, but accepted as an inevitability of the new technology[37]. The narratives that found their way into the new computer RPGs were simpler and more linear than their ancestors and in many respects resembled those of the adventure books discussed previously. In the current and past examples of this genre many games can be found that fall under the broad category of the environmental approach – some of them using vast landscapes as a basis for exploration, others offering narrative through lightly connected threaded branches. Some of these utilised derivatives of the pen and paper rulesets, such as *Eye of the Beholder* or *Knights of the Old Republic*, a Star Wars themed RPG based loosely on the 3.5 edition of Dungeons and Dragons. Most prominent current examples are *Morrowind* and *Oblivion* which forego more complex narrative structures in favour for a vast and backstory-rich environment[38].

A notable branch of the early roleplaying games were MUDs (multi user dungeons) that allowed online play with other human players within a traditional role-playing ruleset. Popular throughout the 1980s and 1990s they were the predecessors of the graphical MMOGs[39] of the 1990s and 2000s (Kirriemuir, 26).

5.3 Graphical Adventures

Graphical Adventures were the evolution of text adventures, in terms of technology, narrative structure and demographic. When computers became powerful enough to support real-time graphics in colour the step away from pure

[37] Cf. *Progress Quest* (20.07.2008) <http://www.progressquest.com/> which parodies this aspect of digital RPGs by providing an RPG entirely without player interaction. It can be regarded as the most pure example of powerlevelling and powerharvesting.

[38] In contrast to *Mass Effect* which features branching dialogues *Oblivion* only allows the player to select topics from a non-exhaustive list, effectively turning dialogue from an exchange into a one-sided information acquisition system. In this regard the NPCs of *Oblivion* have little more function than mobile bulletin boards for quests and backstory.

[39] For an in-depth look at MMOGs and their social context cf. Taylor (21-65)

text was inevitable. The first generation of the new adventures was still heavily based on its ancestors - player inputs still occurred largely via text, with the difference that there was a representation of the player character on screen. This differentiates the graphical adventure genre from graphical puzzle games which stemmed from the same ancestors.

In the early adventure games the player would control the movement and positioning in the game world with the keyboard and engage in interactions through a text parser, later on with a mouse. This meant that for the first time the spatial relationship of the player character to the environment achieved much finer granularity and became a gameplay-critical element. In contrast, the graphical puzzle games like the *Myst* series showed no avatar and had movement only between nodes, i.e. within a node precision placement of the avatar was not available.

Very soon text-based interactions were abandoned in favour of purely mouse-controlled systems since computer mice became a standard accessory in the late eighties and early nineties, and mouse-based systems were easier to use and much easier to control in terms of controlling narrative branches. Typically, the amount of interactions ranged between six and nine available verbs[40]. Redmond based developer Sierra used typed-text inputs[41] before switching to purely icon-driven systems while major rival Lucasfilm Games (now Lucas Arts) used text buttons[42] before switching to context-activated icons (cf. Schütz). These icons typically offered even less interactions, *Full Throttle* (1995) had five icons corresponding to hand, foot, mouth and eyes. In contrast to the previous, verb-based systems this was a marked increase in interactional ambiguity that allowed more creative and flexible actions that were assigned to each icon[43].

In terms of narrative there was no perceptible development throughout the

[40] Compared with the vocabulary of several hundred verbs that the early generations of text adventures featured this provided an immense reduction in the combinations that were possible, on the one hand improving immersion by eliminating dead ends, on the other hand allowing more resources to be spend on graphical environments.

[41] The *Space Quest*, *King's Quest ,Police Quest* and *Leisure Suit Larry* series all had a text parser. Later games in each series had a text parser which paused the game to allow less time-critical input, in the latter stages of each series Sierra switched to icon driven interfaces as well (cf. Schönlein, Schütz).

[42] In *Indiana Jones and the Fate of Atlantis,* a typical Lucas Arts adventure the possible interactions were: Give, Pick Up, Use, Open, Talk to, Push, Close, Look at, Pull. (cf. Schütz.)

[43] E.g. the use of the mouth icon would usually be utilised to initiate dialogue, but would also be applied to suck on a hose to funnel gasoline from a car.

evolution of the genre. Stories remained strictly linear, with puzzles or interactions making up for the node boundaries. Alternate pathways were rare[44], and never had any impact on the story as a whole.

5.4 Genre Mixes and Diversification

In the mid-90s the game development landscape was changing - hardware became more and more powerful, with 3d accelerator cards starting to saturate the market from the mid-1990s onward and a much larger installed guaranteeing larger sales volumes. With the increasing graphical prowess the development focus began to shift towards providing visually engaging games. The first hardware accelerated 3d games occurred in this period, as well as developments in the area of interactive film[45]. In terms of storytelling games became more complex, stories were added to genres which had previously done very well without. This included simulations, but more notably affected the emerging action-adventure genre. The mid and late nineties also gave birth to very interesting genre mix products, providing more freedom and complexity than ever before. In the area of RPGs a high number of threaded narratives became the norm, coupled with very large and complex game worlds[46]. One of these games is *Blade Runner,* an arcade/adventure hybrid which is loosely based on the film with the same name. This game featured a number of innovations in the field of narrative, on the one hand it had a node based storyline with true branching and several possible different outcomes, on the other hand a dynamic system was used to simulate the movement and behaviour of characters within the game world. While this added an interesting element of uncertainty, it caused occasional problems when characters critical for the plot to move forward simply were not where they were supposed to be.

5.5 Re-emergence of linear narratives

In the early 2000s an interesting development occurred. The trend towards more freedom of interaction and freeform narratives reversed and more restrictive

[44] *Indiana Jones and the Fate of Atlantis* allowed some puzzles to be overcome in two different ways, one of the options usually resulting in a fistfight that was solved as a minigame, the other requiring the player to solve an object based puzzle.
[45] E.g. *7th guest, Wing Commander III*
[46] E.g. *Baldur's Gate, Ultima Underworld.*

systems re-emerged, however with much more focus on a dense and engaging presentation.

The product that heralded the new turn towards linear narratives was *Half Life*. Released in 1998 it was a first person shooter with game mechanics that were very similar to previous games[47]. In presentation however, *Half Life* differed markedly. Up to that time first person shooters usually featured very light story, with the main focus being on the visceral thrill of the situation[48], story would usually be presented in cut-scenes or between levels. In Half Life, the story is presented seamlessly within the game through a high number of scripted events during which the player can usually move freely within the environment. This provided a very intense playing experience because at regular intervals things would happen that were outside the player's control, but directly affected the game world. In addition to this, NPCs that the player had to interact with populated the game world (Musgrove). After the success of Half Life many other developers chose to focus their efforts on providing linear narratives with "crafted intensity" (Rolston, *Vast Narratives*).

That this trend has spread so quickly and widely can be attributed to a number of different factors. Apart from the commercial success of key forerunner products, rising development costs force developers to focus more and more on features that have a high commercial impact. The rising costs are an inevitable development that is tied to the development of hardware. Each generation brings more and more powerful graphics cards and processors, and thereby offers game developers more visual opportunities. However these developments come at the cost of development time - more resolution and more detailed graphics mean that more manpower must be expended in order to fully utilise these new possibilities. And while the overall revenue of the games industry is steadily increasing, it is not increasing at the same rate as development costs. This means that, on average, a developer must spend a large percentage of his budget on graphics. In turn, this means that fewer resources are available for all other areas.

The conclusion is simple - it is not feasible to expend effort for assets that the

[47] The interactions available in *Half Life* are navingating through the 3d environment, shooting and pushing buttons in the game world to open doors or activate elevators.

[48] Callois terms this kind of game Ilinx, cf. Callois (32f).

typical player will never see, high replayability is neither expected nor wanted (cf. Takatsuki, Brightman).

Despite the limitations imposed by technical developments and the market there have been some notable developments in the area of linear narratives. *Mass Effect* has already been discussed in previous chapters, a game that is similar in its visually filmic presentation is *Fahrenheit*. Here, in contrast to *Mass Effect* the visual presentation of the narrative is the foremost element. While there are a number of interactions and even multiple solutions to some puzzles[49] the main gameplay element is a mini-game, which consists of pressing buttons in the right sequence and rhythm. The buttons are indicated on the screen and colour coded. Through this system all action sequences are controlled - from playing guitar to running away from demons to controlling the breathing of a claustrophobic policewoman during her trip to the archives. In Fahrenheit the player controls a young man who wakes up with blood on his hands and no memory at a murder scene in a diner's restroom. After making panicked escape the viewpoint switches to two detectives who have come to investigate the murder. Viewpoints alternate between police and suspect until the story comes to a conclusion. For a spectator the game plays out like a movie, there are few interruptions and camera angles and positions during the action sequences are chosen for maximum dramatic effect[50].

The narrative structure is node based and generally linear, with some instances of minor branching[51] that leads to a total of three possible variants of the ending as well a stats-based deferred influence system for many of the player interactions when controlling the suspect. In this case the traditional hitpoints-bar is masked as a representation of the characters mental health, ranging from "neutral" to "suicidal" - when the player runs out of hitpoints the character commits suicide (cf. Navarro, Reed).

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[49] The underlying structure is foldback by similar solutions. None of the possible pathways within puzzles has any effect on the future course of the game.

