Using Information Visualization to Understand Interactive Narrative: A Case Study on Façade

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Abstract. Video games increasingly take place in dynamic worlds with more autonomous characters and highly variable and moldable narratives. However, our tools for studying how players interact with these complex worlds are severely limited. In this paper, we propose different visualizations that can be used to more effectively analyze interactive narrative systems, and present a case study that applies these techniques to analysis of player logs from the interactive drama Façade.

Keywords: Information visualization, story analysis, game design.

1 Introduction

The future of video games promise highly interactive and flexible worlds which the players can shape to their desires and have a high degree of influence not only on the outcome, but also how each outcome is reached, how the story unfolds and how the player experiences the narrative. Metrics-based analytics is becoming a standard practice in game design, but has not yet had significant impact on interactive storytelling. One of the challenges for applying metrics to the design and analysis of interactive storytelling is developing appropriate visualizations to facilitate designers in developing insights about the player experience. In this paper, we propose different visualizations that can be used to more efficiently analyze interactive storytelling systems, and present a case study that applies these techniques to analysis of player logs from two different versions of Façade.

Façade is an interactive story in which player interaction can influence what topics the characters bring up, what they choose to reveal to the player about their problems and history, and ultimately what the fate of Trip's and Grace's (the two autonomous characters in Façade) marriage will be [10]. Parts of the story may also be enacted differently depending on player's past actions and affinity towards Trip or Grace. This flexibility results in a huge variability on how players experience the narrative of Façade – changes are possible not only on what is being told, but also how it's being communicated to the player. This level of variability makes Façade a good case study for the development of information visualization techniques for interactive story logs.

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This paper is structured as follows: In Section 2, we discuss the previous work in the literature that have explored using information visualization techniques for studying interactive media. In section 3 we detail the different visualizations we use in our analysis of Façade player logs and discuss our findings, and section 4 concludes the paper.

2 Related Work

While information visualization techniques have been used as creative tools for input in some works of digital media [1,2,3], they are rarely employed as functional tools to study digital games. One example is the work on the Restaurant Game by Orkin et al. [4]. In The Restaurant Game the player can assume the role of a customer or a waitress, and try to achieve a simple goal such as earning money or having dinner. The authors collected sequences of actions and utterances from players' interactions with the Restaurant Game which they visualized via tree structures superimposing actions from many player logs. Another work that is focused on visualizing physical actions in virtual worlds is the work by Hoobler et al. [5] on visualizing team strategies and player behavior patterns in Return to Castle Wolfenstein: Enemy Territory.

The visualization of Choose Your Own Adventure (CYOA) books by Christian Swineheart is also a relevant work that uses information visualization techniques to gain insight into the evolution of these books over the years [6]. Swineheart produced visualizations of 12 CYOA books published between 1979 and 1998, focusing on desirability and number of endings and linearity of the plot. These visualizations focus on story structure visualization rather than player actions, appropriate since CYOA limits player action to a relative small number of discrete branches.

More general interactive story visualization tools must provide insight into both player action and story structure, as well as the relationships between the two. The visualizations presented here demonstrate our initial steps towards creating such visualizations.

3 Façade Log Analysis and Visualization Tool

As our case study, we looked at how different dialogue systems affect how players experience the story, and how their interaction patterns change. One of the interfaces that we used is Façade's original dialogue interface, which is a natural language understanding interface where the player can type in anything anytime to converse with the characters. The second interface is what we call a sentence-selection interface, similar to the interface found in games such as the Star Wars: Knights of the Old Republic or Monkey Island series, where the player is prompted with a menu whenever his or her input is required (**Fig. 1**). This choice of dialog system is representative of the types of decisions made by designers of interactive stories, where there is a complicated relationship between the player action space, the interface for taking actions, and the narrative trajectories experienced by players. While the focus of this paper is on the visualization techniques themselves, rather than the dialog system study, it is important that the visualizations were developed in the context of the kinds of real design questions facing interactive storytellers.

(a) (b)

Fig. 1. Different versions of Façade we used in our case study, (a) the sentence-selection version, where the player can only interact at fixed points and can only select utterances from a menu, and (b) the NLU version, where the player can type in anything anytime

We performed a small case study by recruiting 10 participants from an introductory game design class taught at UCSC. Each participant was required to play both versions from which we collected our gameplay logs. The visualization tool was developed using .NET in conjunction with the open source Graph# library [11]. The following sections describe the visualizations provided by our tool, along with the results we obtained from our experiment using the data from participants' gameplay logs.

3.1 Discourse Act Coverage

Façade maps each player utterance to a discourse act, which aims to capture the semantics of the line in the context of the game world. For example, greeting utterances like "Hi, Trip!" or "How are you doing, Grace?" get mapped to "Greet Trip" or "Greet Grace" discourse acts respectively. Façade's NLU version maps player utterances to approximately 30 main discourse act categories; each of those categories can have a varying number of parameters. The player's expressiveness is directly related to how many of those discourse acts they are able to employ using different interfaces when conversing with the characters. We designed a representation based on the squarified treemapping technique [8] to visualize the average percentage each discourse act is addressed over all gameplay logs. The treemapping technique is particularly space-efficient as it enables a compact and concise representation of many different possible player actions, as likely to be supported in NLU systems and rich interactive worlds, and it's also very effective when studying player behavior across different versions as it presents the information in a representation that makes more clear not only the relationships between differences in how players' behavior change across versions, but also how players employ different strategies in terms of discourse acts within the same version. While using regular treemapping techniques might result in many thin rectangles, the squarified treemapping technique attempts to mitigate this problem by using an algorithm which tries to adjust the dimensions of each sub-rectangle so that they

approach a square in shape as much as possible. In our representation, the color of each rectangle is determined by the average percentage each discourse act is used. (**Fig. 2**).

