GENERATING DRAMA AND CONFLICT IN GAMES

Research Report

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Elín Carstensdóttir

BSc | Computer Science

Supervisor: Hannes Högni Vilhjálmsson

T-404-LOKA

School of Computer Science

Abstract

There are many ways to tell a story. One such way is to not tell a specific story at all but let the story and its outcome be decided by the person who is experiencing it. By letting the otherwise passive observer become a participant whose actions shape the story world we enter the realm of interactivity with all the complications, possibilities and questions it brings. Merging a story with an interactive interface is not easy. There have been many approaches to addressing this issue ranging from the detailed decision-tree structures and others methods of the Aristotelian persuasion to the flexible, emergent narrative centred multi-agent structures. These methods offer a specific view and a specific way of combining interactivity and story but very few incorporate the basic notion of the user or that of the user's experience as a component in the narrative process.

This paper introduces the concept of systematic narrative which is a new approach to interactive narrative. It addresses certain limitations of existing methods such as the constraints of interactive systems based on pre-authored plot structures and the overwhelming freedom of emergent narrative systems. Systematic narrative considers the user experience a central part of its reasoning process and the user's perception of events is essential. Systematic narrative poses various questions about the nature of interactivity, drama management and narrative. It offers a new representation through which interaction and story can be discussed.

This paper gives an overview of systematic narrative, the work that had significant impact on its development as well as previous work in field of interactive narrative. The paper also presents and discusses a scenario specific game engine that was implemented based on the systematic narrative approach.

Samantekt

Það er hægt að segja sögu á marga mismunandi vegu. Ein slík leið er að segja ekki eina sögu heldur láta söguþráðinn að vera ákvarðaðan af þeim sem er að upplifir söguna á hverjum tíma. Ef leyfa á þeim sem annars væri í hlutverki áhrofanda að verða þáttakandi í atburðarásinni þarf að íhuga hvernig skuli sameina gagnvirkni og sögu. Það hafa margar nálganir verið fundnar sem leitast við að leysa þennan vanda: frá ítarlega hönnuðum ákvarðanatökutrjám og öðrum aðferðum sem byggja á þeim grunni sem Aristoteles setti fram á sínum tíma, til sjálfsprottina frásagna sem gerðar eru mögulegar með tilkomu sýndarfólks. Þessar nálganir bjóða ákveðna sýn og aðferðafræði til að sameina gagnvirkni og sögu en fáar taka notandan eða upplifun hans með í reikninginn sem hluta af frásagnarferlinu

Þessi ritgerð kynnir til sögunar hugtakið kerfisfrásagnir sem er ný nálgun á gagnvirkar sögur. Þessari nálgun er ætlað að komast yfir takmarkanir sem fylgja þeim aðferðum sem settar hafa verið fram hingað til sem stafa m.a. af ósveigjanlegum undirliggjandi strúktúr í gagnvirkum frásögnum og yfirþyrmandi frelsi sjálfsprottinna frásagnakerfa. Kerfisfrásagnir horfa til upplifunar notandans sem grunn hluta af sinni ákvarðanatöku. Hvernig notandi skynjar og túlkar atburði er því talinn mikilvægur þáttur í ferlinu. Kerfisfrásagnir vekja upp spurningar um eðli gagnvirkni og hvernig hægt sé að stjórna drama og frásögn í gagnvirkum umhverfum. Kerfisfrásagnir bjóða uppá nýjar aðferðir sem hægt er að nota til kanna eðli gagnvirkni og frásagna enn frekar.

Þessi ritgerð gefur yfirlit yfir fræðilegar hliðar kerfisfrásagna, þær kenningar og aðferðir sem höfðu mikilvæg áhrif á þróun þeirra auk annarra mikilvægra kenninga sem falla undir gagnvirkar frásagnir. Ritgerðin kynnir einnig kerfisfrásagnarvél sem byggð er á ákveðnum grunn aðstæðum sem kynntar verða sérstaklega. Vélin var byggð á áðurnefndri kerfisnálgun á gagnvirkar frásagnir.

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1. Introduction

Stories are a central part of the human experience and seem to be present in some form in all human societies. They preserve culture, pass on knowledge of events, teach social and moral values and are also a great source of entertainment. In fact storytelling comes so natural to us that even small children can produce understandable proto-stories to communicate their experiences. Narrating events in our lives and telling stories about ourselves and others continues throughout our life. The narratives we produce become more mature and complex as we age and grow but the core properties remain the same. Almost all forms of entertainment feature stories and narratives as a central component. Books, movies, theatre and many video games are dependent on the story they are meant to tell but it is important to realize that none of them can tell a story the same way.

The virtual worlds of video games offer a more interactive approach to stories than other mediums. Games offer the user the opportunity of being an active participant and possibly influence the outcome of events as the story progresses. This interactive way of telling stories is known as virtual storytelling, commonly referred to as interactive narrative. It has become an important part of the way storytelling is used in gameplay. Though interactive narrative solves important and very specific problems for storytelling in games it cannot be said that it is without limitations.

1.1 Problem Statement and Motivation

The most common method for designing an interactive narrative is a plot-graph structure. One can think of the process in terms of designing a decision tree. For each event or a decision that the user needs to make there is a specific node corresponding to it. Each node has branches, each branch representing a single response or an action that the user is allowed to choose from. The branching factor for trees like this becomes very high in a relatively short amount of time. That means that each action that the user is allowed to choose from results in a new event or a new decision that the user has to respond to. The drawback of this approach is that each possible action and event has to be defined and planned by a human author. The possibility of brittleness increases as the story goes on as and mistakes become likely as the number of possible paths through the story increases. This method is too labour-intensive, expensive and prone to mistakes to be a viable option in future systems, especially if the story takes place in a large game world. This has been managed in various ways in commercial games, for example by making games shorter or by dividing a large story into a number of smaller ones. This plot-graph structure forces the user to follow a specific road map where he/she is essentially allowed to choose where to go next. This allows the user limited flexibility for exploration and prohibits any deviation from the predetermined plot. Dialog and social interaction is also of concern. All such interaction has to be pre-scripted and incorporated into the structure and is likely to result in unrealistic social behaviour and conversation.

Emergent narrative was developed as a response to these specific limitations in the interactive narrative structure. Being defined as narrative that emerges through interaction, it is similar to improvisational drama rather than the traditional authored plot and dialog on which interactive narrative is based. Though it can be considered an improvement on the traditional plot focused methods common in interactive narrative it is not without its own limitations. Being dependant on meaningful interaction for an interesting narrative to emerge there is a very strong likelihood of nothing emerging or occurring at all. Efforts to structure emergent narrative, inspired by its similarities to interactive theatre are underway.

There are many differences between approaches and theoretical frameworks in virtual storytelling research. It is therefore unsurprising that no theoretical framework has been generally agreed upon by the community (Aylett, Louchart, Dias, Paiva, & Vala, 2005). Another issue that is not sufficiently explored by either interactive- or emergent narrative is the role of the user in an interactive experience. While both approaches strive to offer a structure which allows a user to interact and influence a story neither examines what effect specific methods have on the user or how they influence the user's perception of the narrative. Though emergent narrative can be said to take advantage of the user's innate ability and need to narrate his/her own experience, it does not apply to interactive narrative. Neither places particular emphasis on how to influence this developing narrative during the experience. Further including the user's narrative capabilities would increase the expressive potential of interactive stories.

1.2 Project Proposal and Goals

So far current approaches to interactive stories in virtual environments have focused on creating coherent narrative experiences with dramatic value. These approaches are mainly inspired by types of media such as theatre, literature and film whose narrative theories were not originally meant to consider the high level of interactivity found in virtual environments. The nature of interactivity requires an actor to make decisions or perform actions, yet these approaches rarely put the user at the centre of the narrative experience. These approaches rely on representations of concepts that are non-interactive in nature. This requires them to focus more on underlying reasoning processes rather than if they were basing their approaches on concepts that were interactive in nature.

This thesis introduces a new approach to virtual storytelling called systematic narrative. Systematic narrative is based on the idea of simulating multiple conflicting social systems. Social systems are the structure we use in real life to evaluate situations to determine appropriate social behaviour. Each system has specific rules and conditions that determine what is appropriate and what is not. Conflicts between different social systems are a part of the underlying structure of many great stories and plays. Combining this representation of social systems with the play-writing theories of Lajos Egri is the foundation of systematic narratives. This approach differs from earlier virtual storytelling methods since it is based on what is originally an interactive structure rather than a non-interactive one. It has the potential of having a similar degree of freedom as an emergent narrative while having a flexible structure that serves as a foundation for a coherent experience.

This project has two specific main goals. The first is to outline the theoretical foundation for systematic narrative as well as defining key concepts and relationships. The second is to use the systematic narrative approach to design and implement a scenario-specific narrative engine. Development of a general systematic narrative architecture will be conducted during the implementation of the scenario-specific engine. The architecture of the scenario-specific engine will be modified and adapted to fit to the general engine architecture as much as possible.

2. Related Work

Before discussing systematic narrative in detail it is important to examine the body of work that gave rise to its development and define key concepts. There are three main sections in which this work will be discussed. The first focuses on narratives in virtual environments. Here the main emphasis will be on the narrative theory of virtual reality, approaches to narratives in virtual environments as well as notable work done in implementing these approaches.

The second section discusses the role that the user plays in an interactive experience. While the focus of many interactive narrative systems is to produce a coherent plot they do not focus on how these plots are perceived by the user or how they are experienced. This section focuses on what interactivity means for a user and how it can affect his/her experience. In connection to that discussion the concept of procedural rhetoric is introduced.

The third section presents and discusses relevant theories from the theatre and from playwriting. The focus will be on the work done by Stanislavski and Egri respectively. The theatre and the play in particular are in essence a storytelling medium and an art form. As such they offer a specific framework that those using the medium to tell stories can use. It is within this framework that the relationship between interactivity and stories can be discussed in a more abstract manner. Important questions regarding drama, suspense and overall entertainment value can be reasoned about using abstract systems such as the one suggested by Egri in his book The Art of Dramatic Writing.