[50] This is possible since during the action sequences the player only interacts through the mini-game. If he performs well, the action sequence has a positive outcome, if not the character either fails completely, resulting in a game over event, or loses a number of hitpoints.

[51] Most of the observable nonlinearity is cosmetic and conforms to flag-based systems. The underlying structure remains unchanged.

5.6 Conclusion

In the last decade a noticeable trend toward a more filmic representation of narratives could be observed in digital games. In mainstream gaming text has almost disappeared as a means to convey story, the stories themselves have become more linear, shifting emphasis from user choice towards a single path densely populated with content. The ways these stories are transported become more and more film-like, with characters, plots and settings emulating those of Hollywood movies (cf. Adam). It seems clear that Hollywood cinema has become the role model for the digital games of the 21st century, with screenwriters and novelists easily crossing the boundary into the realm of digital game development (cf. Freeman, Musgrove). New technologies such as the previously discussed means for procedural story creation have not yet found their way into the mainstream of commercial game development and remain a marginal influence.
In the next chapters growing affinity of digital games to cinema will be examined from a technical perspective, placing the visuals of digital games in the context of mainstream cinema and television

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6 Visual Analogies of Digital Games and Cinema

Film has always been a medium that has been driven by technology. Unlike written literature which has remained unchanged in term of the production mechanical influences since the invention of the printing press film has made repeated stylistic leaps that were made possible by technological innovation. While written text can be viewed as a logical successor to oral text - a change in form but not content - film has since the beginnings in daguerreotypes been a technology-driven medium. From the inception of silver nitrate soaked celluloid each technological step allowed film makers more and more tools for the telling of visual stories. While the first films were still very true to the theatrical roots of the genre filmmakers soon realised that the new technology offered much more than a simple possibility of storing theatrical performances.

The ability to store audio information next to the image of the film frame led to yet more possibilities and film emulsions that were able to reproduce colour soon followed. Since then the technological advances have slowed somewhat since the underlying technology has not changed drastically in the last decades.

It may be argued that digital cinema and video will cause such a change, but for the recipient of the finished product the transition will not be noticeable - disregarding gimmicks that fall squarely into the carnevalesque realm of the cinema of attractions such as the recent resurgence of 3d films[52].

Visually games have long endeavoured to become more film-like. There have been several trends over the last two decades, almost all of them dictated or at least started by technical developments. Initially games were text-based, there was no other method of representation available. In this era of game development the first games were naturally very close to literature, the first text adventures were created in this time. Soon however ASCII characters were used to represent content instead of merely describing it – the threshold to the mimetic had been crossed. As the first non-text graphics became available games started to use visual representations to a far greater extent. Visually these early adventure games were more influenced from paintings than film as to that time all graphics were still in 2d which of course limits all screen movement to scrolling,

[52] A recent example of 3d cinema is the animated feature “Beowulf” which featured stereoscopic projection requiring 3d glasses for viewing. (01.08.2007) <http://www.imdb.com/title/tt0442933/ >

i.e. panning. The background plates were designed to be visually interesting and provide a backdrop for individual scenes. Compositions were very traditional with clearly divided foreground, mid-ground (where all interactivity took place) and background elements. As development progressed some of these games became more stylised, with elements of painting styles and graphical novels finding their way into the art direction, resulting in very distinct looks.

With the advent of 3d graphics most of this changed. In a 3d world the user has the ability to see an object or scenery from an angle he may select from an infinite variety of possibilities while in 2d graphics all view angles are predetermined. For developers this meant that suddenly they were not limited to a single camera position per scene anymore, thus they had greatly increased their arsenal in terms of Gunning's levels of filmic discourse (Gunning, 19). Previously, only the mise-en-scene was in the hands of the developer, now that the camera had become mobile the control of the enframed image was available, and promptly given to the player.

From mid-2000 onward more and more tools became available for developers to truly start mimicking film. In recent years more and more computing power paved the way for very advanced technologies such as shaders that allow using z-buffer values (cf. Wöß, 24-26) for DOF-like representations, blurring and other postprocessing effects. With these, more and more filmic conventions crept into digital games such as editing, which is now used to a much greater extent than at the beginning of the millennium[53].

6.1 Image Generation in Games and Film

Since both film and digital games are strongly influenced by their production mechanical necessities, one needs to take a look at the technical background of film and digital games in order to understand how their visual aspects interrelate. When regarding digital games as text it may not be necessary to review the technical procedures of image generation, but since the technical evolutions of games and film bear many similarities the "black box" of computer-assisted image generation needs to be opened.

[53] E.g. *Mass Effect* uses highly cinematic editing during its dialogue sequences, while in games up the middle of the decade the cut was rarely used. Instead the freely movable camera was exploited to the utmost, rotating around scenes without motivation.

6.1.1 Projection

From a conceptual point of view the initial premise of film and digital game visuals is the same. An image of entities of the directors/designers choice are to be projected onto a medium that allows the remote and repeated viewing of the occurrence. In film, this means a piece of silver-nitrate coated celluloid, or in recent years more often a silicon chip with photosensitive elements (Monaco, 67-71). In digital games, the medium of projection is the screen - and while it may seem that there are no rays of light being transmitted from objects onto the recording medium, the exact same concept is used. Virtual objects cast virtual rays onto a virtual screen that allows a pixel for pixel depiction of the objects in front of the equally virtual camera. This image can then be further modified by using shaders[54] or other postprocessing effects and is then stored in a frame buffer. From this buffer the image is then transmitted to the physical screen to be displayed. Currently, double-buffering is used which means that the image that is currently displayed on screen is stored in one buffer, the other buffer is used to store the image that is being generated. Once the second image is complete, the buffers are swapped out. This has the benefit of only showing the fully rendered image. In the past single buffering often showed the intermediate stages of image generation on screen. (Wöß, 23-26).

6.1.2 Frame Rates

Unlike analogue film, the duration for which a single frame is displayed is completely variable and only dependent on processing power and user preference. Frame rates are measured in frames per second (fps) or Hertz (Hz). Generally a frame rate of 25 or above is desirable in order to provide images which do not appear stuttery. The 35mm motion picture frame rate of 24fps represents the lower limit for successive images which the eye cannot discern as individual images[55]. In digital games the lower envelope is at around 18 fps, anything lower and the gameplay experience deteriorates markedly.

[54] Cf. Wöß, 36-40
[55] Cf. Monaco 87ff

6.1.3 *Post-Processing*

These images on the virtual celluloid can now be transformed and reprocessed further, enhancing or radically changing the original look. Since the entire process of image generation, from placement of virtual objects to final rendering on a screen for a player should take no longer than 1/30th of a second, a large amount of computing power is required for post-processing. Currently there are a number of different post-processing operations available. These can be used to modify the original image to achieve a more filmic look. Some of these methods are discussed below.

6.1.4 *Resolution, Aliasing and pixel-based imaging*

Digital imaging, regardless of whether digital videography or digital games relies on rasterised images. This is also true for other, non-optical image generation processes, such as the transmission and display of televison images[56].

A single imaging element is called a pixel, it is the atom of any image displayed in a rasterised way. Resolution refers to how many pixels are available on the projection screen, regardless of the technological phenotype[57]. The higher the resolution, the less the individual pixels can be perceived and the finer the detail that can be displayed without negative effects such as aliasing being visible. These occur when the amount of detail in the scene being depicted is equal or greater to the resolution of the imaging device. This and other undesirable effects are caused by the fact that all visual information that has a representation smaller than a single pixel invariably gets lost or changed in some way.

In digital games featuring 2d-graphics this usually isn't a problem since the source information has no higher granularity than then output resolution, i.e. the format of the visual sources are the same as the display medium - in 3d graphics however this is not possible. The base of any 3d graphic is a three dimensional vector space - and coordinates provide absolute information in infinite detail. The visual representation is only a depiction of the underlying 3d-space, and thus contains less than the original information. This can be illustrated by the problem of displaying a line in vector and pixel space respectively. In the vector space, the

[56] Cf. Wood
[57] lcd-projectors, tft-displays, crt-screens, etc.

line has absolute coordinates and can be rendered in absolute detail. When this information must conform to the very limited grid of a pixel space, information is lost as a pixel must have an absolute value - a pixel transected partially by the vector must either be filled or not. This causes a stair-like effect that is more pronounced the lower the resolution is. This phenomenon is called aliasing, and can be observed in almost all 3d games. The most apparent area of occurrence are regions where geometry overlaps, i.e. where a polygon is in front of another, partially obscuring it. In order to get rid of this effect and create smoother looking transitions between objects postprocessing of the generated image is necessary. Analogue imaging is not limited in this way since the only limiting effects are the emulsions that are used[58] and the wavelength of the light hitting the imaging medium[59].

[58] In analogue film blurring occurs at a certain level of detail.
[59] The latter may not seem like a useful distinction for human-viewable images but has become a key factor in the manufacture of microchips, which are photographically etched onto silicon wafers.

6.2 Camera, Point of View and Perspective.

However different the methods of image generation the basics of viewing moving images are the same in digital games. There are objects, actors, props, backgrounds and of course cameras. From the beginning of 3d technology any viewpoint has been referred to as camera, with similar characteristics and options. The same terminology[60] is used for describing camera movement, however with a little more freedom since the virtual cinematographer need not worry about physically moving a camera (Adams and Rollings, 241). The camera is, as in film, the viewport through which the recipient experiences the fictional world that is presented. Usually general position stays fixed for specific segments throughout the game, with changes being made when the depth of the interactivity changes, such as during cut-scenes. Some games adopt a more cinematic approach to placing cameras throughout the virtual world while others prefer to create a homogenous experience without changing the perspective. Some examples illustrating the most common methods of virtual camera placement will be discussed below.

