The Usage of the Structural-Affect Theory of Stories for Narrative Generation

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Abstract

The creation of stories by a computer system that are able to entertain and catch the reader's attention is a complex task. This paper presents a storytelling system that selects and chronologically orders events from a database to produce stories, in the form of text, to arouse three different feelings on readers: suspense surprise and curiosity. To achieve this goal, concepts of the Structural-Affect Theory of Stories [Brewer and Lichtenstein, 1982] were used.

Keywords: storytelling, structural-affect theory of stories, narrative plots.

1. Introduction

Mysterious or spy novels are often in the list of the best seller books. This literature is read not only because of the information that it contains but also due to the pleasure that it brings about.

A common characteristic of narrative plots is that there is actually a more intricate plot behind the reported events. It seems that the plot is just a sample of what is being really presented. Based on this perception, there are, in the literature, several proposals of structuring plots, such as Landa's [1990] and Brewer and Lichtenstein's [1982].

Within a story, there are two distinct time levels. One is the characters' time itself and the other is the time experienced by its readers [Chatman, 1978]. The events in a story are related in the time and in the casual forms, based on the natural order of events in it. However, they may be rearranged intentionally in a narrative. The Structural-Affect Theory of Stories [Brewer and Lichtenstein, 1982] proposes that different emotional responses might be evoked by the manipulation of the events' order, to arousing three kinds of emotions on their readers: suspense, surprise and curiosity.

According to Lima [2010], interactive storytelling systems are applications that try to tell stories and allow the users' interaction to alter the future events somehow. Several studies have already been developed, such as the Oz Project [Bates et al., 1992], Mimesis [Young, 2001], Façade [Mateas 2002; Mateas and Stern, 2003] and Logtell [Ciarlini et al., 2005]. Research in this area is divided into three categories: story generation, users' interaction and dramatization.

Although there exists a number of storytelling systems that evoke some kind of emotion, they usually do not allow the user to select the desired emotion to be evoked by the stories. This article is about the development of a storytelling system (called Kanjo) to create stories that are able to bring about three cognitive emotions in their reader: suspense, surprise and curiosity. The system allows the authors to select the story themes and indicate the emotions that these stories should provoke. Stories must be distinct, coherent and understandable. In addition, their plot structures must be in accordance with the concepts of the Structural-Affect Theory of Stories.

The paper is organized as follows. Section 2 presents related works on interactive storytelling that address some kind of cognitive feeling. Section 3 presents the Structural-Affect Theory of Stories and how it was adapted to our system. Section 4 presents the architecture of our storytelling system and section 5 presents some examples to demonstrate the efficiency of the proposed approach. Finally, in section 6 we present the concluding remarks.

2. Related Work

Many studies have been carried out in order to develop computer systems that are able to produce stories emphasizing some emotional aspect.

Minstrel [Turner, 1994] was one of the first storytelling systems that tried to arouse suspense in its users. Like Kanjo, it adopts a technique to postpone the critical situation of the story. The system tries to include drama elements to produce suspense whenever a new scene is created. It has heuristics that indicate the structure that each scene should have, resulting in a highly predictable plot structure and in the lack of flexibility to develop new stories.

Mexica [Pérez y Pérez, 2001] is a storytelling system that creates stories that try to generate tension on their readers. It checks out if the story is interesting through the comparison of changes in the dramatic tension of the story in progress with the changes in the dramatic tension of previous stories. Changes are carried out by using processes of degradation-improvement in the emotional environment of the story. Mexica also assesses the originality of the story, comparing the number of times that the actions were used in the previous stories.

The Prevoyant system [Bae, 2008] only produces surprise on its readers through the usage of narrative techniques of flashback e foreshadowing. It uses stories organized in plans, built in a chronologic order by a planner. It then redefines the order for the dramatization of events on stage by using three methods: Generator, Evaluator and Implementer. The Generator receives a story in a chronological order and rebuilds its time and its events in order to make flashbacks and foreshadowing. The Evaluator then verifies the unlikelihood of flashbacks and the coherence and cohesion of the story after the selection of flashbacks and foreshadowings. After creating and organizing the plot, the Implementer converts the story plans into a script and sends it to a game engine so that the stories are exhibited in 3D.

The Suspenser [Cheong, 2008] is a system that produces narratives that only arouse suspense. It uses a psycho-cognitive theory that proposes the increase of the suspense level on its audience as the number of success options of the main characters diminishes. To produce stories, a plan structure, representing the objectives and the actions of characters, is used. It receives three input elements: a group of events, the story size and a moment of the story in which the suspense is measured. The system selects the events received and defines a group of fundamental events that cannot be eliminated without compromising the story comprehension. It also searches for actions that might impair the goals of the main characters, testing if the inclusion of other action intensifies the suspense. The final story is formed by the events in the story nucleus, along with the selected actions.