This chapter is meant to serve as a basis for the introduction of systematic narrative by introducing the key components in its development. Systematic narrative itself will be introduced in chapter 3 as previously mentioned.

2.1 Narratives in Virtual Environments

2.1.1 Narrative Theory of Virtual Reality

In almost all entertainment mediums from literature to video games, stories and narratives are a central component. Since all the mediums share this central component it is noteworthy that none of them presents or tell a story in the same way. Limitations and restrictions that apply to literature works for example do not necessarily apply to films. This is also true for video games that rely on virtual worlds and user participation to tell a story. Literature, film and theatre all have separate, mature narrative theories that apply to each mediums particular advantages and limitations. Virtual reality, an umbrella term for interactive media including video games, is in comparison relatively new but has already become a major entertainment medium. Narrative theory has not been developed for virtual reality as it has for its older counterparts. The first efforts to develop interactive experiences drew on narrative theories from literature and film especially. This echoes the early developments of narrative theory for films, where originally narrative in film was regarded in the same way as one would a narrative in a novel.

There is one important characteristic of virtual reality which indicates that it is fundamentally different in nature from other narrative mediums. In virtual reality the role of the subject or user, is not that of a passive observer as it is traditionally in literature and film, but that of an active participant. The roles of observer and participant are fundamentally different in nature and have different sets of characteristics. The role of the observer is to be passive and observe. This renders the user unable to affect the story progression while the participant is able to have direct influence on unfolding events and play an active part in the story. This difference leads to the consideration of the main assumption made by the three main mediums, literature, cinema and theatre, that narrative must be authored. Narrative theories for virtual reality have been heavily influenced by this notion and relevant work and theories converge towards this authorial view on narrative (Aylett & Louchart, 2003).

Other fundamental differences further defining virtual reality as a stand-alone narrative medium have been suggested. When Aylett and Louchart argued that virtual reality should be a narrative medium in its own right they specified that virtual reality should have its own separate narrative theory (Ruth Aylett & Sandy Louchart, 2003). Their argument was supported by their evaluation of four different narrative mediums: cinema, theatre, literature and virtual reality. They based their evaluation on four different types of criteria: contingency on time and space (low to strong), narrative representation (mental or visual), presence (physical or not physical) and interactivity (yes or no). They concluded that virtual reality was the only medium that had strong contingency on both time and space. Contingency as it is defined in their work is the ease of manipulation of time and location that is possible within the medium. This would not be possible in virtual reality because of the level of real-time interactivity available to the user and the user´s involvement in the unfolding narrative. Virtual reality is represented visually as in cinema and the theatre and like cinema and literature the user does not have a physical presence. Virtual reality has the distinction of being the only medium that is fully interactive. The only other medium who offers significant interactivity is theatre according to their analysis. Theatre has interactive elements including participatory theatre but those are not considered to be mainstream theatre methods.

The concept of interactivity in virtual reality is not fully compatible with the traditional view of stories. The authorial view mentioned earlier can be traced as far back as Aristotle and his attempts to apply logical reasoning and structure to the analysis of drama and tragedy. In Aristoteles's Poetics he strived to identify different narrative structures. Of these structures two main concepts Muthos (plot) and Mimesis (mimetic activity) are notable in the context of this work. Mimesis is the representation or the portrayal of actions as cited by (Laurel, 1993). Mimesis is defined by the plot or Muthos. This makes plot the central component in Aristotelian theory. Narratives in Aristotelian theory have six main components: action, character, thought, language, pattern and enactment. These components relate to one another in two directions and this relation forms two opposite causal chains. One chain is from the authorial view i.e. from action to enactment. The other is from the audience view, from enactment to actions (Laurel, 1993).

This theory does not include interactivity as a component and assumes that interactivity is not a part of the narrative process. Allowing it would conflict with the core assumption of Aristotelian theory that all narrative is governed by Muthos, a predetermined plot. To modify Aristotelian theory for interactivity Mateas developed a Neo-Aristotelian theory for interactive narrative (Mateas Michael, 2000). To give the user agency within the narrative, Mateas used the character component, one of the six main components of an Aristotelian narrative. Using this, the user could be represented as a character within a narrative and allowed to interact and participate in the experience. This would result in what is by definition an interactive narrative. The Neo-Aristotelian theory however would still require a predetermined plot and a set of defined actions that the user would be allowed to choose from. This dependency makes it extremely difficult to apply for massive game worlds for example, where the possibilities for the user are expected to be endless and not constrained by a specific story plot. Because of this dependency on a pre-authored plot, implementing a Neo-Aristotelian narrative within virtual reality would be a time-consuming task and massively complex to both plan and implement for a human author.

This problem is referred to as the "narrative paradox" in virtual environments. The narrative paradox was introduced by Aylett (1999) and highlights the contradiction of the desire of allowing the user complete freedom within the environment as well as wanting to include a coherent plot structure in the experience. Aylett suggested emergent narrative as a possible solution to this problem. Emergent narrative is a narrative that emerges through interaction within the story world, through character interaction or interaction with the environment. This approach is more in tune with the nature of interactive environments and more dynamic than the Neo-Aristotelian approach. It implies that a narrative is completely dependent on the user's interaction with the other characters and the environment and that it is without any predetermined structure. That is not to say that the narrative would be completely without structure since the user could have specific goals in mind for the overall experience.

These two approaches to interactivity and narrative are the product of the field of virtual storytelling that has relatively recently become an active research field. It is therefore no surprise that approaches to both theory and implementation differ greatly, even if some belong to the same general approach by definition. Consequently no frameworks (theoretical or otherwise) have been generally agreed upon by the community (Aylett et al., 2005) Certain general approaches such as interactive narrative and emergent narrative are more suitable for specific implementation methods due to how they are defined and how they can be represented in virtual reality.

2.1.2 Interactivity in Narratives – Theory and Implementation

The concept of interactive narrative can be used to describe all narratives which require a user to respond to or take action in an environment and that will subsequently propel the narrative forward. This means that interactive narratives can be completely predetermined regarding plot and structure (interactive narrative as it is described in section 2.1.1) and that they can also emerge through interaction (emergent narrative, see section 2.1.1). These seem to be the extremes that exist on each side of the interactivity spectrum but there are other terms used when referring to the same concept. These are for example interactive drama and interactive storytelling. These differences in terminology refer to how the narrative is presented and constructed. These different concepts can be used to categorize these approaches to interactive narrative in the following categories:

- **Interactive narrative**: High-level plot outline is generated that the user can then follow. This approach mainly utilizes plot-graph methods, planning and Bayesian networks.
- **Interactive drama**: User has the freedom to interact with non-playable characters and/or environment. This approach uses mainly agent-based methods and planning.
- **Interactive storytelling**: Stories are generated and user choices and actions are integrated where possible. Dramatic interest rules, patterns and narrative structures such as Proppian structures (Propp, Scott, & Wagner, 1968) combined with planning are most commonly used for implementation.

It is evident that of the methods used by these three categories plot-graph methods have been the most influential. The most prominent systems in interactive narrative have all had a plot-graph based structure, such as Façade (Mateas & Stern, 2003) and IDA (Magerko, 2005). For a plot-graph structure the stages of interaction have to be determined beforehand. Stages of interaction refer to when the user is allowed to interact with the story in some way that will affect the story progression. These stages can be located anywhere; from being in between big scenes that are then played out based on the user's response down to each small interaction the user can have with the environment.

Figure 1. Screenshot from the interactive drama Facade. The user plays a guest at a dinner party, hosted by Grace and Trip.

The plot-graph structure allows the user to affect what the system determines to be the next part of the story. Therefore different actions in the same situation will cause invariance in the story progression when going through the story again (Arinbjarnar, Kudenko, & Barber, 2009). The limitations of this plot-graph approach are what was identified as one of key short comings of interactive narrative in section 2.1.1 The structure has to be authored beforehand to allow the system to determine when the user is allowed to interact with the story and how that interaction is to take place. Authoring for this approach often requires a tree-like structure such as decision trees. These tree structures have a specific root node or starting point (usually one) which then branches out to other nodes and has multiple endings. Each node represents a stage of interaction and each branch a possible action the user can take. The endings are determined by which path the user's actions have taken him/her.

This is an effective method as is evident by its influence on the interactive narrative field but it limits the number of possible actions available to the user. The tree-like nature of the plot-graph structure means that there are specific limits to the number of possible actions available to the user at any given time and this could limit the story experience. Another consideration is that the authoring for such plot-graph systems will become increasingly complicated as the branching factor related to possible actions increases. This in turn increases the likelihood of repetition, contradiction and other man-related errors. Plot-graph methods are despite this considered reliable and stable but are labour-intensive. They are widely used in the game industry because of it. But the limits of this approach make it unsuitable for large scale storytelling in massive game worlds for example and limits storytelling to what can be defined and implemented within this particular structure.

Bayesian networks have been utilized for a similar purpose. An example of such a system is the NOLIST engine (non-linear interactive storytelling game engine) which uses a Bayesian network to change itself dynamically in response to the user's actions and observations (Bangsø, Jensen, Jensen, Andersen, & Kocka, 2004). The entire story is not pre-scripted and the network infers details to use in the story as well as for creating a background story for the user's character all based on the user's actions in the story. This method is extremely dependant on the user's actions and will likely generate a similar story for the user each time, since users are likely to behave in a similar manner in similar situations (Arinbjarnar et al., 2009).