6.2.1 First Person Perspective

In all instances of first person perspective in games the virtual camera is placed inside the protagonists head, regardless of whether human or not. First person games usually favour dense twitch-skill based action over deep or complex interactivity with the game world. In terms of visuals the first person shooter genre has not changed perceptibly in the last two decades, technology has primarily added more detail and realism to the worlds that are presented.

First person camera in games is seen as an evolution of the subjective point of view of cinema, as

> Virtual reality and digital games are continuing the first person perspective, or the subjective camera of film. A virtual environment is nothing but an exercise in perspective: it puts the viewer into the center of the graphical world and invites him to go explore this world from his point of view. For decades the subjective camera has put the viewer in the centre of a filmic world [..] (Bolter, qtd. in Yoo 201, own translation)

[60] For an in-depth description of the possible types of camera movement refer to section IV of Stephen Katz's *Film Directing Shot By Shot*.

Since the viewer is in the centre of the virtual world, the character/player boundary becomes permeable to some degree, allowing the player to *be* the character.

One of the most stringently immersive first person games is *Dark Messiah of Might and Magic*. Set in a fantasy world, the player has to battle various opponents in varying surroundings. While this is nothing new in any sense of the fps genre, the fact that the first person perspective is rigorously kept to is. This means that the camera at no time moves away from the eye point of the protagonist, even during non-interactive fmv cut scenes. This, coupled with the fact that this is one of the few first-person games where the protagonist actually has a body enforces a greater sense of being inside the world. Protagonists having bodies may seem like a trivial question, but in the first person genre the notion of actually representing the protagonist is fairly new, and has not been explored to a great extent. Traditionally, and in part dependent on the viewport, all that the player sees of the protagonist is the right hand holding a weapon, a fact that also requires far less graphical content (Adams and Rollings, 242). Since the earliest fps did not support looking up and down due to technological constraints, the question of looking at "one's own" body within the game never really occurred. Since then technology has changed to a great extent and these constraints no longer apply. Still most fps games represent the avatar as a floating arm holding a gun, coupled with an equally floating viewport, as this caricature of *Trespasser* portrays (cf. Fig. 6-1).

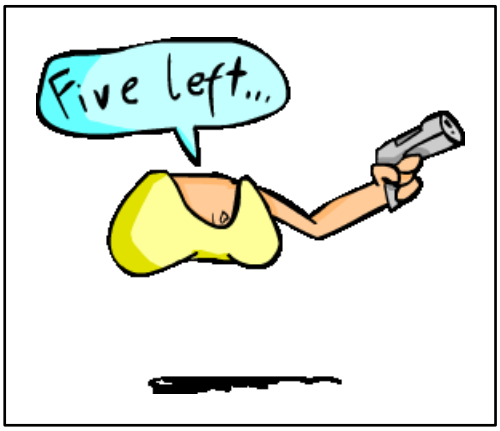

Fig. 6-1 Invalid Validation

Since an avatar without a body cannot be interacted with in any meaningful way, gameworld to avatar body interaction has only been very limited so far - this means that the only real feedback mechanism was taking damage and constraints of movement. In *Dark Messiah of Might and Magic* the new possibilities of having a fully represented avatar body are exploited in order to

create a greater feeling of contact with the surroundings. This encompasses the protagonist's hands gripping things such as ladders, allowing the player to look down at the avatars feet when balancing over narrow ledges and other game world characters physically interacting with the protagonist, such as lifting him up and throwing him around. From the point of interactive freedom this is still not a giant leap forward, but in terms of immersion the improvement is marked and visible.

Another first person shooter that needs to be mentioned here is *Trespasser* that may have been a reason for so little advancement in the area of avatar body representation until now. In this game the protagonist was partially represented within the game world, including a health gauge cleverly designed as a heart-shaped tattoo on the female protagonist's cleavage. The main feature and also problem was that the interaction model was heavily physics based. The player had to move the hands of the protagonist in addition to moving the avatar itself. This navigation system with two frames of reference made navigation very cumbersome, much like remote-controlling a robot. In addition to this the game world would also interact with the hands of the protagonist, mainly in the form of collision detection, which made aiming within enclosed spaces highly cumbersome.

Another interesting form of first person camera placement can be observed in the opening sequence of *Doom 3*. A very filmic sequence introduces two of the main characters, as well as revealing some of the backstory. This includes filmic camera placement and editing. Then the camera shows the protagonist exiting a shuttle, follows him for a few steps and then enters his head from the back. In this instant the controls are transferred to the player, and the player has full interaction with the game world.

On the far end of immersive, character-centric camera placement in fps there are games that allow changing the perspective at the user's discretion, such as *Oblivion* and *Dungeon Keeper*, which combines a management simulation with first-person control of creatures.

6.2.2 Third Person Perspective

Adams and Rollings (243) describe third person perspective as relevant only to games with avatar-based interaction models, i.e. games with a controllable protagonist. They states that

> "[...] it has the great advantage of letting the player see the avatar. The camera normally follows the avatar at a fixed distance, remaining behind and slightly above her as she runs around in the world so as to allow the player to see some way beyond the avatar into the distance." (Adams and Rollings, 243)

Adams and Rollings then go into greater detail explaining how camera placement can handle player movement. While these considerations are relevant for creating algorithms for camera-behaviour, they are secondary in a discussion of filmic influences on camera in digital games. Since in these applications there is an identifiable, visible protagonist the boundary between player and avatar is much more defined, the player *controls* the avatar.

The main visual distinction to be made within the field of third person perspective is that between free camera, a camera that is anchored to the avatar in some way and fixed camera. The former relies on either predefined behaviour or player input or both for its positioning. The latter has a specified camera location and angle for each possible player location.

A good example of free camera is *Super Mario Sunshine* for the GameCube. Here, the camera follows the protagonist at a fixed distance, following certain rules that govern its placement. These include that the camera must never collide with objects, or that the camera must always have a line of sight to the main character[61]. Additionally, there are some instances where camera placement changes to a side view whenever it is more useful to the course of the game, such as when the protagonist walks along a cliffside. The player also has the ability to override the automatic camera placement and move the camera closer or farther away from the protagonist, as well as rotating it around the protagonist. This is necessary in this game because, unlike most other digital games the controls do not use the avatars orientation as a system of reference but rely on the camera as a basis for movement. This means that pressing forward on the control stick

[61] Cf. Adams 244-245

always causes the protagonist to move away from the camera, regardless of where the camera is positioned or whether the camera is moving. Another notable fact about the Super Mario series is that the camera was always acknowledged as an active part within the game - on the one hand through the player being able to control the camera, on the other hand by making the camera visible by walking the protagonist in front of reflecting surfaces. The camera is then represented as a turtle-like creature riding on a cloud, dangling a stylised camera from a fishing pole (cf. Fig. 6-3). Fixed camera perspectives are the most filmic instances of camera placement in digital games.

Fig. 6-3 Lakitu

Since here the camera position is predetermined and usually fixed for each avatar position, a much more controlled and directed placement of camera is possible. On the technical side, all the accessible area within the game world - usually all the area the protagonist can walk on - is divided up into segments, each of which has one corresponding camera position. This means that for each player position there is a specifically positioned camera. These camera positions can of course move, depending on the settings, allowing the usage of more advance filmic camera techniques such as dolly or tracking shots (Adams and Rollings, 247). The earliest of fixed-camera 3d games was *Resident Evil* which used 3d characters in pre-rendered scenes. From a technical point of view this allowed using more computational resources for displaying detailed characters, while the surroundings as 2d-imagery were not limited in any way, especially lighting and detail. The film analogy would be characters acting on a blank stage surrounded by lavish matte paintings. Another advantage was that since each camera position was individually placed, much more visually interesting

Fig. 6-2 Indigo Prophecy Screenshot

camera positions could be chosen. Resident Evil used dutch angles and extreme perspectives in order to enhance the atmosphere to a great extent.
A more current example of this kind filmic camera placement can be observed in *Fahrenheit*. Here, free and fixed third person perspectives are used alternating with first person sequences, depending on which is dramatically better suited (cf. Fig. 6-2).

6.2.3 Omniscent perspective

The third possible perspective used in digital games depicts the scene from somewhere high above. Adams and Rollings (245-246) distinguish between Aerial Perspective, which shows the game world from above and focuses on the game world instead of characters and lets the player see a large portion of the game world at once, Top-Down Perspective which shows the game straight from above and is only applicable in 2d games and Isometric Perspective that allows the player to perceive all three dimensions while retaining a distanced viewing position from above.
Many more distinctions would be possible, however the important common element is that the viewer is decoupled from the avatar – the player takes on the role of a disembodied spectator who can watch and control the game world, but is not a part of it.

