Visualization of Constrainted-based Temporal Scenarios in a Multimedia Authoring Tool

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Abstract: Authoring a multimedia document is known to be a non-trivial task. The use of constraints technology is a good way to ease this task if constraints specification are associated to a powerful visual interface. We discuss in this paper the main requirements for the design of such an interface and we present our proposition experimented in Madeus a constraint-based authoring environment.

Key-words: authoring environment , multimedia document, temporal constraints visualization

(Résumé : tsvp)

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Visualisation de contraintes temporelles dans un environnement d'édition multimédia

Résumé : L'édition de documents multimédia est une tâche complexe. L'utilisation de contraintes temporelles pour la spécification du scénario temporel du document facilite cette phase de conception. Cependant, le besoin en une interface visuelle de haut-niveau permettant de mieux comprendre les dépendances entre contraintes est fortement ressenti. Nous étudions dans ce papier les fonctionnalités que doit offrir une telle interface. Nous présentons aussi une première solution expérimentée dans Madeus, un environnement d'édition de documents multimédia.

Mots-clé : environnement d'édition, documents multimédia, contraintes temporelles, visualisation

1 Introduction

Multimedia documents compose in time and space different types of elements like video, audio, still-picture, text, synthesized image, etc. Interactive multimedia documents aim at transforming the reader from passive : (he cannot interact with the document presentation) to an active one, for instance by using hyperlinks. As compared to classical documents, multimedia documents are characterized by their inherent temporal dimension. Basic media objects, like video, have intrinsic durations and they can be temporally organized by the author. This temporal organization is called the **temporal scenario** of the document : it defines a partial ordering that must be satisfied by document relevant events (mapping of a still picture, start of a video, end of an audio, ...).

Due to the intrinsic dynamics of a multimedia document, the famous static WYSIWYG paradigms, very helpful for the author when writting a classical documents, cannot be applied : it is not possible to specify a dynamic behavior and to see its result at the same time. Edition and presentation phases are not the same, so we must distinguish between the **specification** phase (or editing phase) of the temporal scenario and its **presentation** phase (or execution phase). An authoring system for multimedia documents must handle these two phases.

One of the challenging issues of the multimedia community is to provide an authoring environment easy to use even for the iliterate-computer people. It is not true today with available commercial systems (the leader is Director) which requires to be a real programmer.

We are convainced, like many others people(), that the use of temporal constraints, like the Allen operators (before, after, during, equal,...) is a way to reach the "easy-to-use" goal. It induces a declarative style (the author says what he wants to obtain but not how to get it by operationnal actions) easier to understand and to modify than script approaches. Using temporal constraints to specify the temporal scenario of a document is also an interesting approach as far as another major problem when designing multimedia documents is concerned : there is no garantee that a document, once written, can be played back on different platform according to the author's schedule and with guaranteed quality of service. The use of constraints in the scenario specification is a way to handle this problem (pact97). For all these reasons, we think that the new generation of authoring environments for multimedia documents will be based on the constraints paradigm.

However using temporal constraints does not solve all the problems as far as the requirement of a easy to use interface is concerned. Some non-trivial problems of ** behavioral understanding *** have been highlighted by our first experiments. The remainder of the paper is concerned with describing the needs of a powerful visual interface when handling temporal constraints and numerous problems that these needs raised. We also present our current proposition which is developped in a research project whose aimed is the design of powerful (high level of temporal expressivity) and easy to use authoring environment nammed Madeus.

The paper is organized in two sections. In the first one, we present the visual interface issues raise by specifying temporal scenario of multimedia documents with temporal

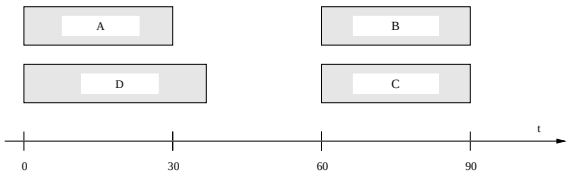

Figure 1:

constraints. In the second one, we present our current proposition and we give a brief description of the difficulties encountered to make it effective.

2 Visual interface issues

We begin this section by presenting how the temporal scenario of a multitmedia document can be defined by using temporal constraints. Although our presentation is "Madeus oriented" principles are the same in other constrained based environment (ISIS, HPAS, ...).

J.F Allen has defined 13 ways for two intervals to be organized in the temporal dimension. We use these operators as a way to specify the temporal scenario of a multimedia document. For instance, in the specification given in ... the author wants that Video1 and Texte1 start at the same time, Video1 must be presented during the same period of time that audio1 and so one. Moreover, suppose that each objects have an associated interval of possible duration. For instance, it is possible to play the video1 during 15 or 20 seconds, the text1 could be presented during 40 or 60 seconds, and so one. The meaning of this interval depends of the nature of the object. For controlable objects as text, still picture, ... it is an interval of choice whereas for uncontrolable objects as programs (applet) or video given in some particular format, it is an interval of possible values at run time.

