A Visual Programming Interface for Specifying Plan Dynamics (Demo Paper)

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Abstract

When planning techniques are used for narrative generation in new media applications different criteria, based on such things as plan dynamics, are required to assess plan quality. In our work we have looked at providing support for specifying this information: we introduced a meta-level of representation that is an abstraction of the domain with respect to time and causality which we have represented visually via a *narrative arc*. We have used this visual representation in a visual programming approach to the exploration and specification of plan dynamics. In this demo we showcase this approach using our system that features virtual characters inspired by Shakespeare's play *The Merchant of Venice*[1].

Introduction

Interactive Storytelling (IS) represents a major new application area for AI planning. New media domains such as IS differ markedly from the benchmark domains that have featured in AI research. One key difference is that the criteria used to assess plan quality are no longer concerned with such things as optimality, rather the focus is the dynamics of the plan, in terms of the shape of its *trajectory* and the intermediate states that will be traversed when it is executed.

In earlier work we developed a plan-based approach to narrative generation that exploits a meta-level of representation via the use of constrained predicates, referred to as *constraints*, representing key narrative situations for the domain of interest (Porteous, Cavazza, and Charles 2010). These constraints are used as intermediate goals to guide generation of narratives featuring these situations. Hence they provide a way to specify the abstract shape of a narrative trajectory in terms of the intermediate states that it will traverse when it is visualised. This abstract meta-level of representation formed the basis for our solution to the problem of specifying plan dynamics: we developed a visual representation in the shape of a narrative arc which facilitated a visual programming approach to specification of plan dynamics.

In the demo we showcase our approach to specifying plan dynamics with reference to an IS system we have developed based on Shakespeares' *Merchant of Venice*. The demo is a companion to our ICAPS paper (Porteous et al. 2011).

[1]The full paper describing this system appears in the ICAPS-11 Proceedings at pages 186-193

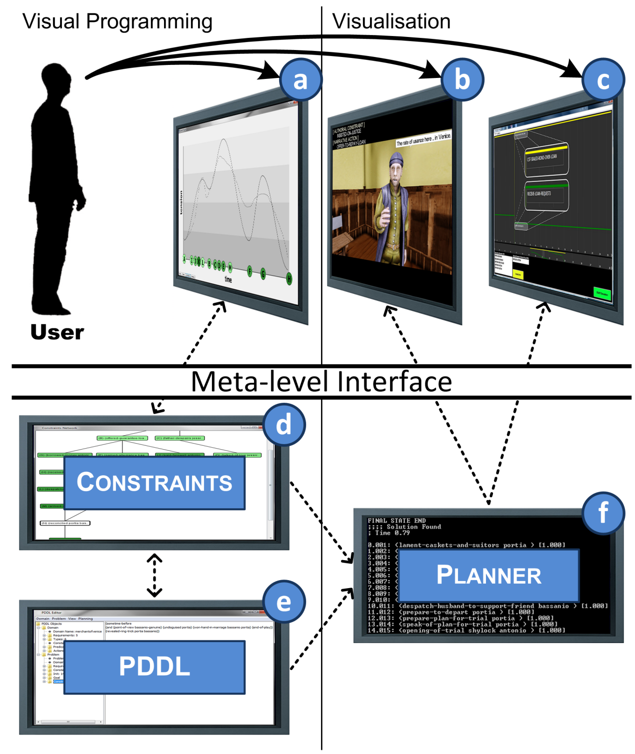

Figure 1: System Architecture Overview. User Interaction is at the meta-level via visual programming (a), visualisation (b) and timeline (c) and not with lower level components.

Demo: System Architecture

Our visual interface for specification of plan dynamics is fully implemented and integrated with our IS system. An overview of the system architecture is shown in figure 1. The user interacts at the meta-level via a *Narrative Arc Window* (a) and can also explore generated narratives via two visualisation windows: an *Animation Window* (b); and a *Timeline Window* (c). The system also features some hierarchically organised lower level components. They include the constraints (d) and other PDDL constituents of the domain model (e). The planner is invoked by the user (f) to explore the narrative possibilities of different plan dynamics.