6.3 Visual Markers of Film

6.3.1 Lens flares

Flares are any kind of non-image forming light, i.e. any light that hits the film or sensor that is not coming directly from the objects in front of the camera. This light can come from luminous objects outside or within the frame and be reflected multiple times by the individual elements of a lens before hitting the imaging element (McHugh). Flaring patterns are often spherical or conforming to the form of the aperture blades in a lens, but can take on any number of shapes. Modern zoom lenses consist of a large number of different optical elements - 8 or more individual lenses within a lens array are not uncommon. These are used on the one hand to eliminate undesired effects such as blurring at the edge of the lens, on the other hand to keep the weight of the lens array down. In zoom lenses they include movable parts to allow the adjustment of the focal distance without having to replace the lens (Monaco, 77-78). Since each individual lens element can bounce unwanted light around, more complex lenses also have far more visible lens flares than prime, i.e. fixed focal length lenses with fewer individual elements (McHugh). Despite Cinematographers and Photographers best efforts to minimize lens flaring it has established itself as a well-visible "badge of authenticity" for photography and film.

In digital games, lens flaring was one of the first occurrences of technologically determined visual markers being transferred from analogue photography. This could be first observed in the late 1990s, a time when 3d graphics were only gradually becoming the standard in digital gaming. From a technological point of view, lens flares were an ideal candidate for transference, as the requirements to display them are fairly low - a singular bright light source at a fixed point and the ability to "blend" various layers over an existing 3d image. Since the lens flares occurrence requires only the relative position of the light source and possible occlusion to the centre of the viewing pane as variables, they were easily realised and subsequently used and overused to a great extent (Gordie).

6.3.2 Depth of Field and Focus

Depth of field is a term used to describe the linear space in front of the lens that is in focus. Since technically only a plane perpendicular to the lens axis is in focus the term depth of field (DOF) is used to describe the area of subjective sharpness that surrounds that plane. Depending on the characteristics of the lens and the medium that the lens projects onto this area can be larger or smaller. Generally, longer focal lengths yield shallower DOF, as do wider apertures. The size of the projection area also plays a role[62]. In modern cinematography, especially 35mm film this is a trait inherent to the technicalities of the medium and can only be controlled but not excluded. It can be used to direct the focus of the viewer, but some directors try to avoid it for this very reason[63] (Monaco, 83f; Katz, 235f). Since it is a trait that is associated with theatrical film it has become a trait that is generally regarded as positive. Since shallow depth of field can be more easily achieved if the projection area is larger 16mm and 8mm film have always lagged behind in that area. Coupled with the costs of film stock the effect of shallow depth of field has become a social ranking mechanism within the film community as much as it is a stylistic feature due to the fact that it was associated with exponentially higher costs[64].

Intriguingly this has not changed at all with the rise of consumer video cameras. Many more people now have access to video equipment which has led to a democratisation of the medium as a whole[65]. However, since in consumer-level video cameras the CCD blocks are very small[66] they tend to produce very sharp, crisp images that have minimum DOF of up to several meters. There are professional cameras available with CCD or CMOS arrays that are up to 35mm in diameter, but since the production cost of a digital camera is directly proportional

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[62] for a concise explanation of focus and depth of field see Monaco, 84.

[63] in the 1971 feature *The Andromeda Strain* director Robert Wise used dioptre lenses in order to achieve deep focus in some shots; dioptres are lenses with different focal characteristics within one lens. Cf. Katz, 235.

[64] In recent years there have been a number of mechanical adapters for consumer-level video cameras that allow the reproduction of shallow DOF of 35mm film. These devices use still-photography lenses that project the image onto a moving piece of ground glass instead of the sensor. The camera then films the image projected onto the ground glass, thus transferring the full depth of field to video. Cf. Letus Adapters (20.07.2008) <http://www.adapterplace.com> or Brevis Adapters (20.07.2008) <http://www.cinevate.com>

[65] Cf. Video hosting portals such as youtube, vimeo or the now defunct stage6 that provide free video hosting and sharing.

[66] usually 1/4'' or 1/3'' in diameter

to how many chips can be placed on a silicon wafer these cameras are prohibitively expensive for all but major studios[67].

In games depth of field effects are a development that has only become widely available through recent technological developments. Reproducing this effect in real-time graphics is a far more challenging task than simulating lens flares due to the fact that several rendering passes are necessary. In the first step the scene is rendered normally. In the second step the amount of blurring is determined by using z-buffer values to determine the distance of each object to the camera. This blurring layer is then applied to the original rendering to produce the desired effect. (James).

The two examples in Fig. 10-5 and Fig. 10-4 show the usage of shallow DOF in *Die Legende vom Zauberer Jackl*[68] and in *Mass Effect*. Both illustrate how shallow depth of field can be used to direct the viewer's attention.

There are several ways of manipulating focus. Focus pulling means to manipulate the focus so that a moving object or character remains in focus. This is a purely technical necessity when dealing with changing object-camera distances. A way to use this as a stylistic element is the rack focus. Here the focus is shifted from one object or actor to another in order to convey a shift of emphasis (Monaco, 83). In the second still from Die *Legende vom Zauberer Jackl* (cf. Fig. 10-6) that is taken approximately a second after Fig. 10-5 focus has shifted as the camera pans right.

In digital games variable focus is a relatively new development. *Mass Effect* utilises rack focus during cinematic sequences, much as in films. This is interesting from a technological point of view, however in non-interactive sequences filmic elements or even live-action video has been in use for over a decade, so the only discriminating element is the use of real-time 3d graphics instead of pre-generated imagery.

Mass Effect also features dynamic DOF effects during its gameplay sequences. When the zoom function on a cannon is used, the area of focus shifts according

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[67] Cf. Sony CineAlta F900 digital camera (20.07.2008) <http://www.sony.com/cinealta>, used on many major motion pictures such as *Cloverfield, Sky Captain and the World of Tomorrow* and *Star Wars: Episode II* (20.07.2008) <http://www.imdb.com>. There is also a new model available with a full-format 35mm sensor priced at 250.000USD. (20.07.2008) <http://pro.sony.com/bbsc/ssr/product-F35/>

[68] This scene shot with a JVC-HD110e camera using a Brevis 35mm adapter with a Nikkor 50mm/f1.8 lens.

to the area that is in the centre of the screen. To emphasise the effect the shift of focus occurs with a slight delay from the movement of the camera (cf. Fig. 10-7, Fig. 10-8 and Fig. 10-9).

6.3.3 Bloom and Glow

Light scattering in the atmosphere or within the human eye causes the perception of glowing auras or halos around very bright objects. For the final image this means that bright areas “spill over” into other areas of the image (Green). This has been used extensively in portrait photography by placing a diffusing filter over the lens to cause scattering. This has the effect of bright areas in the image casting visible auras around their area of occurrence, while retaining the original edge sharpness of the object or objects affected by the glow. The aesthetic effect is a softer, warmer look to the image that tends to obscure small imperfections in portrait photography and adds a certain layer of dreamy kitsch especially to landscape and animal photography. In film soft or diffusing filters have also been used extensively, most prominently so in the era of black and white film when depicting close up shots of female leads.

Since in photography in digital graphics the amount of light reaching the eye is limited, these glowing auras are a good way of indicating very bright light sources, but also for the same uses as in photography. The process of creating glow effects is very similar to that of creating DOF effects, except that in the second step instead of the z-buffer values only areas emitting glow are rendered (James).

6.3.4 Blown-out highlights

One of the most crucial areas of film is exposure. Since every kind of recording medium, regardless if it’s digital or analogue film, has a limited contrast range that can be captured, exposure must be precise or loss of information occurs. In overexposed film, pure white replaces the contrast ranges that make up the visual information. On the other side of the spectrum, pure black is an equally damaging occurrence, but perceptually not as problematic since black shadows are more natural to human vision than white highlights. If this happens one

speaks of "blown-out" highlights. Since film, especially high quality film stock has very high contrast ranges one almost never sees this phenomenon in the movies - in home video it is an everyday occurrence. Even high quality consumer cameras have contrast ranges that are far more limited than that of film, thereby limiting the useful area of image capture (cf Monaco 116-119).
As with lens flaring blown out highlights have become a hallmark of video and thus a phenomenon worthy of digital replication. Since electronic newsgathering has been on the rise in the last eight years and more and more reporters are in the field with small, inexpensive cameras more material suffering of the traditional video flaws such as exposure problems has been available on the internet and even in mainstream news channels (cf. Fig. 10-10).

6.3.5 Motion Blur

Since film and video captures visual information cyclically the duration of one cycle is crucial to the image characteristics. In film and video this is referred to as shutter speed, even if most digital cameras do not have physical shutter mechanisms. The longer the shutter remains open, the more light may hit the recording medium. When fast movements are captured at long times of exposure, the object has moved a considerable distance before the shutter closes again. This means that information of a certain duration of the movement is stored in one frame - the object appears blurred and elongated in the direction of movement (Monaco, 86-88). Generally this is not considered a positive quality, especially sports photography uses very fast lenses[69] to be able to use high shutter speeds - crisp, detail-rich images of "frozen motion" are the result. Similarly, most sports channels that transmit in HD use progressive scanning to render individual frames in more clarity (Wood, 11). In digital games each individual frame can always be rendered in perfect clarity, something which no analogue film is able to do. This again is firmly rooted in the technical development, since when there is no analogue medium to render an image onto each single frame represents a point in time - in contrast to film and photography

[69] The „speed“ of a lens determines how much light it lets through. The more light passes through the lens, the faster the shutter speed can be while still allowing for adequate exposure. Cf. Monaco, 86

exposure, where a single frame always measures a duration. This infinitesimal fragmentation means that every blurring must occur after the initial image has already been generated, which means that more computational cycles are required in order to provide the final image. Since blurring, along with other post-processing effects are computationally expensive, i.e. they require complex and multi-layered calculations they have become available only in the last few years with the rising capabilities of graphics cards (cf. Fig. 10-11).