3. Emotional Structure of the Story Schema

Brewer and Lichtenstein [1982] tried to develop formalizations for some of the psychological processes that are relevant for the stories. They examined some of the fundamental properties of the narrative structure that leads to enjoyment, relating some organizations of narratives to certain emotional answers on readers. They proposed that there are three big structures of the narrative to explain the appreciation of a large number of plots. According to the narrative structure applied, it is possible to make the readers get surprised, thrilled or curious. Thus, they developed the Structural-Affect Theory of Stories, in which they expose that different emotional responses may be obtained by manipulating the event order of a story.

Hoeken e Van Vliet [2000], when analyzed this theory concluded that a story is a description of an event series. The chronological order of these events is called event structure and the order of the narrated events is called narrative structure.

3.1. Adaptations of the Structural-Affect Theory of Stories for our system.

The system proposed in this paper, called Kanjo, aims to produce stories that organize narrative structures in order to arouse on its readers the feelings of surprise, suspense and curiosity. It is based on adapted concepts of the Structural-Affect Theory of Stories. The idea for the system came from the works of [Cheong and Young, 2008] and [Bae and Young, 2008].

According to this theory, authors should highlight certain events to define the narrative structures that produce surprise, suspense and curiosity. The manipulation of the events' order will provoke one of these three cognitive sentiments.

To produce surprise, some critical information that must be present in the beginning of a narrative structure is omitted, without the reader knowing about it. The surprise will happen when the reader reaches the point where the omitted information is revealed. To produce suspense, the discourse organization must contain a first piece of information. It also must be present in the narrative structure the conclusion of this piece of information. When the conclusion is presented the suspense is solved. The narrative structure for suspense obeys the chronological natural order of events. To produce curiosity, the narrative structure must contain significant information in the beginning of the event sequence. This information must be omitted in the narrative but the reader should know that it is missing. The lack of this event makes the reader curious. In order to solve this curiosity, this information is provided in the next parts of the narrative so that the reader can rebuild the significant information that was omitted.

By analyzing the narrative structure of emotions mentioned in Brewer and Lichtenstein's theory, it can be noticed that there is a critical information phase that begins when a certain relevant situation is created and ends when it ends. This phase occurs both in narratives of suspense, surprise and curiosity. The beginning of this phase in the narrative structure of surprise is equivalent to the moment when initial information is given in the beginning of a narrative structure of suspense. It is also equivalent to the beginning of the phase when significant information is given in the curiosity narrative structure. The event that starts this phase, by providing the information that creates the relevant situation, is called the Critical Event.

The end of the critical information phase in the narrative structure of surprise, the conclusion of the initial information in narrative structure of suspense and the end of the significant information in the curiosity narrative structure have the same role, that is, to indicate the end of the most important situation of the story. These elements were labeled as Significant Events.

In the narrative structure, in order to generate curiosity, there is a significant piece of information in the beginning of the event sequence that is omitted in the narrative. However, the reader must know that this event is missing, so that it is necessary to provide some clues for the reader, such as some consequences of this significant information. When analyzing the stories that use these structures, it was noticed that they report the consequences produced by the significant event, what makes the content of the story better. Thus, it was considered in the system an event that represents these consequences. It is called the Outcome Event.

Figure 1 presents a simple story to highlight the Critical, Significant and Outcome Events. All these events are organized in the chronological order that they occurred. The event number 1 corresponds to the Critical Event. It is the beginning of an important situation. The event number 3 is the Significant Event. It ends the situation started in the Critical Event. The event number 4 corresponds to the Outcome Event. It represents a consequence of the Significant Event.

1. The steward puts poison in the wine glass.
2. The steward takes the wine glass to Mr. Smith.
3. Mr. Smith drinks the wine.
4. Mr. Smith dies.

Figure 1: Part of a narrative where the Critical, Significant and Outcome events are present.

Figures 2, 3 and 4 present the narrative structures, adapted for the system according to the concepts of the Structural-Affect Theory of Stories that the system uses to arouse suspense, surprise and curiosity

Figure 2: Narrative Structure for suspense. It corresponds to events´ natural order in a story.

Figure 3: Narrative structure for surprise.

Figure 4: Narrative structure for curiosity.

In the proposed system, the Critical, Significant and Outcome events make part of the basic structure of the story and have a fundamental role during the process of events' reorganization to produce the narrative structure of emotions.

4. Architecture

Kanjo was developed in C++, using the library TinyXML for XML parsing. To produce a story, the system receives a story theme, an XML file containing all the events that may be part of the plot, the kind of emotion that the story must bring about and its size. The relation between the events is given by an oriented graph. They are analyzed for the identification of the important events that will be essential to establish the final order of the narrative. They are organized in intervals and selected for the resulting story based on their actions, objectives, characters and objects. After the story is formed, its events will be automatically sorted so that the final story brings the emotion indicated by the user. Further details about the processes are presented in the following sections. Figure 5 presents the system architecture, its modules and how they are related.