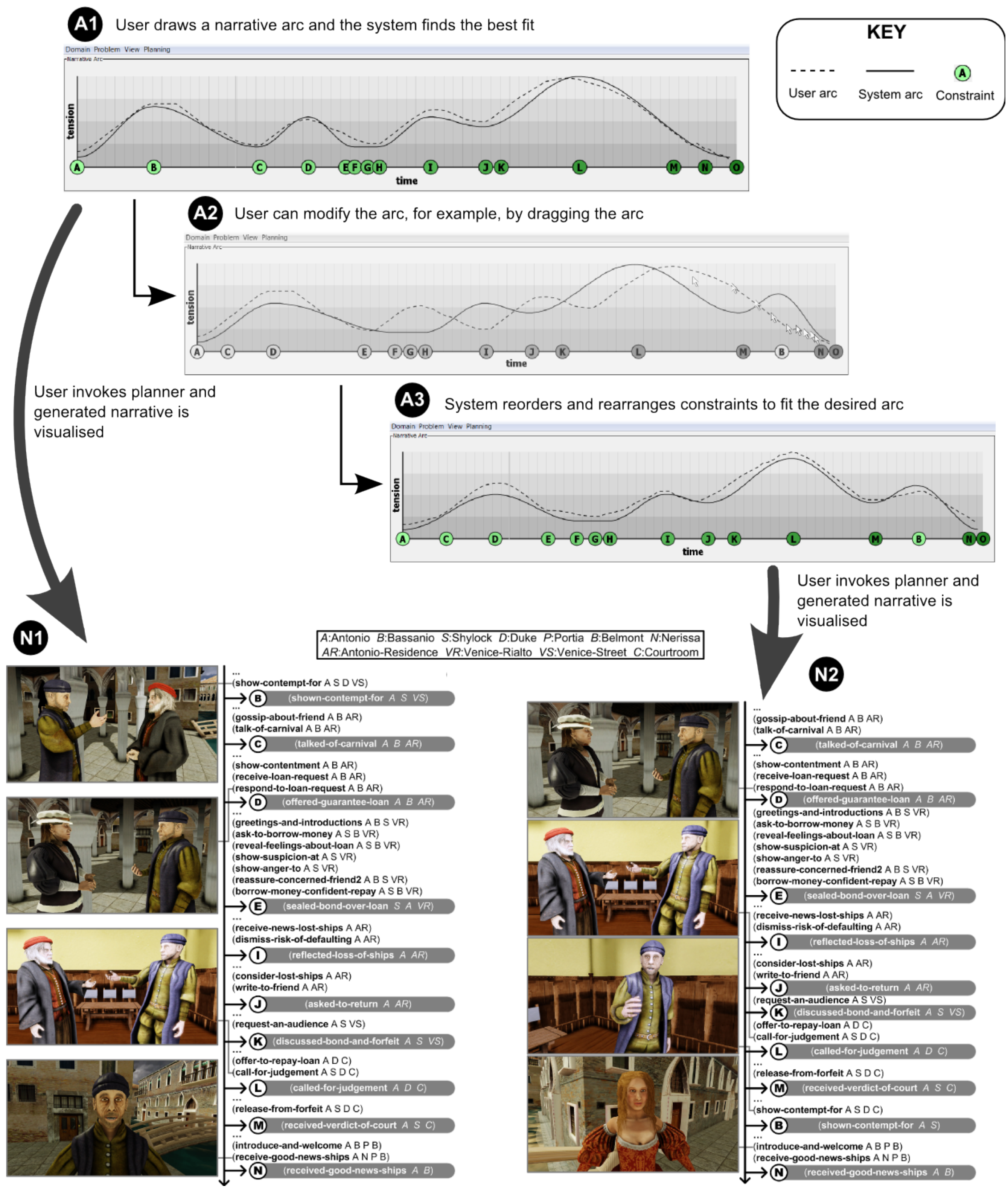

Figure 2: An overview of visual programming of plan dynamics. Screenshots A1, A2 and A3 show an interactive process where an initial user drawn narrative arc (A1) is modified by dragging different sections of the arc (A2) and where the system arc and position of constraints has been automatically adjusted to reflect the user changes (A3). N1 and N2 are representations of the narratives that have been generated in response to user invocation of the planner using the arcs in A1 and A3 respectively.

