So tell me what happened: Turning agent-based interactive drama into comics

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ABSTRACT
As virtual characters become more autonomous, their use in interactive drama is growing. By creating interesting and well authored personalities, these characters are able to interact with each other and create appealing non-scripted stories. As with any other story, we may want to re-tell it or create a summary of the essential parts. Our goal was to create comic-like summaries of these stories. This paper presents a system that analyses story logs, looks at the characters' emotional information to understand their actions and their importance in the story, selects the most important events and creates comic strips. Forty users evaluated the system and the results show that the summaries driven by the characters' emotional information are effective when compared with showing the stories as they unfold.

Categories and Subject Descriptors
I.3.3 [**Computer Graphics**]: Picture/Image Generation - *display algorithms*; D.2.11 [**Software Engineering**]: Software Architectures – *languages*.

General Terms
Algorithms, Design, Languages.

Keywords
Interactive Drama, Emergent Narrative, Story Summaries, Comics Generation

1.INTRODUCTION
The use of virtual characters as the fundamental building elements for interactive drama is a promising technology which follows the example of many computer games. As these characters grow in complexity, we can explore their capabilities as autonomous actors to create interesting emergent stories. State-of-art interactive drama applications like Façade [9], Cavazza's et al. system [4] and FearNot! [2] use autonomous characters that react to what happens in the environment around them, including the actions performed by other characters or by the user. The stories emerge from the interaction between the characters and/or the user.

Creating summaries of these stories is as important as for any other story. But it is more difficult. Emergent stories usually don't have guidelines to structure them and thus it is hard to extract a meaningful sequence of events. Moreover, traditional summarization methods [3, 11] are not prepared to capture and display the characters' intrinsic complexity, like their emotions and the motivations that led to a particular action. These subtle elements are crucial for the outcome of the story and should be part of the summary.

On the other hand, there is a form of summary which can explore subtleness like no other: comics. Comics [10] offer expressive power in a compact format. They are able to tell a story using a limited number of panels and, at the same time, display specific details about the characters that help to understand the story, which is exactly what we need.

Therefore, our aim is to automatically generate comics as visual summaries for interactive drama applications.

The rest of this paper is organised as follows. Section 2 looks at the related work on summarization and comics generation. Section 3 introduces our comics summarization system. Section 4 describes the evaluation and the results. Finally, Section 5 draws some conclusions and outlines the future work.

2.RELATED WORK
There are previous approaches to create summaries from application logs. Halper and Masuch [7] developed a framework which automatically selects action scenes for spectator modes and replays in computer games. The system assumes that interesting events occur when the game or player's state has significantly changed. However, it is adjusted for fast paced games and may be limited in situations where actions have long-term effects.

Cheong and Young [5] translate a game log into a sequence of actions structured as a plan. It identifies the essential events measuring their qualitative importance according to the role they have in the plan.

Friedman et al. [6] create movie summaries removing the obvious events of the story. This solution is limited in scope and domain dependent, but the approach can be generalized to several types of virtual environments.

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Shamir et al. [14] divide game logs in scenes when location and time changes. The system also models the interactions between entities and selects the most relevant looking at the importance of the entities involved.

There is also some previous work that automatically generates comics. Comic Chat [8] generates comics using the conversations from an online chat room. The characters that represent the chat participants have different facial expressions and body postures depending on what the participant is writing. The speech balloons are drawn dynamically.

Shamir et al. [14] use snapshots from a 3D computer game which are stylized and augmented with speech balloons in order to create a comics-like appearance.

3.COMICS SUMMARIZATION SYSTEM

The comics summarization system uses logs of stories generated by FearNot!. Fearnot! (Figure 1) is an interactive drama application that uses emergent narrative and a cast of autonomous characters to create improvised bullying situations which are unscripted by nature [2]. The user witnesses these virtual episodes emerge and helps the victim of bullying by suggesting coping strategies. The advice influences the character's behaviour in the next episodes without compromising its autonomy.

Figure 1. Bullying situation in FearNot!

The autonomous agents behind the characters in FearNot! use an emotional architecture [12] based on the OCC theory of emotions. The behaviour of each character results from a combination of deliberative and reactive processes where emotions play a fundamental role (Figure 2). This is important for the comics summarization system because it can use this emotional information to determine what were the most important events in a story and which should be displayed in the comic strip.

The summarization is performed in two steps. The first step analyses the logs produced by FearNot! and creates a summary using our Comic Strip Description Language (CSDL) [1]. The second step transforms the comic strip description into a visual comic strip.

The log summarizer looks at the actions of the characters in the story and to the associated emotions. Strong emotions reflect important actions. For instance, if a character is really fearful about something, then the resulting action will be considered important. Moreover, the actions that led to that strong emotion are also considered important, like the threat that originated the fear. The important actions and their contextual information are the summary of the story which is transformed into a CSDL description.