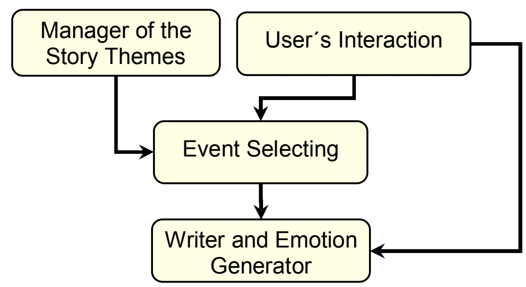

Figure 5: Kanjo architecture

4.1. User's Interaction Module

This module corresponds to the user's interface, by means of which the user interacts with the system, selecting the story theme, its emotion and also the final story size.

4.2. Manager of the Story Themes

This module is responsible for loading the story theme, selected by the user. The story theme is an XML file created by the story author and formed by meta-data that follows a defined pattern. The file contains all the events that may be part of a story, its properties and relationships. The story theme must allow the development of logical plots which can be reorganized to produce the desired emotion. The structure of a story theme file corresponds to a set of events interrelated in a way that they can be represented as a graph. In Figure 6, we have an example of an event.

The story theme file is loaded, and stored into the system memory, in a structure called Group of Story Theme Events (GSTE). Each event of this group that has an action associated with it is defined as a candidate for being the Significant Event of the story and will be stored in the Group of Significant Events. Figure 7 shows how these elements are related.

```
...
<event id_event="69" time="3">
<output_reader emotion="suspense"
               text= " Maria seeing that scene becomes very angry.
               She hasher juice and stand up.</output_reader>
<output_reader emotion="surprise"
               text= "Maria became very angry. She had her juice
               and stood up."></output_reader>
<output_reader emotion="curiosity"
               text= "Maria became very angry. She had her juice
               and stood up."></output_reader>
<character name="Ana"  place="snack bar"></character>
<character name="Maria"  place=" snack bar "></character>
<object description ="glass of juice" place="snack bar"></object>
<objective element="noticed" element_type="character"
      place="balcony"> </objective>
<next_event id_event="70" ></next_event>
<next_event id_event="75" ></next_event>
</event>
...
```

Figure 6: Example of XML tags that corresponds to one event of the story theme.

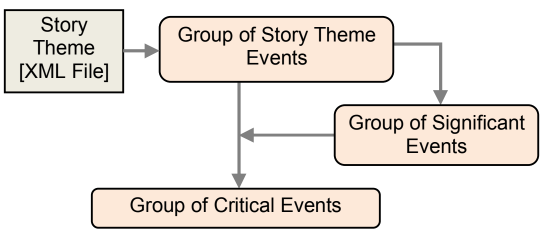

Figure 7: Data structures loaded in this module.

Information about the actions like their types and the involved elements are stored along with each event. In Table 1 the Significant Elements of each action type are indicated. They are used in the identification process of candidates to be the Critical Event. In section 4.2.6, it is presented a very detailed explanation of these actions.

Table 1: Significant Elements of each action type.

Action	Structure	Significant elements
Notice	C1 NOTICE C2 along with C3	Characters C2 and C3
Kill	C1 KILL O1 with C2	Character C1 and object O1
Steal	C1 STEAL O1 with an O2	Character C1 and object O2

An event is identified as a candidate to be the Critical Event when it is the first event in a graph traversal where the Significant Elements are present. The path starts in the first GSTE event and finishes in the candidate Significant Event that defined the elements. Each Critical Event is stored in the Critical Event Group, along with its Significant Event.

The possible properties of the events in the system are the following: Story Text, Event Relations, Characters, Objects, Objectives, Time, Action and Key Character. They are detailed on the next sections.

4.2.1. Story Text

Each event may have a text that will represent it in the final story. In the XML file, this property corresponds to the element *output_reader*, which is composed of two attributes: *emotion* and *text.* The attribute *emotion* determines for what cognitive emotion the text must be used and, in the attribute *text* is the text that will be presented in the final story. Thus, an event can have up to three instances of the element *output_reader*, one for each type of the considered emotions.

Sometimes an event does not have the attribute *output_reader* defined for some of the three cognitive emotions supported by the system. If it happens, this event will only be used in stories that produce the cognitive emotions defined in the attribute.

4.2.2. Event Relations

The events of a story theme must be related to each other. These relations define the ways a story can follow. An event must always point out at least another event. The exceptions are the events that finish a story. This property is represented in a story theme by the element *next_event,* as shown in Figure 6.

4.2.3. Characters and Objects

The property Character and the Object indicate, respectively, the characters and the objects present in the events and their locations in the story world. In each event, there might be several characters or none. This rule is also true for the objects. The characters' positions and the objects are used to infer the objectives when a story is being produced.