6.3.6 Grain

Film stock always has a certain amount of grain, depending on the chemicals used in the emulsion, the physical size of the recording format and the light sensitivity of the material. Like many of the other visual markers of film, grain is a side effect of the production mechanical realities and not a consciously chosen stylistic element
(Monaco, 109-112). In digital video there is a similar, but less aesthetically acceptable phenomenon called noise. Similar to film it is dependent on the light sensitivity, the recording format and the type of recording chip that is used. *Mass Effect* features a film grain postprocessing filter as one of its many visual extensions (cf. Fig. 10-12).

7 Conclusion

Despite the trend towards linearity in the stories of the digital games of today, a number of methods exist which allow nonlinear narratives that respond to player interaction. Their applicability for commercial game development varies greatly, here it has become apparent that pre-generated bits of narrative in a lightly interactive framework provides the best compromise between guaranteeing an engaging, author-crafted story and freedom of movement of the player within the storyworld. Other strategies such as extending the range of predetermined possibilities either prove too costly, or do not yield the desired results.

The applications that were examined in the field of automated story creation show very promising results, however each of these models still has drawbacks that make it unsuitable for the development of narratives in commercial applications. These drama generators or story engines either offer too little flexibility or are too prone to failure. Nevertheless, most of these applications have succeeded in showcasing revolutionary methods of achieving narratives. The next iterations in this field of research will bear watching. It is also likely that many of the core technologies will be adapted for integration into larger projects where they may serve as one component within a more complex system.

It has also become clear that the general trend towards more linear cinematic stories also reflects in the visual side of game development. Great efforts are being undertaken to synchronise the visual presentation with the similarity in narratives that is already in place. The trend towards more life-like and filmic representations within digital games continues in parallel with the technological developments and can be expected to last for some time longer.

Both the fields of automated story creation and film/game interdependencies will yield interesting results in the future due to the ongoing and rapid developments in both.

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9 Glossary

AAA Title – High budget, high profile digital game title, aimed to sell within the top ten.

AI – Artificial Intelligence. In the area of digital games the term is used loosely for any kind of semi-autonomous action of agents that is not player controlled. These usually appear in the form of NPCs or digital opponents.

Aliasing – a phenomenon that occurs in the rendering of images at lower resolutions than the original. Information becomes lost and distortions, such as moiré can occur. Another frequent occurrence is that of a stair-like effect when rasterising single lines. In film this effect manifests itself when fast-moving or rotating objects are filmed that have a frequency close to or at multiples of the frame rate of film. Typical examples are helicopter rotors or wheels appearing to rotate backwards or stand still.

AND - programming term, relation. If a condition depends on two variables linked with AND, both must be true for the condition to be met.

ARPAnet – Advanced Research Projects Agency network, a decentralised military network developed during the cold war that would eventually grow into the world wide web.

ASCII – American Standard Code for Information Interchange. A set of 128 standardised characters which include the alphabet and numbers, as well as special control characters.

Authorial load – any content that is not automatically generated must be authored in some form. The authorial load is the amount of human effort that must be expended to create content for a specific system of narrative presentation or medium.

Backstory – Any information that relates to the narrative, but is not part of the narrative the player can interact with. In digital games backstory is usually revealed through optional means, such as the Codex in *Mass Effect*, or various books located throughout the game world in games such as *Oblivion* or *Baldur's Gate*.

Beat – Smallest self-contained dramatic unit used by the Facade application.

CCD – Charge Coupled Device. Used as imaging elements in digital video cameras.

CMOS – Complementary Metal Oxide Semiconductor. Used as imaging elements in digital photography and video cameras.

Content – complementary to game mechanics. By exclusion, content is everything that is not game mechanics, ranging from graphical assets to voice acting and scripted stories.

CRT – Cathode Ray Tube. Technology used in standard television sets and computers screens.

DOF – (Photography): Depth of Field. The area of relative sharpness. Depends on the focal length of the lens used, the aperture of the lens and the projection area. In digital games or computer graphics the same effect is recreated using shaders and z-buffer values.

DX10 – Microsoft DirectX 10

Emergence – Phenomenon in digital games and simulation when a relatively simple set of rules allows complex behaviours that are not predictable by knowing only the set of rules.

fmv - Full Motion Video. Usually refers to any kind of pre-recorded video within an application.

Foldback – Occurrence in node tree based hypermedia structures when all paths merge back into a single node. The single node usually contains an Inevitable Event.

FPS – First Person Shooter. In the last years the label has been expanded somewhat to include first person games that do not feature actual shooting.

Frame rate – unit: fps (frames per second). In digital games: frequency with which new images are sent to the display. A value above 30 is considered good, values below 18fps cause a noticeable stutter. Not to be confused with the refresh rate of displays which are usually between 60Hz and 100Hz. In digital video and film: frequency with which images are recorded or displayed. In analogue cinema the frame rate is fixed at 24fps, in digital video 24fps (analogue cinema standard), 25(PAL) or 30(NTSC) are standard, with variable recording frame rates being available for special effects or slow motion photography.

f-stop – (Photography) A measurement of how wide the aperture is open, and thus how much light is able to pass through the lens.

Game Mechanics – set of rules that govern gameplay.

Game world – Contains entities such as characters and objects, interactions, a

background and in some cases backstories. Defined by Adams and Rollings (98) as “an artificial universe, an imaginary place in which the events of the game occur”.

Gameplay – Any interaction with the game mechanics. Gameplay in contrast to most interaction with story and narratives always has a very fine granularity and has either no structure or externally imposed structure, usually through level design.

Granularity – Adams and Rollings (205) define granularity in the context of digital games as "[...] the frequency with which the game presents elements of the narrative to the player." They also state that it is theoretically possible to have infinitesimal granularity, i.e. that narrative and gameplay, in this context meaning interactions based on the game mechanics, form a blend indistinguishable to the player. They argue that games that focus all story events on the avatar come closest to this. This refers to granularity of narrative.

HTML – hyper text markup language

Interlaced – (Digital Video) alternating lines are recorded to form a single frame. Cf. progressive.

LCD – Liquid Crystal Display. Technology used in various devices, ranging from mobile phone screens to video projectors.

Minigame – a game within a game that serves as an additional obstacle. Minigames usually have nothing to do with the genre of the game they are in and are usually of the puzzle or reflex variety. Recurring examples are “push the right button at the right time”, Senso-variants that require the player to memorise a progressively longer button, sound or colour combination and the Towers of Hanoi.

MMOG – Massively Multiplayer Online Game. Online Game in which many users can play at the same time, within the same game world. Usually the game worlds are persistent, i.e. they continue to run when the user has logged out.

MMORPG – Massively Multiplayer Online Roleplaying Game. An MMOG in which the user takes control of a single character, or avatar which usually features a number of character variables that influence gameplay. These variables can be increased through playing, allowing the player to take on greater challenges.

Mock-up – a graphical representation of what a typical ingame scene will or

would look like. Used for marketing and development purposes.

Moiré – graphical interference pattern that occurs when regular patterns are depicted that have a level of detail that is close to or lower than the resolution of the imaging element.

NPC – Non Player Character. Any character in a game not directly controlled by the player. Mainly occur in RPGs.

NTSC – national television system committee. An interlaced broadcast format with 525 scan lines, used in America and South-East Asia.

PAL – phase alternating line. An interlaced broadcast format with 625 scanlines, used in most European countries.

Powerharvesting – Harvesting refers to the phenomenon of killing foes in order to gain treasures. In most RPGs, more so in MMORPGs harvesting is a side effect of overcoming foes. Powerharvesting is a phenomenon where the acquisition of treasures as quickly and efficiently as possible becomes the main goal of the player.

Powerlevelling - In most RPGs the player's avatar or character gains "levels" through playing. Traditionally killing foes yields experience (XP), once a certain threshold is reached the character gains a level and his stats increase, allowing the avatar to become more powerful. Powerlevelling is a phenomenon where the act of levelling up the character as quickly and efficiently as possible becomes the main goal of the player.

Progressive – (Digital Video) each frame is recorded or displayed in full. cf. Interlaced.

Quest – a task or goal, typically within an RPG. Many RPGs allow the player to acquire and manage many quests in parallel. A quest usually has an NPC as quest giver and has an associated reward upon completion.

RPG – Role Playing Game. Rooted in the tradition of pen and paper gaming these games place one or more characters in the control of the player. Each of the characters is represented through a number of statistical values, such as strength, intelligence or dexterity. Through play these values can be increased, making the corresponding characters more powerful.

RTS – Real Time Strategy

Rule set – the entirety of the laws governing gameplay, intrinsic to the game world.

Shader – graphical subroutines that are supported by the graphical hardware of modern graphic accelerator cards. They typically allow visual effects rendering such as blur and distortion effects to be computed on the hardware of the accelerator card.

Story Engine – any digital program that assembles individual components into a narrative whole.

Storyworld – the entirety of narrative content that the player can interact with.

Target shot – similar to mock-ups, target shots are created in the early stages of digital game development in order to visualise what the finished product should look like. Mainly used for development purposes.