Demo: Sample User Session

The aim of the demo is to show how user specification of different shaped narrative arcs results in the generation of different narratives. In the demo we will also show these generated narratives visualised in a 3D world and demonstrate tools which support user evaluation of them. Here we illustrate highlights of this process via an example scenario.

A user will typically start by interacting with the visual programming system via the Narrative Arc Window. This enables them to draw and manipulate differently shaped narrative arcs. At any point the user can use this narrative arc to drive narrative generation and to explore the visualisation of this narrative in a 3D world. For the user this means that once a narrative arc has been created they can choose to invoke the narrative generator and the system will begin visualisation of the narrative in a visualisation window. Figure 2 gives an illustration of some important aspects of this process of user interaction with the system.

For instance, figure 2 includes a series of screen shots that show user interaction via the narrative arc (A1, A2 and A3). They show the constituent elements of the window that are presented to the user: the x-axis is the duration of the narrative; the y-axis is the level of narrative tension; and the labelled circles along the x-axis represent narrative constraints (when the user runs the mouse over one of the circles then the constraint name is displayed). Screenshot A1 shows a user drawn desired narrative arc along with an arc that has been generated by the system which is its best fit to the users arc (further detail of this matching process can be found in (Porteous et al. 2011)). Screenshot A2 shows the user in the process of manipulating their desired arc in order to specify different plan dynamics: the user is modifying the arc by dragging different segments of it. In response to the user modifications the system recalculates the best fit and redisplays the constraints and system arc, which results in the situation shown in screenshot A3. For the constraints along the x-axis, observe how both the relative spacing between them and the ordering of the constraints has changed. In particular, constraint B has moved from its position between constraints M and N, to between A and C.

Once a user has specified the shape of their desired narrative arc, they can then choose to generate a narrative that displays those global properties. As an illustration the narratives that have been generated using the arcs in screenshot A1 and A3 are represented in narratives N1 and N2 respectively. The shapes of the arcs in A1 and A3 are very different: for instance, the arc A1 follows an Aristotelian contour, with minor climaxes of increasing tension levels before the final climax of the play and subsequent denouement. This climax is the end of the "pound-of-flesh" sub-plot (Hinely 1980), where it appears all hope is lost for the titular merchant of the play, Antonio, having defaulted on a loan from Shylock, who is unwilling to show mercy and finally begs the court to deliver its judgement represented in our domain with constraint L (called-for-judgement antonio duke courtroom). Segments of the narrative generated from the arc A1, along with shots from its 3D visualisation, are shown in narrative N1. The constraints labelled M and B are interesting in this narrative because they show Antonio revealing his true feelings of contempt for Shylock only after Shylock has continued to demand his pound-of-flesh and failed to show mercy on Antonio. One consequence of these actions is that some justification is given for Antonio's demonstration of contempt for Shylock.

In contrast, arc A3 in figure 2 has a different shape with early and late climaxes with minor crises through the middle section. This user arc has resulted in a different arrangement of constraints and system arc (to that discussed already for arc A1) and the semantics of the resulting narrative (shown in N2) are very different since the constraint that relates to Antonio's bad treatment of Shylock, constraint B, now appears at the start of the narrative. This illustrates how different narrative arcs and the plan dynamics they specify can reveal different semantics. For the generated narrative N2, the semantics are very different to those of narrative N1 since Antonio's merciless treatment of Shylock early on has no justification and any later suffering by Antonio can be seen as deserved.

Our system also features a timeline window, as shown in the system architecture figure on page 3. In this window the segment of the narrative that is currently being visualised is displayed to the user. As the planner proceeds the timeline is updated in real-time. Users can use the timeline for narrative navigation, for example, to rewind and restart the visualisation from a different point in the narrative.

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References

Hinely, J. L. 1980. Bond Priorities in The Merchant of Venice. *Studies in English Literature, 1500-1900* 20(2):217–239.

Porteous, J.; Teutenberg, J.; Pizzi, D.; and Cavazza, M. 2011. Visual Programming of Plan Dynamics using Constraints and Landmarks. In *Proc. of the 21st Int. Conf. on Automated Planning and Scheduling (ICAPS 2011).*

Porteous, J.; Cavazza, M.; and Charles, F. 2010. Applying Planning to Interactive Storytelling: Narrative Control using State Constraints. *ACM Transactions on Intelligent Systems and Technology (ACM TIST)* 1(2):1–21.