Planning is a notable approach as well and one example of a system using this approach is the GADIN system (generator of adaptive dilemma-based interactive narratives) (Barber, 2009). GADIN generates dilemmas during story progression. Dilemmas are difficult decisions the user needs to make, meant to provide dramatic interest. While GADIN is capable of generating dilemmas and stories indefinitely there is a question of scalability, similar to the plot-graph approach. For a system that depends on planning to function, the formation of a bottleneck is not an unlikely possibility. With the increasing number of dilemmas, possible user responses to those dilemmas as well as other actions available to the user in the story raises the question of how much information the system is able to handle. The amount of information and reasoning that needs to be conducted within such a planning system will ultimately cause the system to run too slow for real-time interaction when the limit is reached.

The limitations of the interactive narrative methods mentioned here share a common theme. These methods are either too dependent on a pre-scripted story or present a problem for scalability, i.e. to scale up to be able to handle an increasing number of possibilities in an acceptable manner. Methods from interactive drama suggest an alternative modular approach to these problems such as combining agent architectures with planning elements. This approach originated in part in the Oz project at Carnegie Mellon University (Mateas, 1999). The multi-agent architecture FAtiMA (FearNot! affective mind architecture)

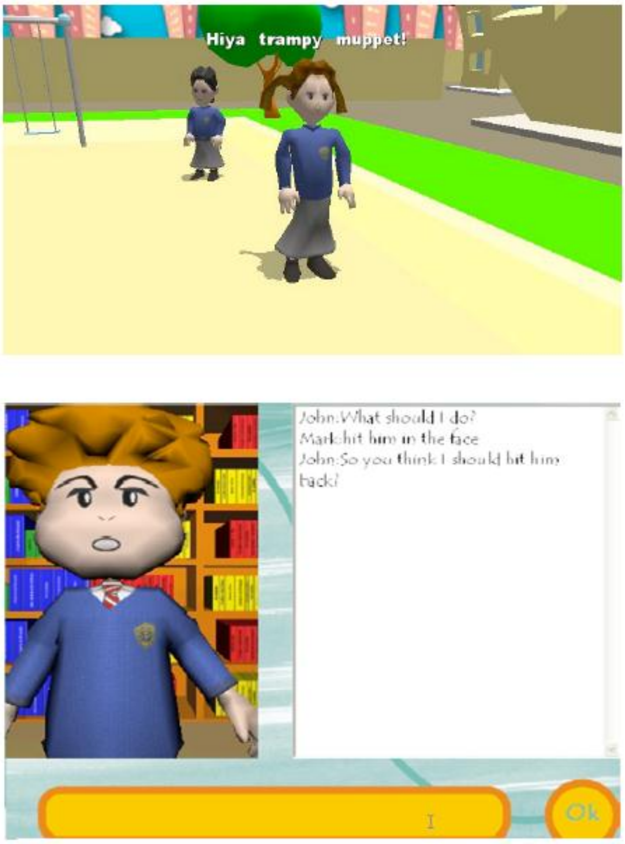

Figure 2. Screenshots from the FearNot! Storytelling applictation. It's purpose is to educate children about the effects of bullying. Copyright: Springer-Verlag.

(Aylett, Dias, & Paiva, 2006) is a prominent example of the interactive drama approach. It is used in the FearNot! storytelling application and relies on the drama that emerges through the interaction that user has with characters (agents) in the story. This is similar to the definition of emergent narrative (see 2.1.1). This raises the question of whether emergent narrative should simply be considered another branch of interactive narrative or even if it should be merged with interactive drama. Another notable example of an interactive drama system is Thespian, a multi-agent framework which uses social norms in addition to other components to control its agents (Si, Marsella, & Pynadath, 2006).

The methods most commonly used to implement emergent narrative are the same as the ones used in interactive drama. The reason that they are not considered to be the same thing is one fundamental difference. Interactive drama can for example include a director or a controller that controls all or most of the components that contribute to the experience. This cannot apply to emergent narrative since the narrative is supposed to emerge through interaction between characters that are not influenced by outside control like a director agent. This is both the strength and the limitation of this approach. The user is given free reign and the flexibility to control the experience which is a considerable asset. The drawback of this however is that there is no guarantee that the interaction that the user has is interesting or compelling or even that it happens at all. Various methods have been suggested to increase dramatic interaction from various interactive mediums notably live action role playing (LARP) and interactive theatre. While FAtiMa and Thespian were mentioned in connection with interactive drama both are considered to be rooted in emergent narrative. FAtiMa in particular is considered an emergent narrative system. Another example of an emergent narrative system is the Virtual Storyteller (Theune, Faas, Heylen, & Nijholt, 2003).

2.2 The Forgotten Narrative Element: The User

The discussion of interactive stories has been more and more prominent in recent years due to the increasing popularity and interest in video games. Academia has been researching methods and theories to find ways to create systems that dynamically generate interactive stories for some time. This effort has produced a number of different narrative generation and storytelling methods as well as systems based on them. These methods can be roughly divided into the two main approaches of interactive narrative and emergent narrative. A notable observation on both approaches is that neither places particular emphasis nor explicitly defines how the narrative was created in the mind of the user or how the interactivity element would affect the user experience. Likewise the literature does not discuss how the cognitive process of creating a narrative can be influenced through the methods used by these approaches. There have been narrative applications that utilized cognitive emotion modelling (Martinho, Machado, & Paiva, 2000) and social norm modelling (Si et al., 2006) and questions have been raised regarding using cognitive models of narrative processing for interactive narrative structures (Young, 2000). These efforts however, have not proposed a solution to the issues mentioned here.

The user is the centre of an interactive experience and it should be the user's actions and the consequences of those actions that influence the experience the most. Having the user at the centre means that it is the user who perceives and interprets the experience and in that sense creates the final story. The ultimate narrative control therefore ceases to lie with the author and is transferred to the user. The problem then becomes how the user's actions can be guided to have a specific story or meaning emerge. One possibility would be to design the environment in such a way that it would influence the user to be more likely to experience events in a certain manner. This would not limit the user by directly forcing him/her to make a decision but could possibly make the user feel obligated to make a decision which would have a much more powerful effect.

Designing the environment and the characters within it to influence the user would require approaches not commonly used in the systems described in section 2.1.2. It is likely that not one but many approaches, ranging from game-design to behavioural theories, are needed to design such an environment effectively. One such approach is procedural rhetoric (Bogost, 2007). It refers to the practice of using processes persuasively i.e. to use procedures as a device for expressing ideas, meaning and arguments about how things work. This approach is ideal for interactive mediums since it can be used to explain function through interaction without having to use verbal or visual explanation. That is not to say that procedural rhetoric demands sophisticated interactivity. Procedural rhetoric is a tool for affecting the user's perception or understanding through a meaningful response to user input. Therefore if it is to be used for environment design meant to influence user choices the design process would need to consider in what way the user input affects a particular process and in what way the response is meaningful to the user, both in the context of the experience itself as well as the user as a person.

2.3 The Theatre and Playwriting

Theories and methods directly from and related to the theatre have become increasingly relevant to the field of interactive narrative. Some interactive forms of theatre such as improvisation and participatory theatre are of particular interest. Effort towards creating models based on improvisation methods for example, has been made and those models have been used to implement interactive systems (Magerko, Dohogne, & DeLeon, 2011). Certain forms of participatory theatre have been researched for a similar purpose, most notably live action role playing (LARP) which is suggested as a possible structure for emergent narrative systems (Aylett et al., 2008). The contribution the theatre makes to systematic narrative is twofold. The System Stanislavsky developed for actor training is one. Exercises meant to enhance the actors nonverbal communication skills offer an insight into simple dramatic moments and how such a moment can be constructed to generate drama. The other is Egri´s system for playwriting. In his book *The Art of Dramatic Writing* he states that tension, drama and atmosphere are the effect of something more than just dialog. His emphasis on the construction and setup of scenes, how to ensure that the unfolding drama both has credibility and effect, greatly influenced the structure of the systematic narrative framework.

2.3.1 Stanislavski‘s System

Konstantin Sergeyevich Alexeyev, better known under his stage name Stanislavski, was a Russian actor and theatre director. Frustrated by the lack of structure and organized process while training to become an actor Stanislavski started to develop a systematic approach to actor training. This approach is now commonly referred to as ‘the System’ and is a dominating presence in Western theatre. The System was Stanislavski’s attempt to analyse and monitor his own progress as well as improving his abilities as an actor. Although the System is mainly based on, tested and verified by Stanislavski himself it is developed out of concrete practice and not untested theories (Benedetti, 1982). The purpose of the System was to systemize acting and actor training. Stanislavski wrote his manuals on the System in the form of a novel, presented his theories and message on acting through stories of actors-in-training. The stories are endless Socratic dialog between the struggling students and the teacher. It is through these stories that Stanislavsky presents exercises as well as situations that the actor must consider in his/her training.

These exercises are divided into two broad groups, according to Carnicke (Carnicke, 2000). Group I consists of exercises that are meant to help the actor develop his/her theatrical sense of self. Exercises in group II are meant to help the actor to work on a role. In group I one of the main focus points is communication between actors. Interaction between scene partners, actors and/or audience is a central component of any theatre production. Interaction is essential since without communication there would be no drama. Since human communication consists of more than just verbal communication nonverbal expressions of feelings and meaning are equally important for the actor. For Stanislavski it was important that the actor would be able to realize this and incorporate it into his/her performance. For this purpose he outlined exercises that would enable the actor to refine his/her nonverbal communication. The exercises relied on improvisation in situations where naturally silent moments occurred. An example of one such exercise involves three actors and is set up as follows: “A sits on a park bench, wanting to meet B, but C has just sat down on the same bench to read a paper. A wants C to leave” (Carnicke, 2000). This example exercise demonstrates a scenario where confrontation between characters and therefore communication between them is inevitable. Exercises such as this one present various scenarios where the focus point is the inevitable confrontation or more precisely conflict. It is within this conflict that drama enters the scene and gives these exercises value. When designing interactive experiences one must consider communication between the entities that are involved. If dramatic effect is to be achieved one has to consider how it can be evoked or developed and conflict is widely considered to be the essence of drama. These exercises, used in actual actor training are therefore a good reference when designing scenarios and experiences that rely on communication and are meant to have dramatic impact on those involved.