TFT – Thin Film Transistor. A technology used in flatscreen television sets and computer screens.

XOR – programming term, relation (eXclusive OR). If a condition depends on two variables linked with XOR, one or the other must be true, but not both or neither.

XP – abbreviation for experience points. In most RPGs player characters gain experience by overcoming obstacles. Higher experience leads to improved character skills.

z-buffer – (computer graphics) Contains information about the relative “depth” of the projected image, i.e. the distance of each object to the viewer. It is used primarily for calculations of occlusion, but can also be utilised for depth of field effects.

10 Appendix

10.1 Primary Text

10.1.1 Der Schatz im Ötscher, Excerpt 1

39

As the water sprite averts his gaze for a second you grab a rock and hurl it with all your might in the direction of the moss-covered Erlauftaler. Did you hit the water sprite? Throw the dice (or use the flipbook).

1,2 or 3
The water sprite flinches! Your rock has hurt his head! He threateningly shakes his fist at you before disappearing under the smooth surface. Continue at 40.

4,5 or 6
The rock has missed its mark! Quickly the water sprite submerges. Continue at 40.

40

“That´s it!” you scowl as soon as the water sprite is out of sight. You climb into your inflatable and leave the shore. You use your spade as a paddle. As soon as you have reached the middle of the *Ice Lake* you feel your raft being lifted up. Before you can do anything about it, you fall into the icy water. Continue at 41.

41

With dread you realise that you’re being pulled under despite your life vest. It’s not the water sprite, it’s your own heavy backpack! You thrash wildly! You are running out of air! Finally you manage to open the straps and free yourself from the burden that almost dragged you to your watery grave. With your last strength you drag yourself ashore. Your expensive equipment is sinking to the bottom of the lake – and with it the valuable cave map! The treasure hunt is over for you! A cold will remind you of your involuntary bath for days to come. Why did you have to throw a rock at the water sprite! Rowdy! Vandal!
(Sklenitzka, 39, 40, 41. Own translation)

10.1.2 Facade, Transcript 1

(Audrey knocks on the front door.)

(Trip opens the front door.)

TRIP

Audrey!!

AUDREY

TRIP I'VE BEEN SHOT!

TRIP

Hi! It's so great to see you! -- (interrupted)

AUDREY

HELP ME

TRIP

Uh...

TRIP

Well come on in...

TRIP

Uh, I'll -- I'll go get Grace...

AUDREY

THERE WAS A MAN WITH A GUN

TRIP

(unintelligable [sic] arguing)

TRIP

b

(unintelligable [sic] arguing)

AUDREY
HELP ME I'M BLEEDING

TRIP
(unintelligable [sic] arguing)

AUDREY
TRIP

AUDREY
HELP

AUDREY
I'M GOING TO DIE

GRACE
Audrey,

GRACE
Hi! How are you? I'm so happy to see you after so long! -- (interrupted)

AUDREY
CALL 911

GRACE
Uh...

AUDREY
HELP

GRACE
So, come in, make yourself at home...

c

AUDREY

I'VE BEEN SHOT

AUDREY

NO

GRACE

Uh...

AUDREY

YOU DON'T UNDERSTAND

TRIP

What...? Audrey, I --

GRACE

Trip, that was just a well-intentioned little poke in the ribs between friends. That's all. -- (interrupted)

AUDREY

I WAS MUGGED

TRIP

Heh heh, Audrey, seeing you brings -- (interrupted)

AUDREY

I AM BLEEDING

TRIP

N -- no, uh, I've -- I've missed you.

AUDREY

HELP

d

TRIP

uh...

AUDREY

OH, FUCK THIS

TRIP

Ha ha! Oh I think we're going to need some drinks first if we're going to talk about sex.

(Fyfe 2008)

10.1.3 Mass Effect, Eden Prime, Structure 1

- Cutscene (spaceship Normandy approaches a planet) automatic
- Dialogue (Hangar) automatic
- Gameplay
- Cutscene (Jenkins is Shot) automatic
- Gameplay
- Dialogue (about Jenkins) “use” interaction with Jenkins’ body, +2 paragon or renegade points
- Gameplay
- Cutscene (Ashley narrowly defeats two pursuers and takes cover behind a rock) locational trigger reached
- Gameplay
- Dialogue (Ashley joins the group) “use” interaction with Ashley, +2 paragon or renegade points
- Gameplay
- Dialogue (the beacon is discovered) locational trigger reached
- Gameplay
- Cutscene (Husks attack the group) locational trigger reached
- Gameplay
- Optional Dialogue (interrogating the two scientists in their hideout) puzzle solved to pick lock on the door to the hideout, +2 paragon or +4 renegade points
- Gameplay
- Cutscene (Saren shoots Nihlus, spaceship Sovereign leaves) locational trigger reached
- Gameplay
- Optional Dialogue (Farmers hiding out in the toolshed) puzzle solved to pick lock on the door to the hideout, +2 paragon or renegade points and optional equipment given and additional dialogue option in the following dialogue sequence
- Gameplay
- Dialogue (confronting the smuggler in the spaceport) “use” interaction with

Nihlus' body, optional equipment given

- Gameplay
- Cutscene (team rides tramway, enemies set bombs and Saren interacts with the beacon) "use" interaction on tramway
- Gameplay (defusing bombs by "use" interaction on bombs)
- Cutscene (the beacon is activated, the avatar has a vision, Saren is mad about the avatars success in saving the colony) "use" interaction with beacon
- Dialogue (waking up in the Normandy sickbay) automatic
- Gameplay

(Mass Effect, own summary)