4.2.4. Objectives

The objectives separate the GSTE events in intervals. They also influence the ways a story should follow. When an objective is defined, it is necessary to find an event that satisfies this goal and therefore finish the interval. An objective is defined when there is at least one instance of the element *objective* in an event, as shown in Figure 6. Finding the end of an objective is not a simple task. When analyzing the conditions of the open goal, it is necessary to verify the characters and the objects presented in the events that follow the event that started the objective. There can be several events in GSTE that have the conditions to finish an open objective, however only one will be selected. It must be the first event in a path where the characters and/or objects defined in the objective are present.

In the system, an event that starts an objective is called Objective Defining Event (ODE) and the event that ends an objective is called Objective Event (OE). Figure 8 is an example of a theme graph with one ODE and three events that are candidates to end the objective (events 12, 13 and 15).

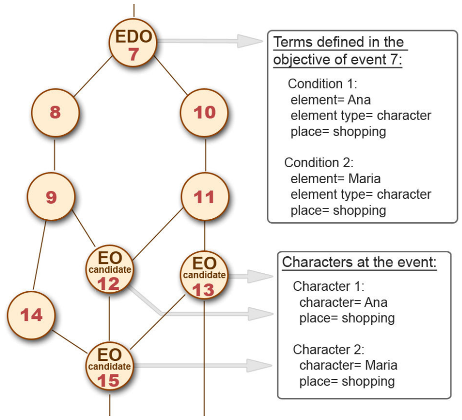

Figure 8: Graph of a story theme with one ODE and its OEs candidates.

The Objective property is directly related to the selection of events that will lead to the end of the story. The event selection is made in intervals, arranged by groups of events that correspond to the paths that a story can follow. All paths inside an interval form a Group of Candidate Paths (GCP) of that interval. There may be several paths inside a GCW but only one will be selected. The events of a selected path will be stored in the Group of Final Story Events (GFSE). In the graph of Figure 8, there is one interval composed of 4 paths defined by the objective started in the event of number 7. In Figure 9 these paths are presented and correspond to the GCP of this interval.

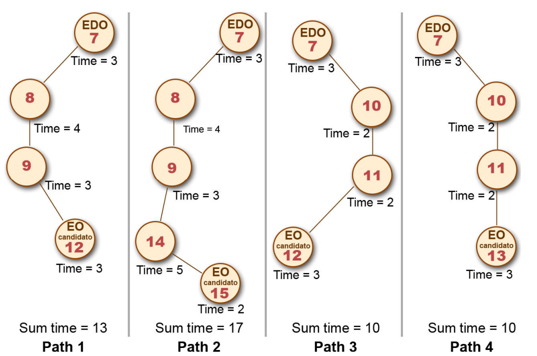

Figure 9: Paths formed by the open objective in the event number 7. There are 4 possible paths to end the objective.

Basically, there are two possibilities of forming intervals in GFSE. One of them is an ODE and its candidate OEs as it was shown in Figure 8. The other one is between the end of an objective and the beginning of another objective. The paths start by the following events of the previous OE and end in the next ODE found. In Figure 10, this situation is illustrated.

A necessary condition for the definition of intervals is that no event that is located before an ODE can take the story to an event located after this ODE. If this condition is not accomplished, the story creation process will fail.

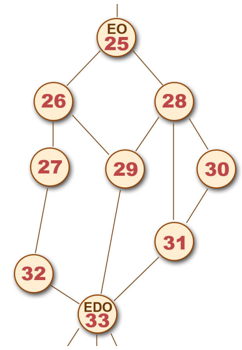

Figure 10: Another way that the system sets the GCPs.

4.2.5. Time

This property is present in all events of the story theme and corresponds to an integer numeric value. The property time does not necessarily correspond to a time measurement unit like minutes or hours. It represents a linear relation of the necessary time space for the events to happen. This property is used as a parameter in the process of selection of events for GFSE, making it possible the selection of different paths of GCPs whenever the story is generated. As a result, the system can produce different versions of stories from the same story theme, even with the same selected emotion.

To allow the creation of different plot versions from a single theme, the system uses some heuristics during event selection. These heuristics generate random numbers that are used as parameters for the selection of the path events in the GCPs. The selected path is the one that has a time sum equals or closer to the generated number. We present a more detailed explanation about these heuristics on the section 4.3.

Figure 9 presents a GCP with 4 paths with time sums of 10, 10, 13 and 17. Using, for instance, a selection heuristic that considers the largest and the smallest sums of time intervals, a random number located between the largest and the smallest numbers will be generated, that is, between 10 and 17. The path with time sum that is the closest to the generated number will be the chosen path. In Table 2, the probability of selecting each path of this GCP is presented.

Table 2: Probability of selecting paths in Figure 9.