2.3.2 Egri‘s System

In his book, Lajos Egri’s book *The Art of Dramatic Writing* (Egri, 2004) discusses what he considers the principles and foundations of playwriting and explains his theory on each in detail. Those aspects of his work relevant to the interactive narrative field and to this work in particular are the premise, character construction and the conflict.

The premise is what is generally referred to as the main-theme of a play. It can also be referred to as its aim, purpose or basic emotion. The premise suggests the nature of the conflict that the play is about. The characters and all other elements of the play should do nothing but bring the viewer to the realization or discovery of its premise. Ideally it should not be directly stated but should be revealed through the interaction between characters for maximum dramatic impact. That said it should be noted that it is not meant to be the plot but rather the goal of the plot. Taking the play Romeo and Juliet as an example Egri offers one interpretation of its premise: “Great love defies even death.”

While the premise is meant as a guiding hand for the writer towards the intended goal of the play it is not its main driving force. Egri argues that it is well defined characters that will drive a plot if their personalities and situation naturally create an unavoidable conflict between them. When discussing how characters and the interaction between them drive a plot forward Egri mentions two main motivating factors that need to be present. The first is the pivotal character’s desire for something and inability to compromise. It is this uncompromising desire that forces other characters into action. It should not merely be the characters desire to do something specific but be so strong that the character “will destroy or be destroyed in the effort to attain his goal.” (Egri, 2004). Compromise should not be possible in this situation. The second is what Egri names “unity” between characters. It refers to how interaction between characters should be inevitable because of their situation binding them together, making the characters unable to part until the situation between them has been resolved. It is through these two elements that conflict is all but guaranteed. To ensure that the conflict produces drama that has both credibility in the mind of the viewer and the intended dramatic effect Egri places particular emphasis on that a conflict should not be isolated. Conflict should always be a part of a bigger whole. It should build up to what Egri terms “crisis” which is the dramatic high note of the play or more precisely “a state of things in which a decisive change one way or the other is impending.” (Egri, 2004). It is the characters actions and decisions during these moments that most commonly reveal or highlight the premise of the play, leading to its conclusion.

The theories presented by Egri lend themselves well to interactivity and the multi-agent adaptation of his work is immediately apparent. In other narrative related work I´ve pursued (Carstensdóttir, 2011). I’ve attempted to build an emergent story agent architecture based on similar principles. Some of those principles were derived in part from the work of Stanislavski (section 2.3.1). I made several observations while designing and building the system components. The most prominent was in tune with Egri's statements about simple character interaction not being enough for a meaningful dramatic experience; other components would need to be present. In the case of interactive experiences, without the guarantee that the user would play along with the characters or take the interaction seriously there would need to be some structure in place to force the user's hand. This leads to the conclusion that the user has to be put into a situation wherein he/she is compelled to interact with other characters or the story-world. But even then there is no guarantee that the interaction will create a conflict or be dramatic in any way. Having autonomous characters create the story entirely requires not only complicated drama management but also complicated reasoning processes about each character's history, personality and state. It would also require designing and creating specific situations that would be able to make the interaction generated interesting. By utilizing Egri's theories this problem can at the very least be simplified but it would not reduce its complexity.

3. Systematic Narrative

In real life humans use rules as guidelines on how to behave and what to do in specific situations. These situations can be social situations, situations that require moral and ethical considerations, work related situations, family related and so on. Every aspect of our lives has its own rules, conditions and codes of conduct. Stories are often written about what happens when these situations collide and conflict with each other. What should be done in which situation? What's the right thing to do and what is the wrong thing? It is this conflict that is interesting to us. It is within these stories and within the struggle of the characters with these conflicts that we find the moral of the story or more accurately the premise. Conflict often occurs because of conflicting rules and conditions of different social systems that put characters at odds with each other. One system may allow certain behaviour while others ban it completely. Conflict can also arise because of the desire of different characters to possess a certain object, person or resource that is of limited supply. It is this conflict that creates drama, gives the story weight and credibility and ultimately drives the story to a conclusion. This makes conflict an essential component of a good story

These social systems can be represented as resource dependent rule-based systems. As such it should be possible to simulate the interaction between them. System simulations are not a new phenomenon but a common practice within both computer science and engineering. Using system simulations in the same way to simulate interactive narratives however has not been done before to the author's knowledge. Going into the realm of system simulations opens up a wide range of possible techniques from among others planning, operations research and game theory. Using system simulation as an approach to interactive narrative raises the question of what kind of stories such simulations will produce, especially if these simulations are interactive and dynamic. This approach to storytelling cannot produce a classic linear story that we know from traditional literature and narrative work, with a coherent pre-scripted plot and premise. Therefore the authoring and writing process for such system narratives will require new methods. Though the end goal is ultimately the same, to produce a good story experience for the user, it requires a different type of thinking.

This chapter starts with an introduction to systems thinking for narratives and goes on to define and explain key concepts of systematic narratives. It goes on to discuss how systematic narratives can be authored and offers a brief description and a step-by-step guide for the process. Unanswered questions as well as challenges that need to be overcome for a successful implementation of a general systematic narrative engine are discussed in section 5.1

3.1 Defining Systematic Narratives

To describe how narratives and stories can emerge through interaction with systems the concept of system thinking needs to be introduced. What I´ve termed systems thinking can be defined as evaluating and analysing interactive stories and games in terms of their systematic structure and/or behaviour and describing them in those terms. The majority of games that are considered to include emergent narrative elements are in fact system simulations to some degree. An example of one of those games is the McDonalds Game (*The McDonald’s Videogame*, 2006). In the game the player is meant to act as a manager of a simplified version of the entire McDonalds fast food chain. The game is divided into four different sectors that need to be managed: the farmlands, the slaughterhouse, the restaurants and the main offices where the board of directors, PR and advertising reside. Each sector has its own challenges and specific tasks that need to be carried out so that everything runs smoothly. These tasks are either dependent on the deliverables of tasks from other sectors and/or are prerequisites for such task. The user’s choices influence the behaviour of the simulation but this is not only a simple simulation. The choices that the user is offered are influenced by another agenda other than correctly simulating the process of running an international corporation. The game is meant to make you realize, through playing, that to make money and win you will have to do unethical and illegal things to get ahead and earn more money. Limited land makes you cut down the nearby rainforest in search for more. The slow process of fattening the cows make you consider using growth hormones, knowing that this will reflect badly on you in the future. Bribing officials and making manipulative ad campaigns are your few of your options when dealing with the fallout of you decisions. The simulation is setting the user up to fail. The system does not offer other options or other solutions than either slow ethical ones or fast unethical and illegal ones. This forces the users hand to eventually go down that path whether he/she has exhausted all other options or not.

When analysing the McDonalds game in terms of systems, each sector can be viewed as a separate subsystem of the system that is being simulated. Each subsystem demands attention so that specific decisions can be made by the user. Each subsystem has its own role in helping the user along the only path that the simulation offers by demanding various resources and limiting the methods that the user has to procure them. This path leads to the real take-home message or premise of the game: you cannot run a pan-global corporation without breaking a few laws and taking advantages in situations where you shouldn't. This is what makes the McDonalds game noteworthy and gives it more dramatic weight as well as giving the experience the appearance of a predetermined meaning and purpose.

This analysis mentions some of the core issues and goals of systematic narrative. A systematic narrative can be described as a set of systems or subsystems that run in parallel in one simulation. The systems and all possible interactions between them are designed specifically to set the user on the right path for realizing the intended premise of the simulation. To make this possible each system consists of various rules and conditions, the rules being in fact decisions that need to be made by the user. The interaction that the user has by making his/her decisions should always affect the system and the progression of the simulation. They should affect it in such a way that the appearance of progress is present. Another important element is to make sure that the user is aware of the consequences of his/her actions in some manner by giving both instant and delayed feedback.

Definitions of key concepts have been a central issue from the beginning. Iterating twice through the process of implementing a scenario-specific prototype engine highlighted the need for clear cut definitions. If a move to a more general architecture is to be attempted all central concepts need to be defined in as much detail as possible and the relationships between them made clear. The central concepts are the system, the rule and the conflict. The representation of the definitions presented in this chapter will be discussed in chapter 4. The aim of each concept definition is to offer a structure that can easily be abstracted to a simple representation for implementation and authoring purposes.

3.1.1 The System

The core of a systematic narrative simulation is the concept of a system. The concept refers to the various social systems each individual belongs to as a part of human society. Each social system has a specific (often unspoken) rule set, conditions and if an individual belongs to the system that same individual has a specific role to play within it. A system as it is referred to in systematic narrative represents one such social system. A simulation consists of running at least two such systems at the same time and lets a user interact with them through an interface. The user interacts with a system which affects its performance within the simulation. This is the driving force of a systematic narrative. The interaction between the user and each system affects the interaction between the systems themselves as well. This interaction between systems is either influenced or controlled by user input, depending on the system. Each system consists of a set of rules, conditions and definitions of various types (see 3.1.2 for details) that require the use specific resources, making the system dependent on these resources to function. The combination of these components is specific to each system. For each simulation there are two or more systems running at the same time as previously stated. During the course of a simulation each system requests the use of specific resources needed to fulfil conditions or to run various rules necessary for the simulation to continue. These requests are managed by the user who needs to moderate each systems use of the resources available. These resources are limited and have to be used by most or all systems in some capacity and should ideally be vital to their function. The most common and most useful of possible resource types is time. Other examples include money, food and water. The following is an example of a system simulation based on the scenario used in the prototype engine (see section 4.1. for a detailed description):

> *Investment banker Bob has a limited amount of time during each day to finish specific things. His work (a system) makes demands that he work on assignments (rules) that take a specific amount of time (a limited resource) to finish before heading home. At home (another system) he is also required to do specific things that take time and that he needs to finish within time limits.*

This by itself is not that interesting from a user experience stand point or a narrative standpoint. It gets interesting when the systems require the same resource at the same time. When that happens a conflict has emerged. To explain this we continue to explore the example above, at one point each system asks for more time. The work system requests that Bob go to a dinner party with his boss to discuss future investments during a time he usually reserves for his family. The home system could ask that Bob leave work to go to a mandatory parent-teacher meeting at his son’s school. Both are important to Bob so the user has to decide what to do i.e. which system should be allowed to access the resource. When a conflict emerges the user has to decide on how to handle the situation. To make sure a conflict emerges the key is to design the systems in such a way as to guarantee that the systems will need the same resource at some point as previously mentioned. That no matter what or how the user tries to avoid it, his interaction with the simulation will always lead to a conflict between systems over resources. This is in tune with Egri’s theories on playwriting (see 2.3.2). The nature of the systems has to be constructed in such a way that they will naturally collide. To make the conflict inevitable using the example of Bob, the systems both make such high demands upon his limited time that he has to choose whether to do well at work or at home, it being very difficult to be able to do both reasonably well at the same time. The interface that the user has to communicate with these systems is, in its simplest form, through accepting or rejecting acting on rules and conditions offered by the simulation. It is through these rules that the user gets his/her sense of the nature of each system.