10.2 Images

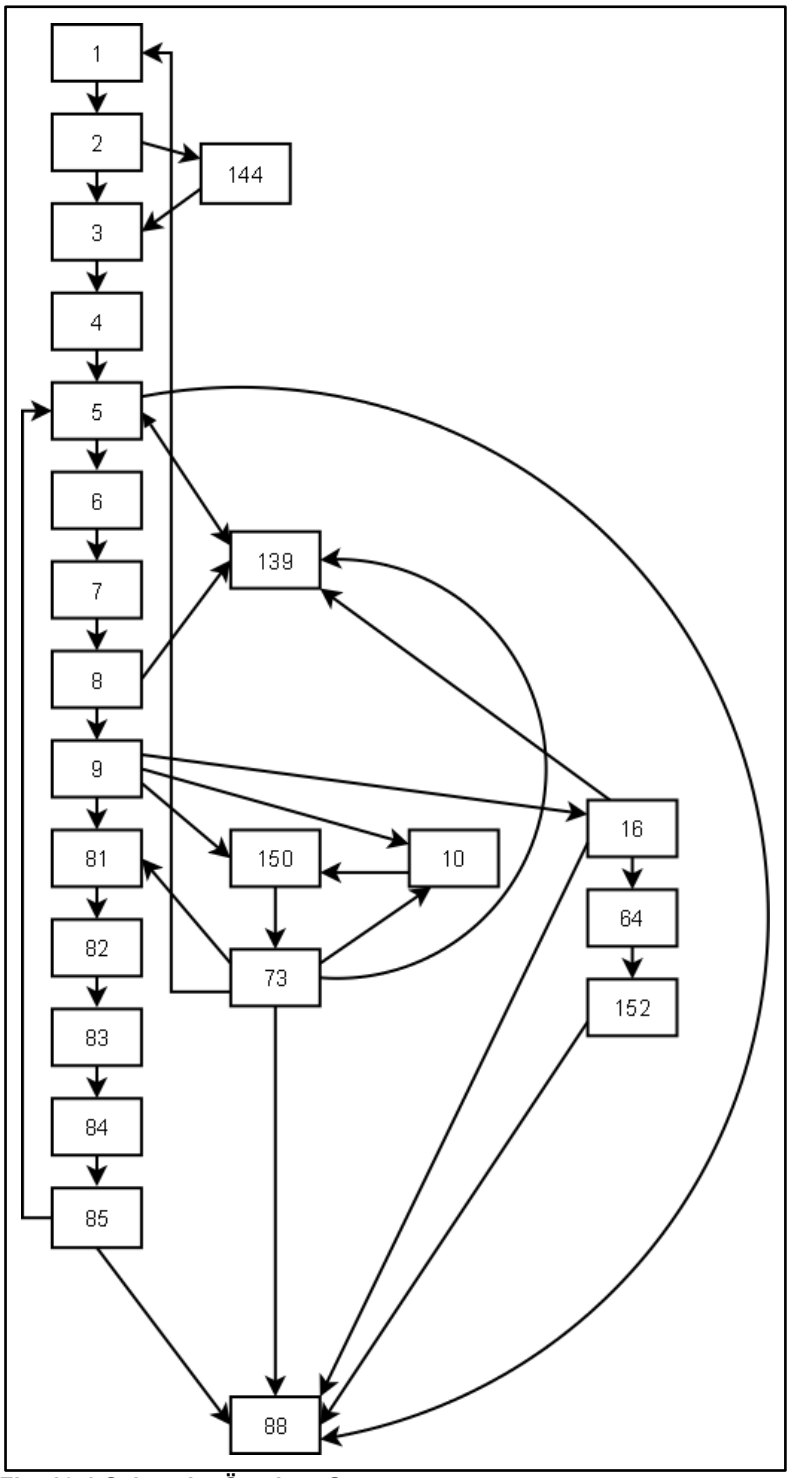


Fig. 10-1 Schatz im Ötscher: Structure

h

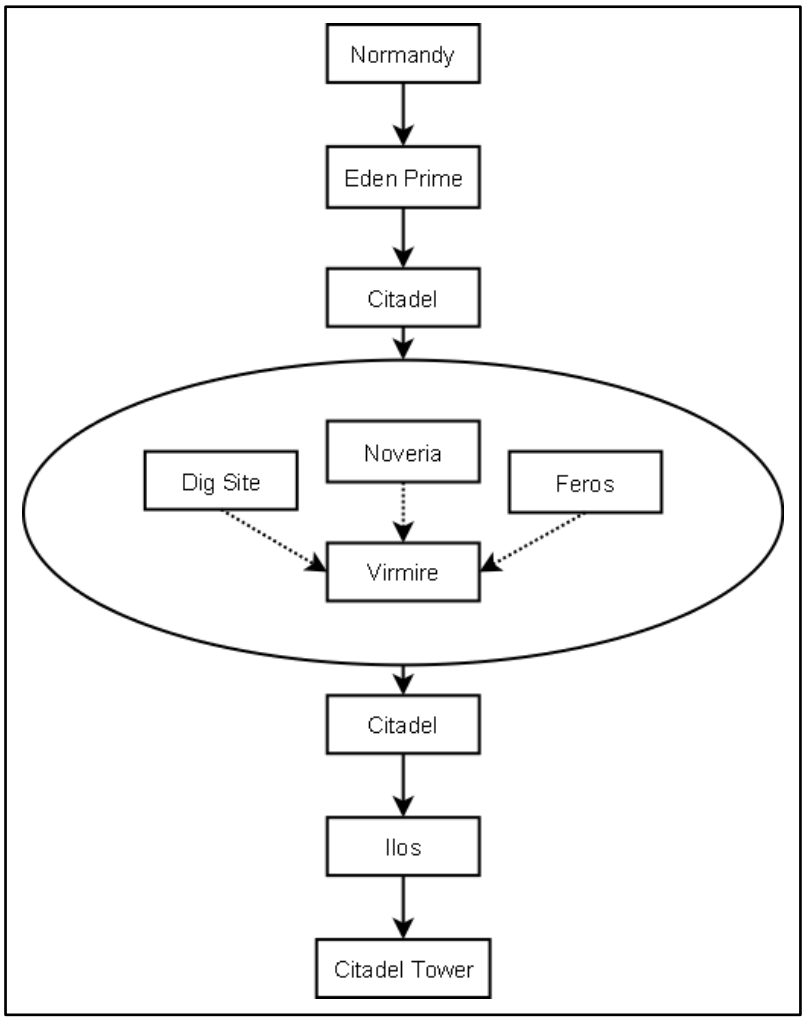
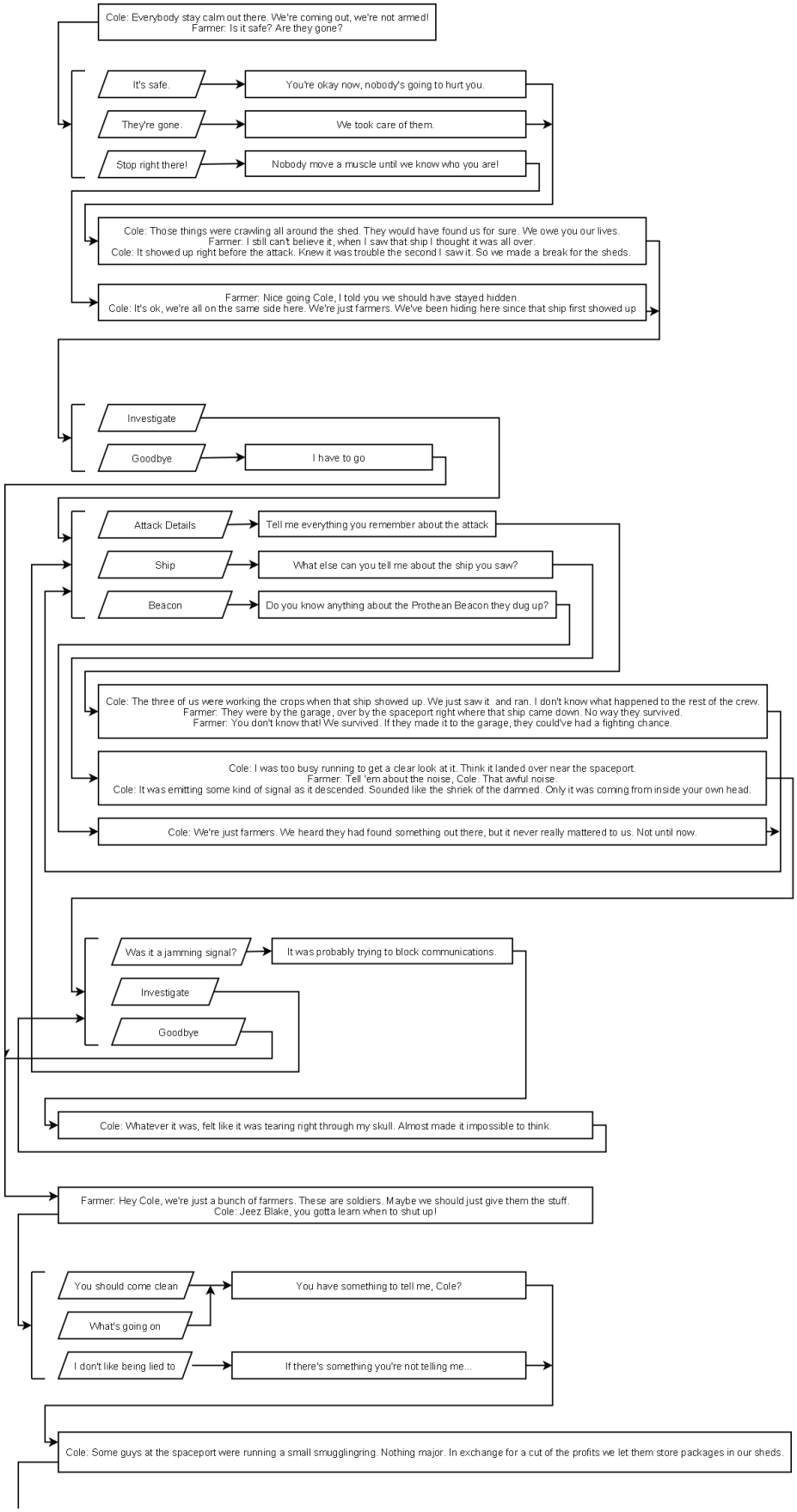


Fig. 10-2 Mass Effect Superstructure


Cole: Everybody stay calm out there. We're coming out, we're not armed!
Farmer: Is it safe? Are they gone?
It's safe.
You're okay now, nobody's going to hurt you.
They're gone.
We took care of them.
Stop right there!
Nobody move a muscle until we know who you are!
Cole: Those things were crawling all around the shed. They would have found us for sure. We owe you our lives.
Farmer: I still can't believe it, when I saw that ship I thought it was all over.
Cole: It showed up right before the attack. Knew it was trouble the second I saw it. So we made a break for the sheds.
Farmer: Nice going Cole, I told you we should have stayed hidden.
Cole: It's ok, we're all on the same side here. We're just farmers. We've been hiding here since that ship first showed up
Investigate
Goodbye
I have to go
Attack Details
Tell me everything you remember about the attack
Ship
What else can you tell me about the ship you saw?
Beacon
Do you know anything about the Prothean Beacon they dug up?
Cole: The three of us were working the crops when that ship showed up. We just saw it and ran. I don't know what happened to the rest of the crew.
Farmer: They were by the garage, over by the spaceport right where that ship came down. No way they survived.
Farmer: You don't know that! We survived. If they made it to the garage, they could've had a fighting chance.
Cole: I was too busy running to get a clear look at it. Think it landed over near the spaceport.
Farmer: Tell 'em about the noise, Cole. That awful noise.
Cole: It was emitting some kind of signal as it descended. Sounded like the shriek of the damned. Only it was coming from inside your own head.
Cole: We're just farmers. We heard they had found something out there, but it never really mattered to us. Not until now.
Was it a jamming signal?
It was probably trying to block communications.
Investigate
Goodbye
Cole: Whatever it was, felt like it was tearing right through my skull. Almost made it impossible to think.
Farmer: Hey Cole, we're just a bunch of farmers. These are soldiers. Maybe we should just give them the stuff.
Cole: Jeez Blake, you gotta learn when to shut up!
You should come clean
You have something to tell me, Cole?
What's going on
I don't like being lied to
If there's something you're not telling me...
Cole: Some guys at the spaceport were running a small smugglingring. Nothing major. In exchange for a cut of the profits we let them store packages in our sheds.