Path	Sum	Probability
Path 1	13	50,01%
Path 2	17	28,57%
Path 3	10	10,71%
Path 4	10	10,71%

Table 3: Description of action types

Action	Structure	Character	Element 1	Element 2	Outcome Element	Significant Elements	Key Character
Notice	C1 NOTICES C2 along with C3	Character C1. He notices the character C2 along with character C3.	Character C2. He is along with character C3.	Character C3. He is along with character C2.	Character C1	Characters C2 and C3	Character C2
Kill	C1 KILLS O1 with C2	Character C1. He is the killer of story. He kills character C2.	Character C2. He is killed by character C1.	Object O1. Weapon used to kill C2 by C1	Character C2	Character C1 and object O1	Character C1
Steal	C1 STEALS O1 with an O2	Character C1. He is the thief of the story and steals object O1.	Object O1. It is stolen by Character C1.	Object O2. It is used to assist of object O1.	Object O1	Character C1 and object O2	Character C1

4.2.6. Action

Three actions were considered in the system: *notice*, *kill* and *steal*. The structure that defines these actions is defined in Figure 11.

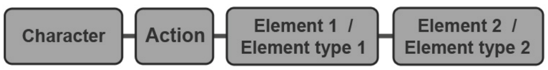

Figure 11: Structure of Action property.

Although the actions have a common structure, the types of elements might vary, since they are related to the action characteristics. The elements that participate of actions are classified in accordance with their roles: The Outcome Element, used to identify the Outcome Event in the story, and the Significant Elements, a pair of elements that identify the candidate events for the Critical Event. The actions and their elements are detailed in Table 3.

4.2.7. Key Character

In the proposed system, the character that is responsible for the most dramatic situation is identified as the key character. Depending on how the theme is built, this character might be hidden for the readers. When it happens, it is not possible to identify this character until the moment when he is introduced. This creates curiosity stories, whether this cognitive emotion has been selected for the final story or not. For instance, in a thriller story of murdery, if the murderer is not introduced by the moment of the crime, the reader will get curious to know who killed the victim. The curiosity will be solved when the murderer is introduced.

The XML element that identifies this property in a theme story is called *key character*. There can be several events in a theme with this element, but only one can be selected for the final story. The chosen event is called Key Character Introduction Event and the interval where this event is present is called Key Character Introduction Interval. In Table 3, it is shown the types of actions considered in the system and their correspondent key characters.

The key character defines where the explanation of the most important fact of the story will be presented. It is presented after the Key Character Introduction Interval, if the key character is hidden and before the Introduction of the Key Character Event if this character is explicit.

4.3. Event Selecting Module

In this module, it is carried out the selection of events that will take part of the story. From the events of GSTE and their properties, the processes that divide the events of this group into intervals and construct the GCPs are executed. The property Objective is responsible for the formation of these intervals. One group of each GCP is chosen for the GSFE through non-deterministic processes. The Group of Significant Events also takes part in the processes.

The role of GSFE is to store all the events that will take part in the story. The events are organized in intervals in accordance with their selection in GFSE. They follow a chronological order. The information that will be used in the processes of reorganizing the narrative and writing the story is stored along with each event.

In the system, there are two event selection heuristics for GSFE: Selection by the Range of Extreme Time and Selection by the Average of Extreme Times and the Longest Time. The first heuristic selects, with the same probability, any path of a GCP which sum of times is large.

The possibility that the users have to indicate the story sizes produced by Kanjo determines the heuristics of event selection that are used. The suggested size also determines if the event that corresponds to the story introduction will be presented. In GSFE, the introduction corresponds to all intervals of this group that are located before the Critical Interval. However, if the first interval of GSFE is a Critical Interval, the plot won't feature the introduction. In Table 4, it is indicated the heuristics of event selection and whether the introduction events will be presented, according to the size specified for the final story.

Table 4: Relation of the story size with the selection heuristics applied and the use or not of the introduction.

Size	Heuristic of Selection	Introduction
Long	Average of Extreme times and the Longest time	Yes
Short	Range of Extreme Time	No
Not Defined	Range of Extreme time	Yes

The identification of the Outcome Event also occurs in this module. An event is identified as the Outcome Event of the story when, in GFSE, this is the last event where the Outcome Element appears in the following interval of the interval where the Significant Event is.

The story skeleton is another data structure used in this module. It indicates the events that correspond to the Critical, Significant and Outcome events and the Key Character Introduction, besides the initial and final events of the intervals where these events are located. It also stores the type of action. Figure 12 depicts the Event selecting Module architecture.

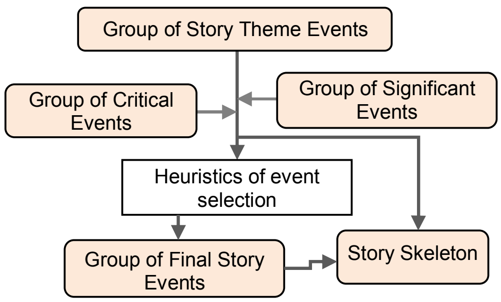

Figure 12: Data structures involved in the selection of events

4.4. Writer and Emotion Generator Module

The Writer and Emotion generation module performs the last two processes for the story generation: reorganizes the narrative structure from the GFSE in order to produce the desired emotion and writes the final story into a text file.