3.1.2 The Rule

Rules are the building blocks of each system. A simple way of representing rules is having a rule equal an event or an assignment that is given to the user by a specific system. Each rule requires the use of a specific resource and might also need to meet other specific conditions to function in the simulation. Each rule only belongs to one system. The rules are roughly divided into different categories, each category serving a specific purpose. Those categories are premise rules, immersion rules and simulation rules. These rule categories reflect the nature of the content of the rules and the importance of the preconditions for the rules being run. That does not mean that there is a difference in the format of definitions and/or variables included in the rule representation for different categories. All rules should have the same representation in all systems running in the simulation.

The *premise* rules are the foundation of each system. Each should be designed to work toward the user´s realization and understanding of the simulation's premise in some way. Their purpose is to ensure that critical events or decisions have to be made when the conditions for a high dramatic impact are met, i.e. to ensure that critical points of conflict will emerge. This makes conditions particularly important in the design of premise rules. Premise rules can be any significant decision that the user needs to make or just decisions relevant to bringing about certain situations. An example of this would be to decide between two different things, both of which you need/want. It could also be to go somewhere or as small as deciding whether to bring a co-worker coffee. The *immersion* rules are meant to influence and maintain the user's sense of immersion and engagement in the simulation. Though not directly related to the premise, immersion rules help to build up to critical premise points by making sure that smaller events take place that maintain the integrity of the user's experience. This rule type can for example be used to increase the sense of urgency and pressure for making a particular decision. An example from the life of investment banker Bob would be to increase his normal workload at work and then having home (the other system) ask for time off for important reasons. This type of pressure makes the decision presented to the user clearer and urges the user in a more realistic manner to choose one way or the other. The *system* rules do not have as clear cut purpose for the user experience as do the other two. They include, as the name suggests, all system specific rules that handle any outlying rules and elements related to the system that do not fall under the definition of premise or immersion rules. This could include high-level rules needed for monitoring and managing resources and environment related issues, simulation specific rules and so on.

All rules have the same representation in all systems regardless of category. Each rule contains all components necessary for monitoring and evaluation purposes as well as resource demands, which system it belongs to, a description of its purpose, consequences of the users reply to it as well as other variables specific to each system and simulation such as rewards, difficulty and duration. The categories mentioned earlier are not a part of the rule structure. The reason for this is that although each category has different requirements due to its role in the simulation it would not be feasible to have different systems communicating and reasoning about different rule structures at the same time. It would make reasoning about the rules very complex, computationally expensive and would likely take a significant amount of time. The categorization is therefore not a part of the rule structure on the implementation level but is meant to be used as a tool to simplify authoring.

The most important parts of each rule from the authoring perspective are the description and the consequences presented after a reply has been decided by the user. These are visible to the user and it is through this component that the authors can influence the user’s perception of his/her choices and progress. It can also be used to give information about the nature of the systems in the simulation or give hints as to their function. Though the real conflict between systems is over resources it can be handled as the author sees fit on the surface through the description but ultimately it is the description that gives the resource conflict dramatic weight.

3.1.3 The Conflict

Conflict between systems is what drives systematic narrative. Conflict is when two or more systems stake a claim on or request the user of the same limited resource at the same time. A resource, as previously noted can be anything from time, money, food or things as long as it is of limited quantity in some shape or form. It is the key component of the simulation as it highlights the clash between systems and by doing that helping the user realize the premise.

The most challenging problem with the conflict concept was how to evaluate it while the simulation was running i.e. how to know when a conflict is taking place. Other interesting problems included how it could be reasoned about and predicted, how it could be simple enough to foresee and predict by a human author and how it could be incorporated into the authoring process. The goal is to have the core systematic narrative engine dynamically look for possible conflicts and be able to reason about their significance, impact and contribution to the simulations development. Conflicts are harder to reason about than rules since they only exist if and when the rules collide over resources. To be able to both find and reason about them the engine has to utilize two separate functions: dynamic conflict monitoring and conflict prediction. The monitoring module should both respond directly to the current simulation state and send relevant information to the prediction module. The prediction module would strive to predict possible conflicts of interesting dramatic value based on an evaluation function and modify the simulation to make the most interesting situation emerge. The prediction module will therefore need to reason about its response in a very specific way that would include reasoning about the users decisions and arranging their options to influence their decisions. One classic strategy would be to constrain the set of possible actions (rules in this case) that the user has access to.

Both functions need to cooperate to successfully function within the simulation. While the monitoring module is relatively straight forward the real problem lies in the representation and possible strategies that can be used for the prediction module. Both functions lend themselves well to be represented as either planning or optimization problems. One possible solution would be to represent the prediction module as an inverse planning problem (more on this issue in section 5.1).

3.2 Authoring for Systematic Narratives

Calling the process of creating a systematic narrative 'authoring' might seem a misnomer after some consideration. Design seems a better fit. The principles of systematic narrative authoring are more related to rule-based systems design than the traditional linear story authoring we see in non-interactive mediums. This is not to say that linear authoring methods are not compatible or unusable. To design a systematic narrative there are a few steps that simplify the process. These are based on its core design and are therefore largely inspired by Egri's playwriting theories (see 2.3.2).

The first step is finding the premise and this is the only component not incorporated directly into the systems or the simulation. Premise is, as defined in section 2.3.2 the main theme or message that is realized through the experience, either during, at the end or after it has ended. The premise should not be built upon any specific character or situation. It should state the effect the simulation has on its users understanding of his/her experience or the user's interpretation of his/her interaction with the simulation. The premise is the end goal for the simulation and should therefore be as clear as possible before designing the systems since they should strive to realize it, not the other way around.

The next step is describing the situation. This situation could be anything that is relevant for the user to know in the beginning of the simulation and refers to the user's characters background, social situation, current predicaments, obligations, problems etc. It is important for this description to include what can be termed a survival component. This is to force the user, for all intents and purposes to interact with the simulation and is a classic strategy for both interactive and non-interactive mediums. It is not only meant to compel the user to act but also to make sure that the interaction with the other characters is interesting. A ´survival' component means that the characters situation needs to be about survival in some way, a do-or-die situation. In the much used example of Bob this component would be that if he doesn't perform at work he's fired making the user lose the game. Another example would be that if you don't steal food you'll die.

After having described the situation it is important to look for and identify possible points of conflict. By using the 'survival' strategy it is relatively easy to identify both central systems and resources. Using the example about Bob described in the previous paragraph since his predicament is about keeping his job then work must be a key system. Those who would prevent him for doing well in his job would also be possible key systems for example home, friends, hobbies etc. Being able to do his job depends on factors like time, energy etc. but it is clear that Bob needs to go to work and stay there so time immediately jumps out as a possible resource. The conflicts would / could centre around him needing to go to work but being needed or wanting to go elsewhere. After identifying possible systems and conflicts over resources the next step is to define the rules. To do that there are several issues that need to be taken into consideration and are included in the next 3 steps.

The next step is to find the grounding element. The grounding element refers to what could also be called repetition or connection elements. This means defining how the user connects with the environment and feels a part of it. If the user is supposed to take on the role of an investment banker then the most obvious element would be that he goes to work every weekday, comes home later that same day and has the weekends off to spend however he likes. If this was an adventure RPG type game then the repetition would be in training, acquiring skills etc. The grounding element is an element of the simulation that increases investment in the world. This corresponds directly to the immersion rules while premise rules would focus on elements from the previous two steps (see 3.1.2 for a detailed description of rule categories).

Finding short-term stimulants is next on the list. Short-term stimulants are the feedback the user gets that is meant to increase or decrease certain behaviours and decision choices and are meant to influence the user to make certain choices and behave in a way the designer intended. Short-term stimulants could easily be incorporated through immersion rules. These stimulants need to be decidedly and obviously good or bad if they are to be used to influence behaviour. It needs to be absolutely clear whether the action had a positive or negative influence on the user's status or state. This is a possible conditioning approach in the design and is meant to be used for leading the user down a path the designer wants the user to go down without directly stating that intention. This is meant to be used to lead to the premise but could possibly be used for other purposes. An example is using short-term stimulants to make one system more exciting and demanding than the other to make the user more biased toward that system.

The final step is to find the long-term stimulants which refer to the long term effects of the user's decisions during the experience. These will affect the users perception of the experience and should ideally not be revealed until late in the simulation or at the end of it. These are similar to the first step since they are meant to capture the user's motivations going into the experience. The long-term stimulants therefore refer to methods and goals that are meant to subtly influence the user during the simulation. These long-term stimulants could be implemented as both premise and immersion rules and should ultimately lead to critical dramatic points.