j

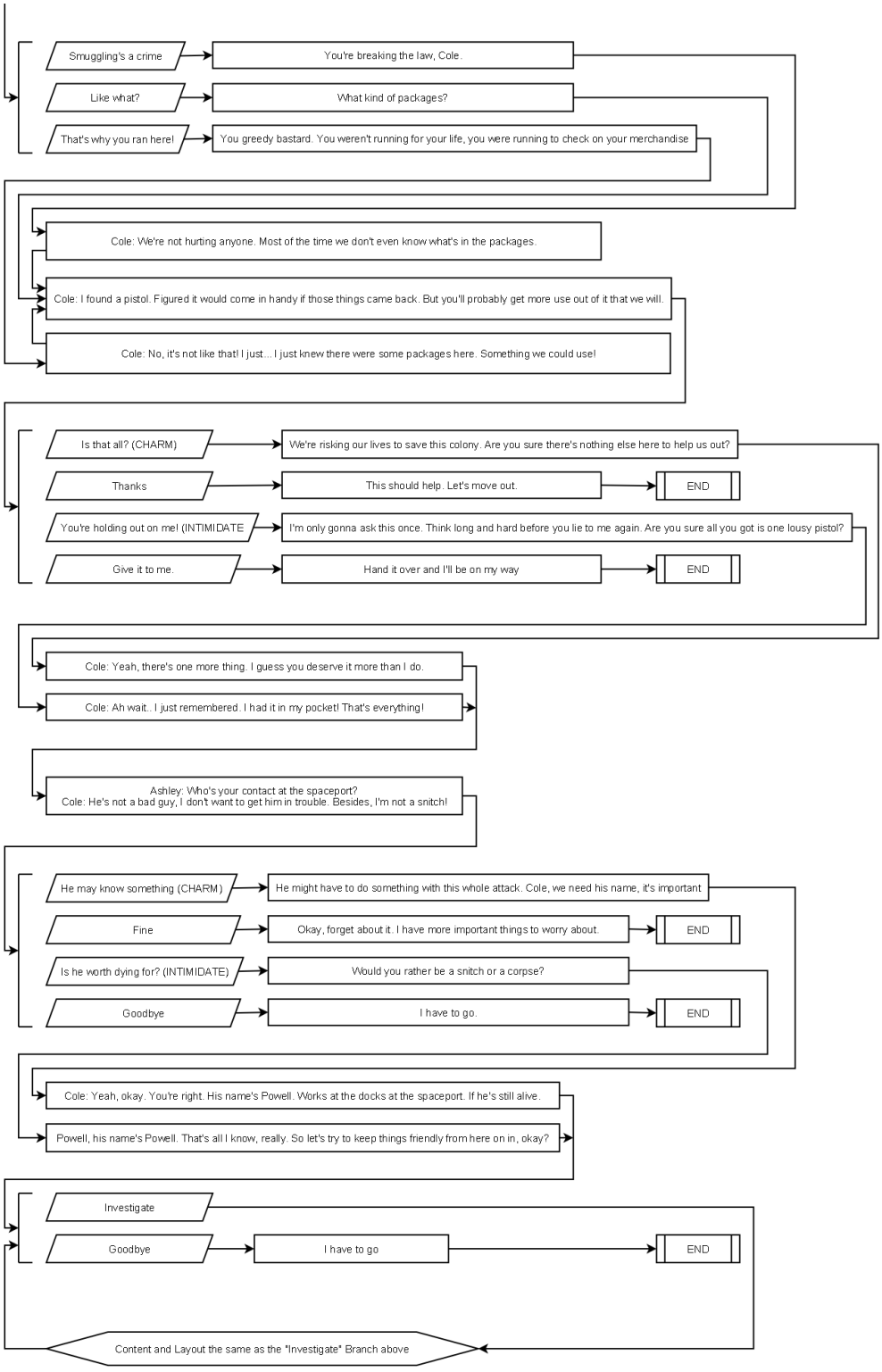


Fig. 10-3 Mass Effect Dialogue Structure

Fig. 10-4 Mass Effect Screenshot – Depth of Field

Fig. 10-5 Zauberer Jackl - Depth of Field 1

Fig. 10-6 Zauberer Jackl - Depth of Field 2

Fig. 10-7 Mass Effect Screenshout - Foreground

Fig. 10-8 Mass Effect Screenshot - Midground

Fig. 10-9 Mass Effect Screenshot - Background

Fig. 10-10 Call of Duty 4 Screenshot

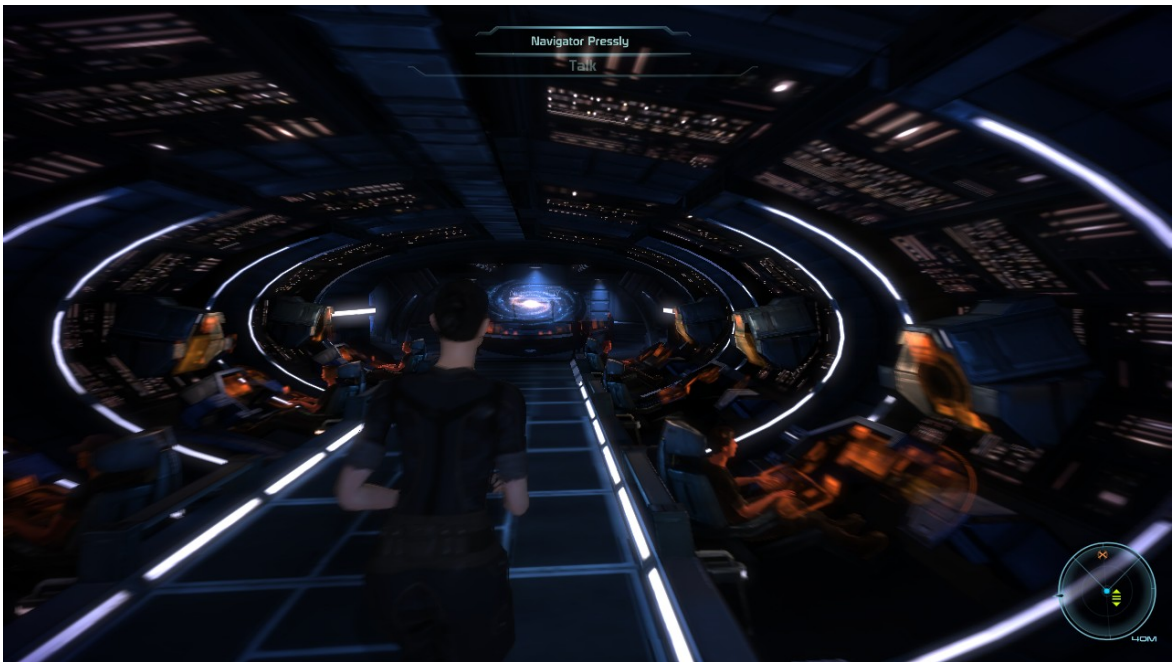


Fig. 10-11 Mass Effect Screenshot - Motionblur

Fig. 10-12 Mass Effect Screenshot - Film Grain

Zusammenfassung

Digitale Spiele waren schon lange Gegenstand von wissenschaftlichen Studien, in letzter Zeit häuften sich die Diskussionen, ob Ansätze der traditionellen Medienwissenschaften auch auf digitale Spiele angewendet werden können, oder ob ein völlig neuer Zugang notwendig ist. Im Kontrast zu diesen Diskussionen stehen Publikationen aus dem Bereich der Spieleentwicklung selbst, die sich primär mit produktionstechnischen und ästhetischen Aspekten beschäftigen und damit oft Werke normativer Poetik hervorbringen.

Diese Arbeit versucht, die Struktur von digitalen Spielen in einem Referenzsystem mit anderen Hypermedia-Artefakten zu platzieren um aufzuzeigen, welche Erzählstrukturen vorhanden sind und wie sie zustande kommen. Die Strukturen von untersuchten Spielen, Filmen und Hypertexten werden als Knoten-basierende Hypermediaartefakte behandelt. Darüberhinaus werden etliche Methoden untersucht, Erzählstrukturen zu generieren die nicht diesem System entsprechen.

Im zweiten Teil der Arbeit werden visuelle Aspekte von digitalen Spielen denen der Kinofilme gegenübergestellt.

Die Analyse der Strukturen zeigt, dass die Knoten-basierende Herangehensweise für eine Vielfalt von Hypermedia funktioniert, auch digitale Spiele. In diesem Sinne können digitale Spiele wie jede andere Form der Hypermedia behandelt werden ohne dass das Element der Interaktivität das Modell stört. Die behandelten dynamischen und teilweise autonomen Systeme Erzählstrukturen zu schaffen können in der kommerziellen Anwendung noch nicht beobachtet werden. Hier zeigt sich eher ein Trend zu linearen, film-artigen Strukturen. Dies wird auch im zweiten Teil der Arbeit bestätigt, wo gezeigt wird, dass auch die visuelle Seite der Spiele immer filmischere Qualitäten annimmt.

Curriculum Vitae

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Ausbildung

1986-1990	Volksschule Rohrbach
1990-1998	BRG Rohrbach
1998-2008	Studium Anglistik und Amerikanistik (LA) und P.P.P (LA) an der Universität Wien
2000 -	Erweiterungsstudium Informatikmanagement und Informatik (LA) an der Universität Wien

Berufserfahrung

2001-2005	Game Design: dion-software GmbH (Wien)
2005-2006	Game Design: maxartists/csp-mobile ltd (Deutschland)
2006-2007	Game and System Design: dion-software GmbH (Wien)
2007-2008	Zivildienst: Burg Altpernstein
2007-2008	Game Design & QA: 10tacle Studios Vienna GmbH

Weitere Berufserfahrung

2002-	Freelance 2d / 3d Grafik-Design
2007-	Freelance Kamera & Postproduktion