It takes as input the GFSE and the story skeleton and processes all events from these sets in order to reposition the relevant intervals of the narrative structure and change the order the events will be presented to the reader. Figure 13 presents the data structures and heuristics used by this module.

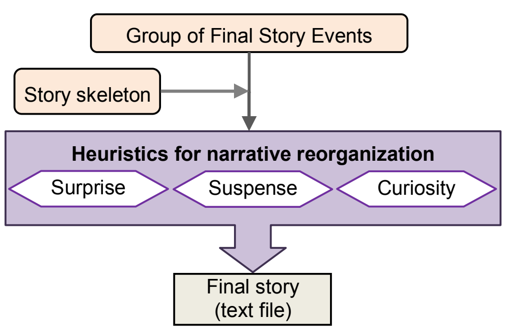

Figure 13: Structures and processes used in this module

There is a heuristic to sort the events for each emotion the system can produce: suspense, surprise and curiosity. These heuristics were built over adapted concepts from Brewer e Lichtenstein theory, which considers rearranging the order of the Significant, Critical and Outcome events in order to produce the desired emotion. In our work, we also consider rearranging the events even on the intervals where these events figure out, this means the Significant, Critical and Outcome intervals. This adaptation became necessary to avoid that changes in the order of the narrative structures could affect the final plot.

To create suspense, there is no need to change the narrative structure, since, as presented in Figure 2, the events' order is the chronological natural order of the narrative. Instead, it is just necessary to use, in the Event Selecting Module, the Selection by the Average of Extreme Times and The Longest Time heuristic to select the Critical, Significant and all other intervals between them, independently of the story size selected. As the method to create suspense is based on the postponement of the end of the most significant situation of the story, we adopted a heuristic that favors the selection of intervals with greater number of events, delaying thus the presentation of the Significant Event.

To produce surprise, the events structure must contain some early information from a critical event of the story. This information, at this time, must be however omitted from the narrative and the user must be unaware of this fact. This information will be reinserted ahead. The user will become astonished when this information is revealed. The surprise is enlightened as the user reinterprets the underlying sequence of events, already knowing the new information.

The output file stores the texts of the events that are presented to readers, according to the type of emotion selected by the user.

5. Examples of Usage

To demonstrate the operation of the system, we created a small story theme, presented on Figure 14, in the form of a graph, with only one Critical Event and one Significant Event, where a theft is reported. Two story examples were produced from this theme, one to arouse surprise and another to arouse curiosity. In both examples, we decided not to specify the size, in order to allow the generation of more diversified stories. Thus, in both examples it is used only the Selection by the Range of Extremes Times heuristic to select the events.

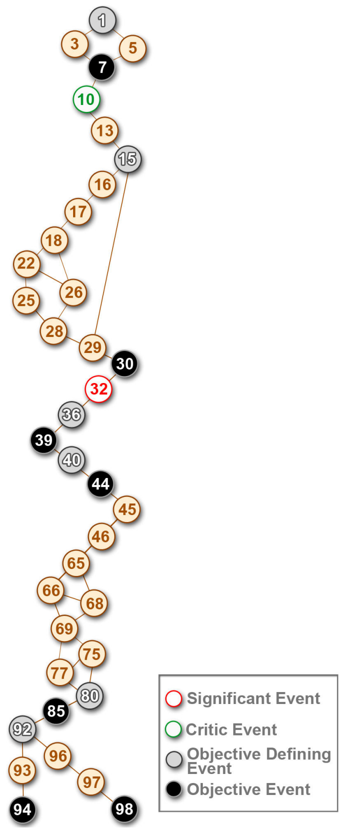

Figure 14: example of a story theme's graph

To facilitate the visualization of intervals and the understanding of the algorithms, the events were intentionally highlighted in different colors. The events are numbered following the same numbering of the graph. The following story arouses surprise on the reader.

