

Storyboard Authoring of Plan-Based Interactive Dramas

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INTRODUCTION

The creation of high quality interactive dramas requires both expertise in authoring (compelling plot arcs, dialog, character conflicts, etc.) and technical expertise in computational and generative story representations. Currently, authors, or more typically author teams, must have competence in programming, a background in artificial intelligence, competence in interaction and game design, and skill in story authoring, including the creation of compelling plot spaces (potential plots), rich characters, and believable dialog. Even for experts, the necessity of bringing all these skills to bear can make the authoring of complete interactive drama experiences a heroic undertaking; for novices, the creation of such experiences is out of the question. The interactive drama *Façade* [7], for example, uses over 200,000 lines of behavior code to represent a 30-minute dynamic player experience. In addition to relegating interactive drama authoring to a small group of experts, these requirements limit the exploration of the potential design space of interactive dramas and slow the adoption of these technologies in the game industry, which stands to benefit from meaningful social interactions and dynamic story spaces that are much larger than any that could be realistically hand-authored.

These daunting challenges motivate the development of a practical and usable authoring interface that can harness the computational power of plan-based interactive dramas and still appeal to writers and game designers without a technical background. My dissertation work aims to develop, in three primary project stages, a complete authoring interface that allows users to design high quality interactive dramatic experiences like *Façade* without ever having to look at or touch a line of code. The first two stages, Wide Ruled and StoryCanvas, take a simple sequential story planner and create tools with traditional and graphical storyboard-based interfaces, respectively, to discover and analyze the challenges of interactive story creation and their possible related visual metaphors for non-technical users. The final and largest stage of my research is a complete intelligent interface for authoring concurrent, hierarchical plan-based interactive dramas. It will take the lessons learned from Wide Ruled and the visual metaphors and dynamic feedback capabilities of StoryCanvas and develop a new reactive and

intelligent authoring system for interactive dramas, built to encourage a continuous, iterative, and creative exploration between author and interface.

PRELIMINARY WORK

The first stage of my work, Wide Ruled, has been fully developed and successfully deployed to multiple classrooms of technical and non-technical users. StoryCanvas is currently in progress and the first version of the system will be evaluated in winter quarter of 2009.

Wide Ruled

The first project, called Wide Ruled, is text-based interactive story generator that uses a simple, easy-to-understand story planner with a traditional windowed interface [9]. The story generator in this tool is a modified version of the UNIVERSE model of story planning [5] which models story structure as a set of hierarchical plans that encompass one or more ways to accomplish a story goal for the author, and was chosen due to its success with students in previous Interactive Narrative classes [9]. A Wide Ruled story world contains a set of author-created story objects – characters and environments (concrete entities), and plot points (abstract episodic story information). Plot fragments are the primary component of story generation, and represent a story event that fulfills a high level author goal. They contain a precondition, which is a set of constraints on story world objects, and bindings to any of those constrained objects. When a plot fragment is valid (has a precondition that is fully satisfied) and it is chosen by the story generator, a series of author-designed story actions associated with that plot fragment are sequentially executed, modifying the bound story objects, displaying text, and pursuing other author goals, which in turn activate other plot fragments. Beginning with an initial author goal, this hierarchical execution allows for repetition through recursion, and random selection of valid plot fragments introduces story variation.

Wide Ruled has been used in three separate classroom settings, twice in the UC Santa Cruz Interactive Narrative class, and once in the Communications and New Media Programme at the National University of Singapore. All of these instances saw use of the tool by those with and without a technical background. As seen in our more complete published results for the first iteration of Wide Ruled [9], students were able to create complex story plans with high breadth and depth, but had trouble with the concept of plot points and the complex precondition constraints of the plot fragment editor, which was improved in Wide Ruled version 2. Preliminary feedback from the latest use of Wide Ruled version 2 used at NUS indicates that this improvement was effective¹.

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¹ Personal communication, Alex Mitchell (NUS)

StoryCanvas

StoryCanvas is an evolution of Wide Ruled, in which the techniques of comics and storyboards provide visual authoring metaphors for all the components of that story generator, in order to simplify the authoring process and seamlessly utilize and manage complex computational concepts. The success of the sequential art style of storyboards and comics as a spatio-temporal visualization technique for films, computer animation, and game, and their extensive documented analysis [1, 6] prompted their selection as our metaphor of choice. My work develops on these extensive analyses, along with previous work in comic-based programming and planning interfaces [3, 4] and comic-style story authoring [2]. Currently in development, the first version of StoryCanvas will represent the plot fragments of Wide Ruled as a set of comic-style panes with visualized representations of story objects, constraints, and actions. Authors are able to associate characters and environments with static, high quality artist-drawn avatars/icons, customized with simple drawing tools. Within plot fragments, story actions are visually realized in different ways. For example, the printing of text is a floating narration bubble, or a speech or thought bubble associated from some specific character. The author is also able to select the number and ordering of panes in a plot fragment, and what story actions they contain. Static or dynamically bound environment objects are associated with each of those panes, to provide a backdrop for story actions. Furthermore, the author can also control the composition of a pane, allowing translation, scaling, rotation, and object depth ordering in each pane to contribute to the potential meaning of a story event.