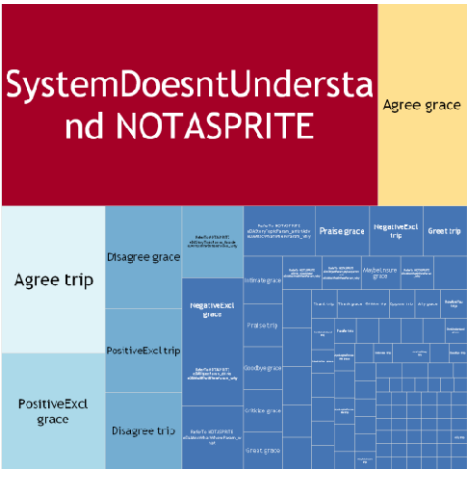

Fig. 2. Squarified treemaps for discourse act usage patterns for the NLU version

The most striking observation in the figure above is the relatively high percentage of the "System Doesn't Understand" category in the NLU version, which means the NLU module was unable to map the player utterance to any of the discourse acts it understands. However, it should also be noted that a previous study by Mehta et al [7] showed that the perceived failure rate of the NLU system was much lower since players were able to rationalize those failures in context when playing the game.

Another interesting point we noticed is how the players were inclined towards empathetic responses in both versions. Positive discourse acts such as Agree, Positive Exclamation, Support make up a much higher percentage of discourse acts employed in both versions than negative responses, especially when we look at the discourse act distribution without considering the parameters.

We also looked at how many unique discourse acts (including the parameters) the players were able to discover in a single playthrough. That number ranged from 14 to 35 for the NLU version, and 15 to 33 for the sentence-selection version, which is low given the huge set of discourse acts available to the players. However, given a large percentage of the discourse acts were not understood by the system in the NLU version as evidenced by the treemaps above, we can see that the average probability of each player utterance having a meaningful impact within the current context in the game is higher in the sentence selection version than in the NLU version.

3.2 Story Space Coverage

To visualize story space coverage we use a graph that we call a "story graph". The story graph uses a coloring scheme inspired by heatmapping, which is a frequently used technique in information visualization in which values are represented by colors

[9]. In our story graphs nodes represent story beats and edges connect beats follow one another in a gameplay log. Color corresponds to the number of incoming edges to a beat.

A close-up of the story graph from 10 logs from the NLU version is shown in **Fig. 3**. This map allows us to observe which story beats occur more frequently in story logs compared to others. In the example below in **Fig. 3**, we can clearly see that players were more likely to encounter the story piece where there's a discussion over which drinks to have (FASKDRINKT1NTPA) than the beat where Grace complains about the apartment's decoration (AAT1GPA).

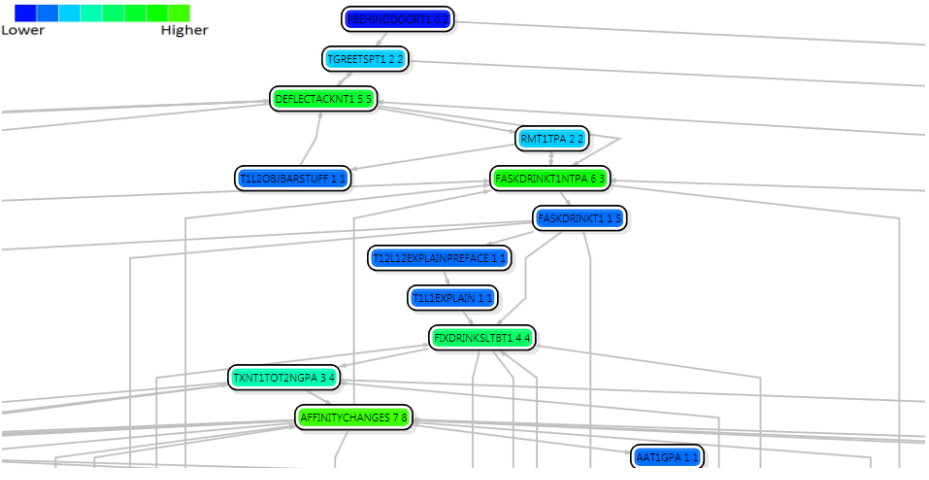

Fig. 3. A close-up view of the story graph

Players experienced more variety of story beats in the NLU vs. the sentence selection version – 57 different beats in total across 10 playthroughs in the NLU version vs. 43 for sentence selection. Thus players experienced greater story variation in the NLU version. This highlights an important design trade-off between menu-based and NLU interfaces: The sentence-selection version allows a higher degree of local influence, since the system is explicitly aware of what each utterance means. But since the number of options that can be presented to the player is limited, the NLU version allowed the players more global freedom in shaping and creating variations in the story by addressing various mixins, subtopics and objects. A look at the average in-degree of nodes also reveals that the sentence-selection version graph has slightly higher average in-degree (2.37) than the NLU version graph (2.2), which also indicates that player experience was more linear in the sentence-selection version than in the NLU version.

4 Conclusion

In this paper, we have presented a visualization tool that aims to enhance our current toolset for studying interactive narratives. We have also demonstrated the usability of

our visualizations in a simple case study using two different versions of Façade. Our analysis shows that information visualization techniques have the potential to be useful in the field of game studies where highly interactive and flexible story worlds are poised to become a norm.

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