Taking these three final steps into consideration when writing the rules should help guide the designer to narrow down possible rules from the more abstract concepts of premise and immersion rules. The aim of these steps is to make them more suited for implementation. This process was used to come up with the scenario used for both prototype engines (see 4.1. for details) but has, as of yet, not been tested further. This authoring process is not only suited to systematic narratives but can be abstracted to apply to interactive experiences in general. Having a systematic process like this offers a convenient and efficient way to author these types of experiences.

4. The Engine

The process of implementing systematic narrative theories contributed significantly to their development, mainly by raising several questions regarding the representation. The first iteration of this implementation process resulted in a small, scenario-specific prototype engine. Its structure was very simple and all user interaction was text based. The product of the second iteration is the subject of this chapter. The second prototype engine was based on the same principles as its predecessor and has the same abstract structure. Many notable improvements, specifically regarding rule management moved the second prototype one step closer to a general systematic narrative engine. The prototype has other additions which do not fit directly into the systematic narrative approach but belong to the realm of gameplay. Because of its dependence on a specific scenario the engine is similar to a video game in its current form. Therefore gameplay aspects were included in the structure to help maintain engagement and increase investment. It is unknown whether gameplay should be included into systematic narrative directly or if it should only be included when stories are the desired end product. This issue is discussed in section 5.1.

This chapter gives a detailed overview of the second engine prototype. The first section presents the scenario on which the engine was based and offers an example of a possible story from the engine or a possible simulation run to be more precise. This simulation run is meant to describe what the engine is meant to be capable of producing when all modules have been implemented. The second section discusses the current version of the second prototype and how it incorporates the theories from the previous chapter into its structure. The third section provides an evaluation of the engine and its capabilities and the last section features a discussion about a proposed general architecture for future implementation and its key components.

4.1 An Introduction to Investment Banker Bob

The scenario that the engine is based on puts the user in the mind of the dedicated investment banker and family man, Bob. Bob is happily married to Nancy and they have a son called Johnny. He enjoys his work at the bank immensely and equally enjoys being at home with his family. His work keeps him busy and his boss is very demanding, making him stay longer to finish important assignments and projects. His wife needs all the help she can get with both Johnny and the housework since she is also a full-time employee at her place of work.

This scenario presents two main systems in the underlying structure: work and home. Both systems are very demanding and it is clear that they are going to clash at some point since Bob does not have unlimited time to do everything required of him. The premise of the scenario is that maintaining good balance between work and personal life is very hard and that sometimes you will need to sacrifice one for the other. The immersion rules are therefore assignments, tasks, everyday events and meetings for the most part. The design of the premise rules focuses on the sudden illness of Bob's son Johnny, which forces the user both consciously and unconsciously during the simulation to choose between his family and his work. By continually forcing this choice on the user the premise is being pushed to the foreground. The following story describes a possible turn of events of a single simulation:

Bob has so far been doing a good job at work, so good in fact that his boss announces that he's up for a promotion if he keeps up the good work. Bob gets a new assignment from the Boss: to find and train a replacement on top of all other duties that he has been assigned. Bob is now increadibly busy and quickly realizes that he has to work overtime for a while to manage his overwhelming workload.

Later that week Bob's wife Nancy calls the office unexpectedly. Their son Johnny is sick and they need to take him to the doctor as soon as possible. Johnny has been sick for a while now and Nancy is worried. She has been staying at home with him she needs Bob to come and pick them up so that they can go the hospital. Bob asks for the time off to take his son to the doctor and gets it without a problem. The doctor can't find the cause of the illness and schedules further tests.

Bob still needs to go to work and on top of that he needs to work overtime to make up for the time he took off as well as finishing his various assignments. Johnny's mystery condition continues to be untreated, Nancy is growing increasingly worried and Bob fears that he might not be able to finish all the work in time. Most importantly, he has to find ways (and time) to train the one he has personally chosen and deemed fit to replace him before the deadline that the company gave him. As the deadline approaches Johnny has to be taken to a few more appointments and tests. Bob has been forced to take more time off due to doctors appointments and tests for Johnny and his bosses have taken notice. One of Bob's co-workers shares a bit of office-gossip and says that because of the economy situation the company needs to downsize. The bosses have decided that the middle management will be the first group to be downsized. Only the top performing employees will remain. The co-worker notes that his continued absences have been noted by the bosses and that the replacement he's training up has been mentioned as a possibility for the promotion originally promised to Bob. That same day Nancy calls Bob at the office. She has repeatedly been mentioned to Bob that they need to spend more time together and now that Johnny is sick it is even more important that Bob spend more time with the family and less at the office. She needs his support at home and she can't go to all the *appointments and tests Johnny has to go to on her own. She also has a job where they are also pressuring her to perform better and she has maxed out her vacation time. Bob needs to cut back on his work if they are going to make everything work. Bob needs to decide whether to put in more hours at work or risk being fired. But him not being at home enough and supporting Nancy like she expects of him to could cause irrevertable damage to their relationship*

This simple scenario has all the components needed for a systematic narrative to function and have dramatic value. It was designed using the steps described in section 3.2. To make the scenario and the experience more engaging it was decided to structure it like a game. The user is given assignments or events that require a response. Each of these will have a deadline and a reward attached to them. Failing to complete the assignment or responding to the event will result in negative rewards which will reflect badly on the users score. The user will have access to two types of scores, one for each system. When completing an assignment for example, then the user recieves a reward in the form of points from that system. This is to give the user a better sense of the nature of the experience. This gameplay aspect is reflected in the rules and in the interface but is not a part of the base function of the engine and does not influence its behaviour and function other than through variable values.

4.2 Engine Architecture

The current engine can be divided into three separate sections: interface (GUI), simulation runner and rules. All components were written in Python and the GUI was created using the wxPython GUI toolkit. The GUI allows the user to monitor his progress both overall and on individual tasks using lists, system specific scores and progress bars. The inner simulation time is shown and runs at the top of the screen. The GUI is updated by the simulation runner which tracks and monitors the time and agent (user) status. The user can request a new task at any given time. The simulation runner subsequently requests the rule module to select appropriate rules which it sends directly to the GUI. The rule section goes through its full set of rules and filters out rules based on preconditions such as time and location. The rule sections consist of two modules: rule selector and the rule evaluator. The rule selector handles the filtering and sends the list of remaining rules to the evaluator. The evaluator

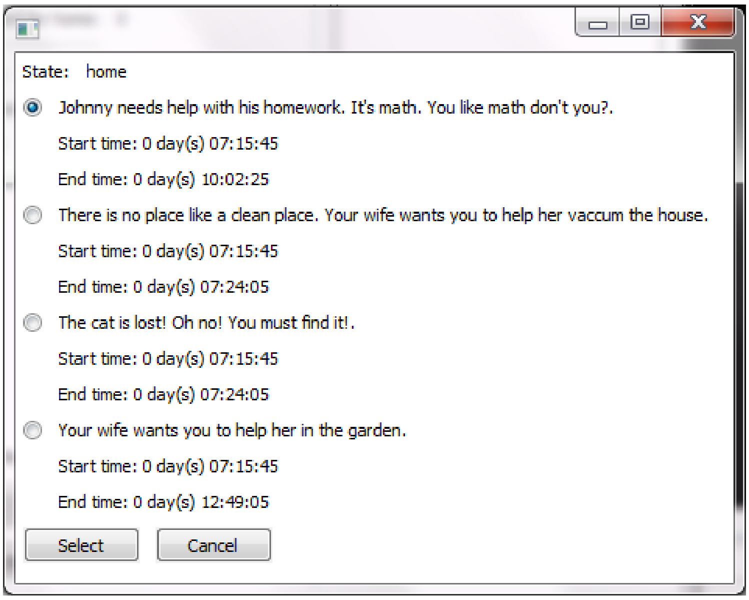

Figure 3. An screenshot from the engine. An example of a rule list, as presented to the user when the system is asked for a new task.

uses a very simple selection method based on the ratio between the accumulated reward scores between the systems. If the system with the highest score is more than 30% larger than the current system, the current systems selects one premise rule. The final rule list, which consists of either one premise rule or 5 immersion rules, is then presented to the user in a separate window.

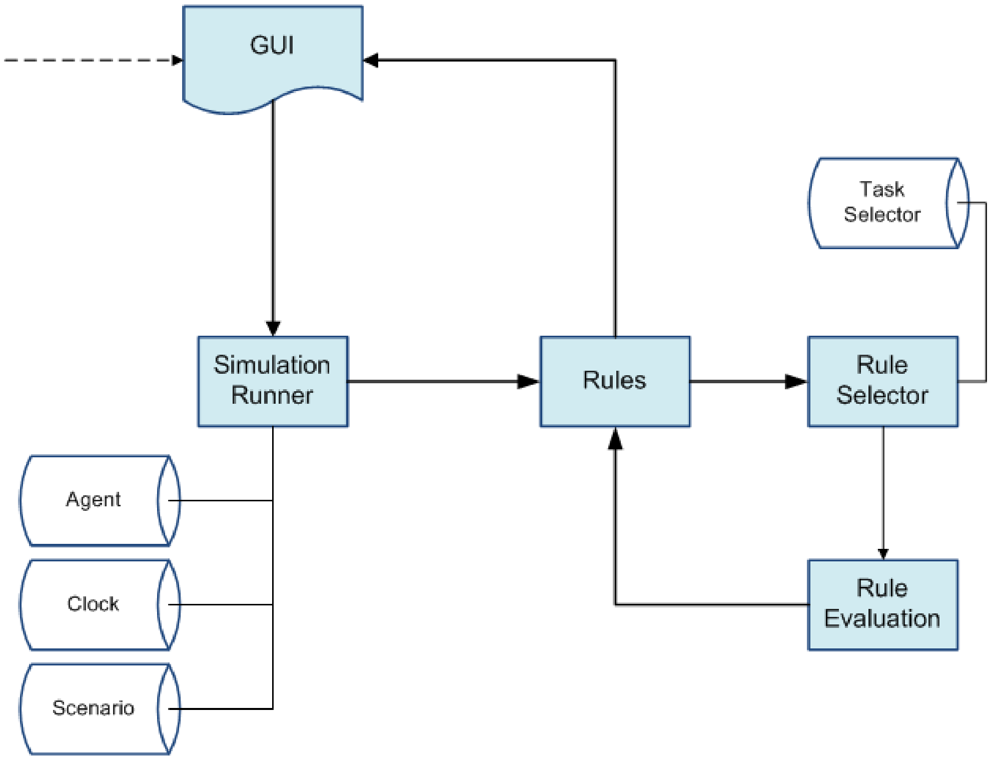

Figure 4. The architecture of the second prototype engine. It's composed of three different sections. The user interface (GUI) handles the interaction with the user and sends information regarding this interaction to the simulation runner. The rule section, whose functionality is divided down to two modules, receives a request from the simulation runner for new rules. The rule section filters the rule set based on the information from the simulation runner and returns matching rules to the GUI for the user to choose from. Sections and modules are represented with square shapes. The main classes for each section are represented by the cylinders.