The storyboard panes of a plot fragment are split into two groups - a "precondition pane", and a series of sequential story "action panes", as seen in figure 1. The precondition pane visualizes constraints and bindings for this plot fragment, and the action panes represent all of the story actions, visual and non-visual, that can occur during plan execution. On the left, the precondition pane contains all of the potentially matched characters, environments and plot points that fulfill all constraints, and are displayed as yet-unknown silhouetted icons. These icons carry with them various individual trait constraints or relationship constraints that may be compared to literal values, or reference the binding of another potential object's trait (represented by edges joining two silhouetted story objects). Above each pane is a "virtual pane" that can contain any precondition constraints or actions that affect non-visual elements, such as computed temporary variables and plot points. Subgoal actions are represented as empty action panes with many possible branching paths, to visualize the potential plot fragments that can execute from the pursuit of an author goal. The interface manages this expanded plan visualization, ensuring not to overlap and clutter the screen so that the author can select any of the potential plot fragments and smoothly transition the editing interface to any part of this potential tree of story plans.

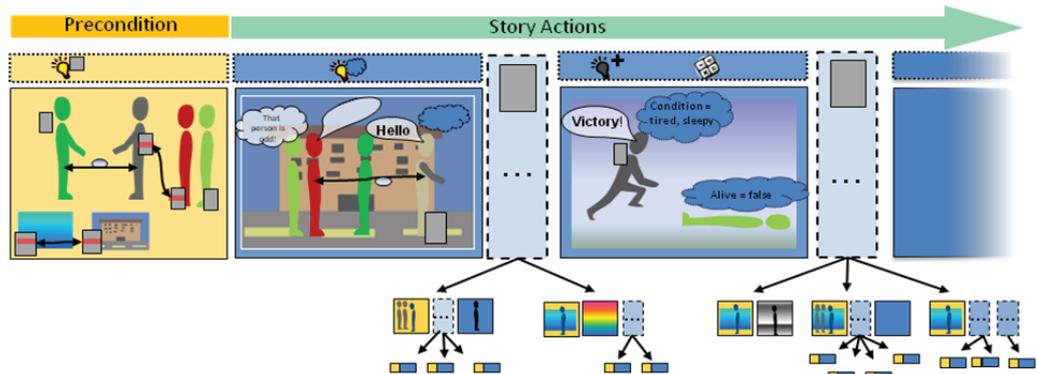


Figure 1 – An illustration of the in-development StoryCanvas plot fragment authoring interface

During generation, StoryCanvas appears as a dynamic comic book that is progressively being appended, pane by pane, across the screen. A reader sees a single instance of a generated story, and is only presented the visible output of the story action panes, including character and environment graphics, and thought and speech bubbles. Once generated, all the potential (unbound) story objects captured in the invisible precondition pane appear grounded out to concretely visualized characters and environments in the visible action panes of the story.

PROPOSED WORK

My immediate next steps include the completion of a more robust and intelligent version of StoryCanvas, to be completed later this year. I will also begin the final stage of my work, a reactive and intelligent storyboard-based interface for authoring interactive dramas, which will tap into the work of two other PhD students and require several rounds of development and evaluation. This large project will account for the bulk my remaining dissertation research, from 2009 onward.

StoryCanvas 2

The next version of StoryCanvas will attempt to increase the authorial power of the system by introducing intelligence into the interface that manages complex visualization techniques, supports automatic composition tasks, and provides real-time feedback on the complexity of the potential stories generated by the tool. Characters and environments will become more customizable, with detailed articulation and dynamic, parameterized appearance, and support automatic author-triggered composition themes to convey various common social situations and emotions, utilizing more of the comic-style methods present in previous research [1, 6]. A primary goal of this next iteration is to continue to explore the broad space of visual techniques known to storyboard and comic authors, hone them based on user-studies and experimentation. The system will also inform authors and assist them in managing large story plans, by executing an author's partially completed story plan in the background, rapidly and repeatedly, tracking the distribution of potential story plans across the entire potential story space. Using heuristics, the interface will then evaluate these execution runs and determine if the author's plan will potentially loop indefinitely, or likely never generate in a particular area of potential story space. These repeated runs will then generate heatmaps that track and visualize plot fragment selection frequencies and help the author determine

problem areas of his or her story plans that do not achieve desirable coverage. The system will also attempt to let an author manage large story spaces more efficiently by grouping together structurally similar plot fragments and subplans.

The first version of StoryCanvas, like Wide Ruled, will be evaluated in the winter and spring quarters of 2009, and provide initial feedback on the first iteration of comic-style interface metaphors and visualization methods. I will then have feedback to analyze and be in the process of developing the next iteration of the tool, which will likely be evaluated in the late spring and summer quarters of 2009.