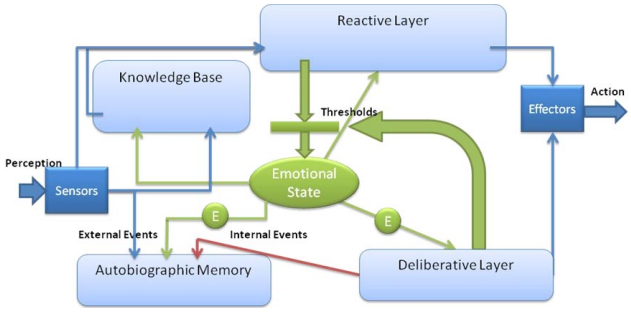

Figure 2. Agents architecture in FearNot!

The comics generator transforms CSDL descriptions into comic strips. It is independent from the log summarizer and has a modular architecture with different modules responsible for each type of element in the comic strip: background, characters, balloons and layout.

The background module picks the appropriate background image for the panel. It shifts the perspective randomly to avoid repetitive panels which are often seen as a flaw in automatically generated comics.

The character module places the characters in the panel taking into account their social behaviour. It analyses to whom a certain character speaks or gazes the most. The characters who interact the most (by speaking or gazing) are placed in opposing positions near to each other. This avoids the placement of other characters in-between them. It can also create accurate representations of small groups of characters interacting with each other.

The balloon module generates speech balloons as needed. The balloons are automatically placed in a empty space in the panel as close as possible to the character that is speaking. The dialogue sequence is also taken into account and balloons are placed from left to right and from top to bottom.

Finally, the layout module puts all the panels together and generates the visual output of the comic strip. Currently we are using a traditional comics layout and SVG files [13] as output, but we can easily replace the layout module to support other formats. We can also add more modules which support new elements and create richer comics.

All the modules share an image library which includes backgrounds, characters' heads and bodies with different emotions and postures, and objects. The library defines the drawing style and it is domain dependent. Using a different library we can generate the same comic strip with a completely different drawing style.

Figure 3 shows a segment of a comic strip generated by our system. Panels 1 and 2 depict a typical bullying situation from FearNot!. Then, panels 3 and 4 represent the user interacting with the victim, which is denoted by the character speaking towards the reader and by speech balloons that point to the outside of the panel (the user's advice). In the panels 5, 6 and 7 the story continues with another bullying episode. It looks like the victim couldn't fight back this time and was pushed again!

Figure 3. A segment from a comic strip created by our system depicting a story generated by FearNot!

4.EVALUATION

The evaluation of the comics summarization system consisted in two distinct studies. The first one tried to assess the effectiveness of the summaries produced by the log summarizer while the second looked at the quality of the generated comic strips.

The first study was conducted with forty participants divided in two groups. The first group watched a video with a complete episode from FearNot!. The other group read a comic strip of the same episode generated by our system. The participants had to indicate what happened in the story and which were the more significant events.

The results show that most participants understood the comic strip at least as well as the video. Therefore, we can conclude that the log summarizer selected the most important events and didn't left behind events that might have influence in the story.

The second study was an online survey and collected answers from one hundred participants. We tried to assess several issues like the quality of the speech balloons (placement and representation), the identification of social groups (related to the placement of the characters), or the correct display of emotions.

The speech balloons had very positive results when compared with balloons drawn by digital artists or generated by other comics systems.

A significant number of participants couldn't identify social relations looking at the placement of the characters in a panel (without speech balloons), for instance which characters are friends of the bully. However, we believe that in a normal situation these relations would be clarified by the speech balloons and by the context created in a sequence of panels.

Most participants correctly interpreted the emotions displayed by the characters. Although it has more to do with the quality of the image library than with the comics generation, the incorrect perception of emotions could make the difference between an accurate and inaccurate interpretation of the story.

The overall user satisfaction was not surprisingly high but it was as expected. We think that all the participants understood that the system does not try to create art. Rather, it tries to be an alternative solution to generate summaries of stories.

5.CONCLUSIONS

This paper presents a system that automatically generates comic-like summaries of stories created by autonomous characters in interactive drama applications. Our stories were bullying situations from FearNot! and we used the emotional information of the characters to determine what were the most important events in the story.

The results of the evaluation show that the readers of the summary end up recalling the same situations as the viewers of the full story.

However, we could improve the system adding more elements of comics, like perspective. A simple manipulation of perspective could significantly improve the dramatic effect and emphasize important segments of the story.

We believe that in the context of interactive drama and emergent narrative, comic-like summaries are more efficient and more appealing than traditional text-based summaries.

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