1- It's almost 2 AM and the Inspector Arruda is still working.
5- As he was sleepy, he decided to let his reports for the next day and go to sleep.
7- He slips into his bed and soon begins to snore.
40- It´s 9 o´clock. People are lining up to enter the museum. Everyone wants to see the Egyptian Cup that is on exhibition.
44- The door opens and the director goes to see the Cup. As he approached the pedestal where the Cup is, he cries out: Oh No! The Cup was stolen!
45- The Inspector Arruda was getting ready to go to the police station when your phone rings.
46- He answers the phone. It is the museum's director telling the theft of the cup. Arruda takes his hat and goes to the museum.
65- He arrives at the museum. The inspector is received by the museum's director, Mr. Grimaldi and his assistant Archibald. Grimaldi tells everything he knows to the inspector.
66- – It is a tragedy, the Cup is a very rare piece. Its value is inestimable.
68- When he finishes his report, Grimaldi leads the inspector to the place of the robbery. After, he returns to his room and leaves Arruda working alone at the museum
69- Inspector Arruda meticulously examines the museum.
77- After analyzing all the information, the Inspector Arruda has a solution to the crime.
80- He calls two assistants and together they go to the director's office.
85- They enter the office and Arruda reports to Grimaldi as the theft was carried out:
10- The thief entered through the back door of the museum carrying a sledgehammer and a flashlight.
13- Arriving at the Egyptian Room, he saw the Cup surrounded by a transparent dome. This dome was made of ultra-resistant glass.
15- He took a sledgehammer at the dome, but it should not have broken. This should have produced a loud noise.
29- To avoid more loud noise with the sledgehammer, the thief put his coat over the glass dome.
30- He hit again with the sledgehammer until the glass dome break up.
32- The thief took the cup, left the museum and ran away through the park which is located back here.
92- Analyzing all the information that we got it, we know who stole the cup.
96- All the clues lead us to believe that who carried out the theft was Archibald, his assistant Mr. Grimaldi.
97- At this moment enters the room two other assistants bringing Archibald handcuffed.
When he sees Archibald, Grimaldi asks for the police took him. He is taken into the police car that is parked in the back of the museum.

Analyzing the produced story, the first part of the narrative (events 1, 5 and 7) corresponds to the introduction of the story. In the GFSE, the introduction is formed by the first event of this set until the last event of the interval before the Critical Interval. For this example, Figure 13 shows us that the introduction has only one interval and ends at event number 7. The introduction is important to complete the story and to enrich the plot, but does not influence the surprise. If the system is configured to produce a shorter story, the intervals that correspond to the introduction would not be incorporated into the narrative. In this story theme, the introduction will always start at event number 1 and end at event number 7, regardless of the emotion type specified.

The second part of the story begins with the outcome interval highlighted in blue. It consists of the event number 40 and 44 and is crucial in the process of producing surprise. According to the concepts of Structural-Affect Theory of Stories, to produce surprise, important information that should be present at the start of the event structure is omitted and the reader is not aware that the information is being omitted. The surprise will occur when the reader reaches the moment where the missing information is revealed. In our story, the important information is the theft of the cup, which until this point is omitted. The moment where this information is revealed to the reader corresponds in the story to the Outcome Event, represented by event number 44.

There is a system rule for the stories of surprise, according to which all intervals between the Outcome interval and the Key Character Presentation Interval will be inserted after the Outcome Interval. In the example, these intervals correspond to events situated between numbers 45 to 85. The events present consequences of the most significant fact of the story and are useful to create a more consistent story.

As the key character is hidden in the story, his presentation will occur at the end of the narrative. Now, the system inserts the Critical Interval (highlighted in green and composed of event numbers 10 and 13), the Significant Interval (highlighted in red and composed of the event number 32) and all the intervals situated between them. These intervals will present the important information that was removed from the normal chronological sequence of the story and will consequently explain the surprise. Brewer and

Lichtenstein [1982] proved that the stories that are most appreciated by readers are those where the most important situation is explained. Due to this analysis, the system was designed so that the generated stories always explain the most important fact of the narrative, regardless of the cognitive sense that the story arouses.

As the key character is hidden, the explanation of the most important fact showed how the robbery took place but did not reveal who carried it out. This is the only information that is still pending in the story. The insertion of Key Character Introduction Interval will reveal this information. It is the last interval of the story, highlighted in orange, and is represented by the events numbers 92, 96, 97 and 98.

The following example shows the version of the story to arouse curiosity.