Intelligent Authoring Interface for Interactive Dramas

As a culmination of the lessons learned, visual metaphors, and interface techniques gathered from my Wide Ruled and StoryCanvas work, I plan to create a storyboard-based intelligent authoring interface for the creation of plan-based interactive dramas akin to Mateas and Stern's *Façade* [7]. Underneath a modified StoryCanvas-style interface, the project will utilize a mixed-initiative planner that combines a domain metatheory of social interaction with the existing character designs and story plan choices made by the author. The interface will engage in opportunistic exploration of the potential story space to constantly suggest new potential plans and present them to the user. Because of the intelligence embedded in the interface, authors will have the freedom to specify at any level his or her story and selectively rely on the dynamic suggestions of the system to flesh out a complete interactive experience. The plans selected by the author will be able to be continually customized and iteratively refined by both the author and the interface until the story matches the author's vision. The finalized plan will then be used to generate behaviors for agents in a real-time interactive drama. Ultimately, this interface aims to make the authoring of complex expressive characters in rich interactive dramas a task that can be accomplished by a broader audience, from the high school classroom to the game design studio.

This underlying technology of this system will be based on a mixed-initiative HTN planner, informed by a storytelling ontology and connected to a dialog generation system developed by two other students in the Expressive Intelligence Studio. The intelligent interface will use task networks to represent dramatic beats—a unit of dramatic action that causes a dramatic value, such as love, hate, or trust, to change. These beats will be based on social games, in which NPCs engage the player in an interaction that will involve a significant change in social state depending on the player's reaction. The storytelling ontology will inform a domain metatheory of social games that categorizes plan objects and operations within the task networks of the underlying HTN planner and generalizes the conditions required for various social game plans to be valid for a given story world state. This builds from previous relevant research in story-based mixed-initiative planning [10]. Dialog generation technology will create concrete dialog interactions from the abstract social interactions, tailored to the characters and existing story plan in the interface. When authoring is complete, these declarative HTN plans will be translated and ground out into concrete coordinated multi-agent behaviors represented in the ABL reactive planning language [7], guided by the translation techniques of existing research [11]. The interface for this system will allow authors to drill down and customize the task networks of the story plan at every level of the

hierarchy, utilizing the interaction and visualization methods researched and developed in StoryCanvas. The core components of the story plan, the task networks, will be presented as a progression of storyboards similar to those developed in StoryCanvas, modified to deal with potentially deep plan hierarchies and complex potential orderings of actions in the story space. The goal is to enable the user to easily constrain the potential story space for each social game and visualize its associated preconditions, potential player interactions, and resulting story state modifications with ease.

There will be many new challenges in developing this system, including managing blended and overlapping character actions, parallel story events, and visualizing extremely large story spaces dense with potential player interaction. As this system is developed, the multiple planned user studies to evaluate progressive iterations of this project will undoubtedly reveal unforeseen complications or limitations of the system that will guide its evolution into a practical, usable intelligent authoring tool. While there does exist previous research in HTN-based story planners [8], none of the work uses this metaphor of storyboards to author complete character plans for interactive drama. Consequently, I hope that my contributions will represent a vital step in the development of practical and non-technical authoring tools that allow high quality dramatic social experiences to be commonplace in future games.

REFERENCES

- [1] Eisner, W. 1985. *Comics and Sequential Art*. Tamarac, FL: Poorhouse Press.
- [2] Gingold, C. 2003. *Miniature Gardens & Magic Crayons: Games, Spaces, & Worlds*. Master's Thesis. School of Literature, Communication and Culture, Georgia Institute of Technology.
- [3] Kindborg, M. and McGee, K. 2005. *Comic Strip Programs: Beyond Graphical Rewrite Rules*. International Workshop on Visual Languages and Computing VLC2005, Canada, 5-7.
- [4] Jahala, A., Rawls, C. and Young, R. M. 2008. *Longboard: A Sketch Based Intelligent Storyboarding Tool for Creating Machinima*. Proceedings of the Florida Artificial Intelligence Research Society Conference (FLAIRS).
- [5] Lebowitz, M. 1985. *Story Telling as Planning and Learning*. *Poetics* 14, pp. 483-502.
- [6] McCloud, S. 1993. *Understanding Comics*. New York, NY: Kitchen Sink Press/Harper Perennial.
- [7] Mateas, M and Stern, A. 2003. *Façade: An Experiment in Building a Fully-Realized Interactive Drama*. Game Developers Conference, Game Design track.
- [8] Riedl, M. and Young, R. M. 2004. *An intent-driven planner for multi-agent story generation*. In the Proceedings of the 3rd International Conference on Autonomous Agents and Multi Agent Systems.
- [9] Skorupski, J., Jayapalan, L., Marquez, S., and Mateas, M. 2007. *Wide Ruled: A Friendly Interface to Author-Goal Based Story Generation*. Submitted to International Conference on Virtual Storytelling .
- [10] Thomas, J. and Young, R. M. 2006. *Author in the Loop: Using Mixed-Initiative Planning to Improve Interactive Narrative*. ICAPS 2006 Workshop on AI Planning for Computer Games and Synthetic Characters.
- [11] Wilkins, D. E. and Myers, K. L. 1995. *A common knowledge representation for plan generation and reactive execution*. *Journal of Logic and Computation*, vol. 5, number 6, pp. 731-761.