The structure of the engine allows any of the three main components to be replaced by other components that will perform the same function. This also applies to the rule selector and the rule evaluator. This is an important feature of the design particularly for the evaluator as future versions will be used to test the effects of different evaluation methods and how they affect the narration process of the user.

Finding a general representation for systematic narrative concepts is an important part of moving closer to a general narrative engine. Although the aim of the current engine was to move closer to a more general structure it was decided that the representation would be scenario specific to simplify the issue. The focus was on establishing what kind of requirements would need to be met for both the simulation and the scenario. This applied almost exclusively to rules. For this version of the engine the most important goals were that it should be easy to author experiences for the engine and that rules should include simulation variables since the simulation was scenario specific. Each rule is represented by a set of variables. These also include not only gameplay specific variables. Each rule is required to have the following information: unique ID, description, location, reward, difficulty, duration (in seconds), start time, end time and rejection limit.

The location variable refers to which system the rule belongs to. What can be referred to as preconditions would be location, start time and end time. Start time refers to when the rule should be run and end time indicates before what time the rule should be accepted without receiving the penalty. Both the reward and rejection limit variables are gameplay specific.

4.3 Evaluating the Engine

The original goals that were set for the engine development at the beginning were either concerned with underlying structure or adding specific functionality. The main goal was to adapt the architecture further towards a general structure. To do this the representation problem for the rules needed to be solved or at least simplified and the engine structure made more modular. Other goals included adding a graphic user interface thereby eliminating the text based interface used in the first engine and develop simple methods to select the appropriate rules for creating a dramatic effect. No specific goals for technical requirements were set so to evaluate the result of the system contribution of this work the engine will be evaluated based on the aforementioned goals.

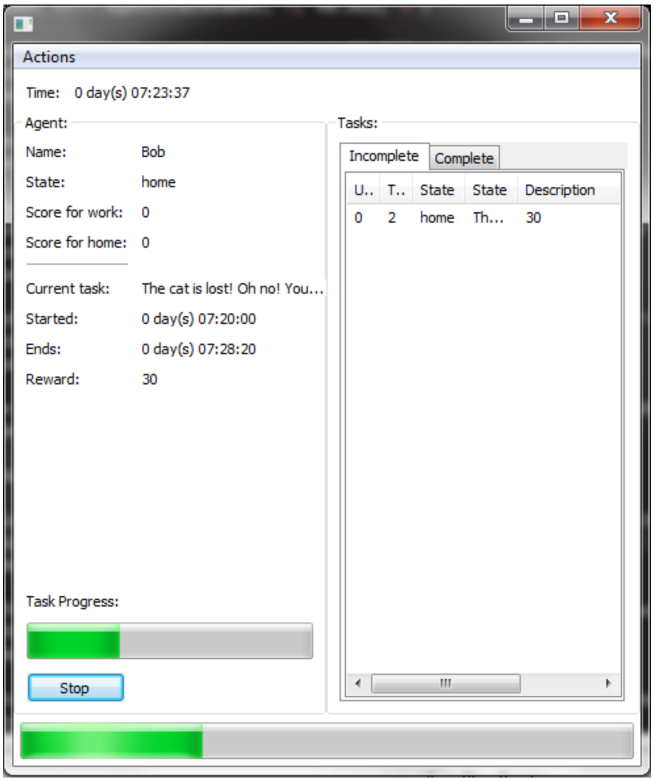

Figure 5. A screenshot from the engine.

When comparing the architecture for the general engine discussed proposed later in this chapter to the architecture of the scenario-based engine the similarities are clear. The scenario-based engine is close to becoming general with only a few challenges blocking the way. These challenges, excluding the much conflict prediction module and rule selection methods, are mainly related to the GUI. There are also the challenge of how to make the modules less dependent on each other for a more clean and modular structure. It is safe to say that this goal has been achieved. There were few minor considerations. One was that the GUI should not be communicating with more than one section. It is currently sending information to the simulation runner and receiving information from the rule section when it should only be sending/receiving information from the simulation runner. Eliminating this dependency would simplify the structure and to make it easier to use as a separate library or an engine in other applications in the future. A relatively simple issue to rectify and this will be done in the next version. A graphic user interface has been successfully added and the engine does not use the text based interface any longer. The interface is a decided improvement to the engine and makes the interaction in the simulation clearer than its predecessor. I consider this goal as having been achieved as well. The last of the three main goals was to develop a simple rule selection strategy. The engine currently uses a simple evaluation strategy based on the ratio of accumulated points in each system which checks if the ratio is outside a specified range. While this method works perfectly there are some considerations regarding its function that need to be considered. Most importantly, the question of if this particular evaluation function is sufficient or an effective enough strategy to have dramatic impact. This goal has not been achieved to the same degree as the other two goals as the functionality has not been sufficiently tested yet. But since the functionality is in place I will consider this goal achieved.

Overall the implementation of the engine was successful and met all of its three main design goals. There were several questions raised during the design and the implementation process regarding various elements, components and issues. These questions ranged from significant questions regarding the systematic narrative approach to how the engine could be used for other purposes than to create interactive drama or stories.

4.4 A Proposal for a General Engine Architecture

Moving away from a scenario-specific engine to a general would be a large step forward for the development of systematic narrative as a theoretical approach. It would also open up possible applications of systematic narrative in other fields than in video games such as learning and training. The following general architecture was developed alongside the first two implementation cycles and as such shares many of the same base structures, especially the simulation and rule modules. This structure is composed out of 4 main modules (Figure 6). These are the simulation module, rule module, conflict monitoring and conflict prediction modules. The *simulation module* is the heart of the engine. It handles resource management and switching between systems. It updates the simulation state, communicates with the interface and handles everything else that is directly related to running the simulation and is not managed by the other three. The simulation module runs and receives information about the rules from the rule module. The *rule module* is a combined set of all rules from all the systems in the simulation. It would also include all functionality needed to manage them, one being filtering. Filtering refers to the rule module needing to filter out which rules would be available at any given time. The available rules would then be sent to both the prediction module and the monitoring module for further filtering. Both the conflict monitoring module and the conflict prediction module are using information gathered from the simulation in their evaluation. Their roles include selecting rules that would be most likely to influence the simulation in a particular way. The goal of the simulation is meant to be drama then the modules would evaluate the rules and return the

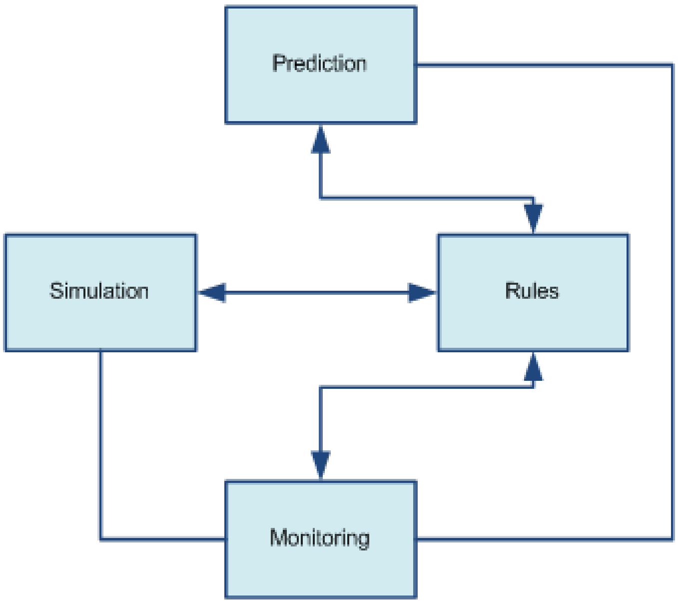

Figure 6. The proposed general engine architecture. The simulation module handles all simulation specific functions, recieving assignments and tasks in the form of rules from the rule module. The monitoring and prediction modules filter out unrelevant rules and return rules that can make the desired impact on both the simulation and the user experience.

set of rules that are most likely to result in dramatic impact on the user. The *monitoring module* focuses on short term effects and corresponds to short term stimulants (see 3.2) and immersion rules (see 3.1.2) in regard to function. Its role is to monitor and reason about short term impact on the experience and react by choosing rules that respond to events and behaviour as it is occurring in the simulation. It sends information about this behaviour to the prediction module. The *conflict prediction module* corresponds to long term stimulants and premise rules and is by far the most complicated of the four modules. It uses information gathered by the monitoring module to reason about the user's behaviour and how dramatic impact is achieved, given that drama is the goal. The purpose of the prediction module is therefore to seek out points of conflict and reason about how these conflicts can be achieved through available rules. It would also reason about the experience intensity and seek to control it.

5. Discussion and Future Work

5.1 Challenges and Unanswered Questions

For systematic narrative to move towards becoming a more structured approach there are several questions and issues that need to be addressed. These follow several distinct trends, the biggest being questions regarding rule structure, rule selection strategies and methods and how these will contribute to the prediction module. There are also questions regarding how systematic narrative relates to gameplay and possible applications for functionality other than drama.