36- The thief arrives at his hideout. Remove the Egyptian Cup from the bag and put it on top of a round table.
39- He lays on the couch located in front of the table. He is tired and soon fell asleep.
1- It's almost 2 AM and the Inspector Arruda is still working.
3- He was analyzing the documents in a complicated case, but he was very sleepy and he decides to go to bed.
7- He slips into his bed and soon begins to snore.
40- It´s 9 o´clock. People are lining up to enter the museum. Everyone wants to see the Egyptian Cup that is on exhibition.
44- The door opens and the director goes to see the Cup. As he approached the pedestal where the Cup is, he cries out: Oh No! The Cup was stolen!
45- The Inspector Arruda was getting ready to go the police station when your phone rings.
46- He answers the phone. It is the museum's director telling the theft of the Cup. Arruda takes his hat and goes to the museum.
65- He arrives at the museum. The inspector is received by the museum's director, Mr. Grimaldi and his assistant Archibald. Grimaldi tells everything he knows to the inspector.
68- When he finishes his report, Grimaldi leads the inspector to the place of the robbery. After, he returns to his room and leaves Arruda working alone at the museum
69- Inspector Arruda meticulously examines the museum.
75- He also interviews the guard of the museum to get more information about the previous night.
77- After analyzing all the information, the Inspector Arruda already has a solution to the crime.
80- He calls two assistants and together they go to the director’s office.
85- They enter the office and Arruda reports to Grimaldi as the theft was carried out:
10- The thief entered through the back door of the museum carrying a sledgehammer and a flashlight.
13- Arriving at the Egyptian Room, he saw the Cup surrounded by a transparent dome. This dome was made of ultra-resistant glass.
15- He took a sledgehammer at the dome, but it should not have broken. It should have produced a loud noise.
16- The museum´s guard heard the noise. He walked through the museum to check if something was wrong.
17- Listening the guard approaching, the thief hid himself.
18- The guard entered the room where was the cup. He turned on the light and looked quickly around the place.
26- The guard did not see anything wrong in the room, so he returned to his rounds through the museum.
29- To avoid loud noise with the sledgehammer, the thief put his coat over the glass dome.
30- He hit many times with the sledgehammer until the glass dome break up.
32- The thief took the cup, left the museum and ran away through the park which is located back here.
92- Analyzing all the information that we got it, we know who stole the cup.
93- All the clues lead us to believe that was you that carried out the theft, Mr. Grimaldi.
94- Grimaldi is arrested and taken into the police car that is parked in the back of the museum.

Analyzing this example with the narrative structure to arouse curiosity, it turns out that the story begins with a sequence of events that reports an event subsequent to the theft of the cup. Although the theft is not directly reported, the reader can understand what happened. The system obtained this story with the presentation of the Outcome Interval, in the example highlighted in blue and formed by events number 36 and 39. Presenting the information that there was a theft, but without giving further details, awakens curiosity in readers because they will wonder how the theft occurred and who carried it out.

Comparing the Outcome Interval of this story with the Outcome Interval of the story intended to create suspense, it was noticed that they are different. The events that correspond to the Outcomes Interval in the surprise sample are also present in the story of curiosity; but they do not correspond to any particular interval that Kanjo can handle. The events that correspond to the Outcome Interval in the story to arouse curiosity do not appear in the story of surprise because these events do not have the *output_reader* property for surprise.

Events with numbers 1, 3 and 7 correspond to the introduction of the story, which is ruled by the same mechanism previously mentioned.

According to the system rules, in the stories of curiosity, all intervals situated between the Outcome interval and before the Key Character Presentation Interval are added after the introduction. In the example, these intervals correspond to the events between the numbers 40 to 85.

As the key character is hidden in the story, the next step is to explain its most important fact. Like in the surprise story, it will present the important information that was hidden from the normal chronological sequence. The system will then insert the Critical Interval, highlighted in green and composed of the event numbers 10 and 13, the Significant Interval, highlighted in red and composed of the event number 32 and all the intervals situated between them. If the key character was not hidden, it would be presented before the presentation of the Critical Interval and its subsequent intervals. This rule also applies to the stories of surprise.

In this example, we have the same situation as the example of surprise. Due to the fact that the key character is hidden, the explanation of the important event informs how the theft was carried out but did not reveal who did it. The insertion of the Key Character Introduction Interval will reveal the thief and end the curiosity of readers. It corresponds to the last interval inserted into the story. It is highlighted in orange and is represented by the events of 92, 93 and 94.

Analyzing the examples, we can see that the system succeeded in producing the two stories. Their narrative structures were in agreement with the narrative structures to arouse curiosity and surprise, respectively.

The events organization kept the consistency of the stories and the order they were presented did not create any logical conflict in the narrative.

6. Conclusion

The generation of stories by computers has been the focus of digital storytelling researchers for several decades. Although a number of approaches have shown to be promising in their ability to generate narrative, there has been little research on creating stories for intended emotions. To address this problem, we presented a computational model that uses Structural-Affect Theory of Stories concepts to evoke three cognitive feelings on readers: suspense, surprise and curiosity. Based on adaptations of this theory, the system identifies key events on the narrative and by means of rearranging their order, creates stories with the intended emotions. During system development, some factors such as nondeterminism and user interaction were considered for selecting story duration and themes. The system always tries to generate different story versions from the same story theme for each user request.

We didn't develop yet an authoring tool to help the author during story theme creation. The sample story presented in this paper was created with the aid of the XML Copy Editor tool. Since this is not an easy task and susceptible to logical inconsistencies, the developed tool contains some resources to check if the story is concise.

The system reached the main purpose to evoke the three cognitive feelings on readers. However, some improvements are still necessary. To produce suspense stories, the system delays the end of the significant event, by selecting the intervals with the greater number of events between the critical and significant event. It is not taken into account the tension level of the events. In this way, the system can select events with low levels of tension instead of those with high ones. Thus, a function that evaluates the tension level of events can be a future work for the construction of scarier stories.

The system can produce different versions of stories from a single story theme; however there is no feature to control the originality of these versions, what is also suggested as a future work.

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