At the core of several of these planning and representation issues there are important questions regarding system behaviour especially regarding how to manage a transfer between systems and the representation of user state. The engine uses a simple location change to change between systems currently in use: now Bob is at home and now Bob is at Work. There is no time used to travel between the two locations (systems). This will not do since it can possibly diminish the user's immersion and the flow of the simulation. The question then becomes what happens or should happen between system changes? An example of what could happen between the main systems would be Bob driving home from work and picking up Johnny on the way. This offers several possibilities, for example if Bob is driving with his son in the car and a co-worker calls his phone the user can make Bob answer the phone thereby increasing his work status since that rule belongs to the work system. If however he does not pick up the phone his home status would increase since he is directly choosing the home system over the work system. He decides not to answer but his persistent co-worker continues her efforts to reach him. The user knows that not answering the phone would in all likelihood decrease his work status, especially if it is important. Having now picked up his wife Bob knows that she would not be happy about him taking a call from work while spending time with the family. This example shows that there is significant potential for some very interesting conflicts and situations during the time the user spends away from the main systems.

In future implementations it would be rational to trigger a system change when going from one system to another. As in the Bob example, such location (system) change would require time and offer the user a chance to continue interacting with the simulation. This introduces the possibility of a new type of a system, a sort of an in between system that would manage the transfer. This system will need to have its own rules before it can be considered a full-fledged system. This raises the question of how to represent the state of the user during this process. Should the user have one representation in the simulation or should the user have one for each system?

This issue is directly related to the question of what kind of a representation would be suitable for reasoning about this. A possible solution would be to refer to this time spent in-between systems as a special state or a sub-system which uses specific rule sets defined in each system. Each system would have a subset of rules that applied exclusively in such sub-systems. One example would be a telephone call event. These rules could then be used by one system to gain resources already in use in others. Such rule subsets could then not only apply to the in-between systems states but to all systems excluding the one you are in at the time. The representation problem is heavily dependent on what methods are used for the prediction module. The prediction module’s role is to actively look for possible future conflicts that have dramatic impact and influence the user’s behaviour so the conflicts will take place. This suggests planning methods as a possible solution although planning is more often used to minimize conflict and satisfy goals. Other methods like optimization methods from the field operations research as well as game theory models are also likely to be of use. To reason about the user´s behaviour it might be interesting to have the engine model the user with machine learning methods but that would have to be considered at a later date. With planning looking like the most promising path to take the representation of the rules should be modified accordingly when the time comes.

There seems to be a fine line between what is considered interactive narrative and what is considered a video game. Interactive experiences, especially for entertainment purposes are most commonly in the form of video games. Video games introduce the user into its inner world which requires the user to learn how to interact with it. This includes learning and adjusting to the in-game physics engine or more precisely the natural order of things within the world. Systematic narrative requires the same kind of learning in the beginning where the user learns the nature of the overall system and how the subsystems within interact and contribute to the whole picture. This similarity raises the question of where systematic narrative ends and where the game begins. Systematic narrative is not meant to serve as specific game mechanic but more of a drama and story module within a game. Basic gameplay aspects such as short term stimulants are present in systematic narrative and in the current engine the game is directly integrated in the engine through the rules and the evaluation of them. Directly including gameplay components could become a flaw if they are included in the same way in the general engine. Including them would possibly restrict the approach to games instead of leaving it open to explore its usefulness to other approaches such as education and training. That is not to say that its potential use for gaming should not be explored. It is possible that instead of using the engine to look for dramatic conflicts it could be used for dynamic quest selection. For massive multiplayer games that rely on missions or quests for gameplay such as EVE Online (*Eve Online*, 2003) or World of Warcraft (*World of Warcraft*, 2004) one possibility would be to use dynamic quest selection to send players on similar levels after the same thing or resource at the same time. Another possibility would be to use the character's avatar as a system that requires a certain resource to keep playing. If that system is the avatar's specific race, an elf for example, it would require that all elves would need this resource to play. Making this resource limited would create an interesting situation for players to resolve between themselves. A general engine could also possibly be used for dialog selection. This could be achieved by making each rule a set of a statement template and answer options. The template would be filled out based on the player's character and the nature of the relationship between the player and the in game character. The statement would be the player's words and the answer options would be chosen based on the relationship between them and the player's state in the game. Other possible video game applications include dynamic non-playable character control and a suspense control.

5.2 Future Work

Of the possible next steps of the work presented here the most obvious one is improving the prototype engine and move it completely forward to becoming a full fledge systematic narrative engine. This move would sever all undesirable dependencies present in the current version on components that are not strictly a part of systematic narrative theory. Of these dependencies the most notable is the scenario dependency. Other important components would also need to be added such as more refined conflict monitoring and prediction modules and an application programming interface (API).

The conflict prediction module poses several interesting challenges that are for the large part unresolved at this moment. Representation of rules and conflicts is a key component of most of these challenges. The question of which method would be best for the prediction process will remain open for debate but strong contenders include planning and optimization methods. There is also the question of whether different prediction strategies would yield different effects on the experience. If that would be the case it begs the question of whether the prediction module should be accessible to the author. Because of these questions and many others, the prediction module has not yet been designed in the same capacity as other components. It is therefore an important part of any future effort to develop this work further and to design and implement a prediction module as soon as possible.

Another important future effort lies in the evaluation of systematic narrative. No evaluation of the engine or the theories it is based on has been conducted at this stage. This is of particular concern and validating these theories and the engine is of top priority. The evaluation will be conducted through user testing. To be able to conduct any specific tests on the engine it has to be improved further. It will also require experiences designed to test specific components and cognitive effects as well as a new interface.

Making the engine more general would open the door for other important lines of inquiry that have not yet been explored. One would be to test the engine as a component in various video games from different genres. The purpose would be to see if the engine could be adapted into that game/genre and if so how. This would serve both as a theoretical exercise and also as a test of the flexibility of the engine, if possible. A scenario that would be interesting to test in a game using the engine would be where advancement in one system would mean abandoning or deliberately sabotaging other systems necessary for the user's survival in the game. An example of this is a game where the ultimate goal of the player is to become as powerful as possible. The power being measured by the amount of influence, resources and alliances a player has. This could also include a specific place in the power hierarchy of the game. In this example the power hierarchy would be one system, each alliance would be represented by a single system and commercial influence could be multiple other systems depending on the in-game structure. An alliance is based on loyalty and trust between players and the player's trustworthiness or public reputation plays a key part in maintaining these alliances. The player is at one point offered to "move up" in the power hierarchy which would give the player access to more power of a specific kind. The condition for this promotion would be that he needs to betray specific alliances and this would mean a severe damage to his reputation. Not to mention the probable loss of friends and possible future allies who will hear of this betrayal through various channels. Setting up specific situations that require ethical and political consideration like this would be a very interesting possibility to explore, especially for massive multiplayer games.

It would also be interesting to explore other applications of the engine in the realm of video games, beside generating drama or setting up specific situations, such as dialog generation and dynamic quest management.

5.3 Summary and Final Words

This thesis presented a new approach to interactive drama and narrative called systematic narrative. This approach is based on the concept of using system simulation for constructing user experiences and interactive narratives. A user is given access to a simulation of a specific environment. Included in this simulation is an underlying system simulation running at least two separate systems. This simulation can for example be based on a specific situation or a scenario. To structure a simulation an author or designer has to identify separate underlying systems in his/her scenario. These systems can be thought of as a simplified version of a human social system. As such a system is meant to influence the user's reaction and interaction with the environment. Each system is a collection of rules and conditions that are used to immerse the user in the simulation and more importantly to create conflict with other systems. To design a compelling scenario to base the simulation on the underlying systems should be structured in such a way that conflict is unavoidable. Conflicts come to be when a system demands or stakes a claim on a limited resource that it shares with other systems in the simulation. Time and food are good examples of such resources. The system and its rules especially should be structured to lead the user to realize or understand what has been called premise. A premise is the main-theme or message of the experience. The realization of the premise in the mind of the user is the main goal of a systematic narrative simulation and should drive the experience and interaction forward.

This approach was used to build a prototype engine. The future goal of this work is to build a general engine capable of taking in any scenario, system and rule and run them. Several questions and challenges regarding the basic structure and complicated functionality of its components have yet to be solved. For that reason it was decided that building an engine based on a specific scenario would be a more suitable first step while developing solutions to the more complicated problems in the meantime. The goal was to have the scenario-specific engine as similar to the proposed general engine structure as possible. This was achieved as the scenario-specific engine shares almost the exact same underlying structure as the general engine though it lacks the complicated functionality of the general engine. The aim of the work presented here was first to introduce the systematic narrative approach and the theories that gave rise to its development and then to build an engine based on this approach. Future work includes conducting extensive user testing to examine how and to what extent this approach effects user experience and perception of narrative and interactive drama.

The systematic narrative approach was meant to suggest a new solution to a serious limitation of both interactive and emergent narrative. A most notable limitation of both approaches is that both have problems that stem from being either too strict or too loose when structuring the experience. While systematic narrative would perhaps be considered more structured than emergent narrative it still retains a similar flexibility for the user to explore and experience in his/her own way. Systematic narrative is meant to make authoring for interactive experiences simpler without compromising dramatic effect or impose restricting pre-authored plot on the user. It is my belief that this has been accomplished without having lost much of the flexibility or potential that interactivity offers. There are still many unresolved issues and unanswered questions that need to be answered and this will be a part of future efforts. The most important of these unresolved issues and questions are regarding the complicated function of conflict prediction mainly its design and implementation.

This new approach to interactive drama and narrative offers a new view of interactivity and its relationship with drama, stories and how they are represented in virtual environments. This approach has various possible applications for interactive entertainment, video games, training and education, all of which are unexplored and will be an exciting subject of future research efforts.

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