From this specification the presentation system has to compute both the starting points of each object and durations of each controlable one in a way which satisfied all the constraints whatever the duration of uncontrolable objects are. Sometimes it is not possible and the presentation system has to detect an unconsistency. Most of the time a lot of solutions are possible and the system has to choose one solution. It is obvious that the textual specification does not give to the author a clear visualisation of the global behavior of its scenario. The document presentation is not very satisfying too : the author only sees one solution which is dynamically computes due to uncontrolable objects. As a consequence, the solution presented can be different at each run. Moreover, the presentation system does not give a global perception of this particular solution but only a sequence of instantaneous views.

We were very surprise to see that researchs in the area of visual interface for the specification of constraints (temporal, spatial, geometrical, ...) were very poor, although constraints are widely studies from the theoretical and practical point of views. The only interesting works we found where [Drawing with Constraints] since this is the only visual interface of a

constraint -based specification approach which do not provide the author with the classical and unsuable constraints graph. We give in figure ..., the constraint graph associated to the specification given in . This is obviously not a visual solution very helpful for the author.

The rest of the section is devoted to the presentation of the main issues in designing a visual interface of a specification tool of temporal scenario based on temporal constraints. It is neccesary to provide the author with

- **Links between the set of contraints and a particular solution** : to understand why this solution is possible and why another solution is not possible. For instance, the temporal placement given in figure ???(a) is not a possible solution of our example, although the one given in ??? (b) is possible. It is not obvious to understand the reasons why (a) is not possible.
- **Access to the whole set of solutions** : due to uncontrollable objects, showing only one solution is not satisfying since there is no particular relations between this solution and the one computed dynamically ? Covering the space of solutions, the author could detect something he have not expected (for instance that two audio speachs could overlaps)
- **Links between a particular solution and this one presented by the presentation system**. It is obvious that each solution have not the same interest from the author point of view. The visual interface should help him to express these kind of preferences and particularly it must help him to know exactly where he has some possiblities of actions. Indeed, due to uncontrolable objects some controlable objects becomes uncontrolable from the author point of view. Moreover the visual interface must help the author to recognize which solution has been dynamically computed.
- **Links between two steps of the editing process** : building a document is an incremental process. At each step the author add/remore objects or relations. The visual interface must help him to understand the modifications introduce by its actions. Morover, if an unconsistency is detected due to its modifications, it is important to help him to understand where this error comes from.

3 The Visual Interface of Madeus

Our proposition tries to give a satisfying answer to the two fist needs listed in the previous section. It is based on the following principles :

- Provide the user with a view of a temporal placement of objects consistent with the set of constraints with a graphical representations of each constraints. Figures ??? gives the view associated to our scenario example. Spring are used to represent flexibility introduces by constraints such before, during , ... Horizontal lines represent fixed delay and vertical lines link simultaneous instants. Moreover to help the author to

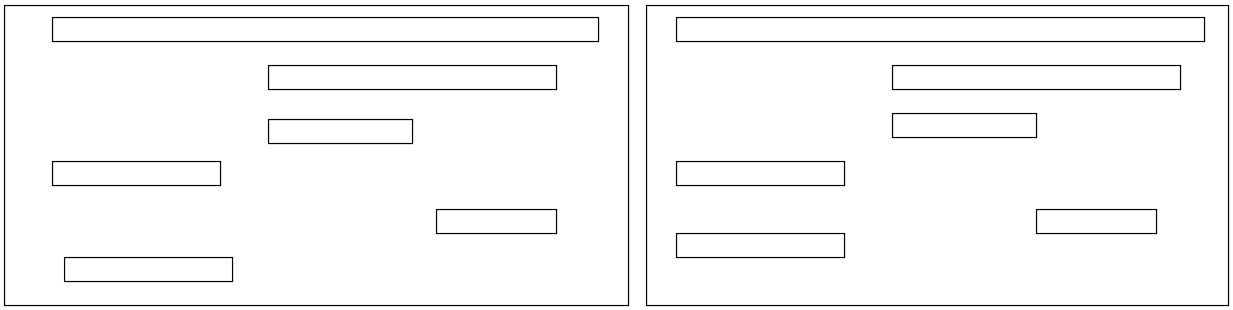

Figure 2:

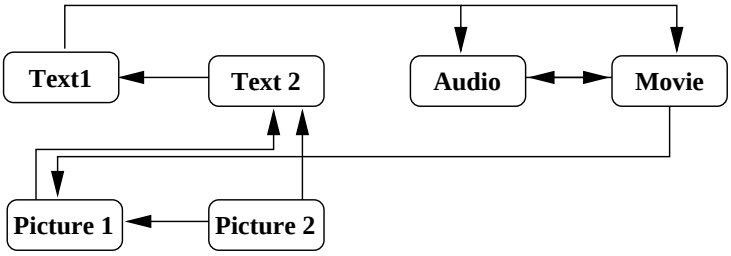

Figure 3:

understand why this solution is possible, the two views (textual and graphical) are linked : the author can select a constraint in the textual view, it makes the associated graphical elements highlighted in the graphical view. He can also select an object in the graphical view and see every constraints directly supported by the object highlighted in the textual view.

- Allow direct manipulation of objects (resizing or displacement along temporal axis) with real-time modifications of the other objects temporal position or duration. Only consistent manipulations are allowed (it is possible to reach another consistent solution). Moreover, in order to help the author to anticipate the allowed modifications and the way their disturb the other objects, each time an object (resp an object border) is selected in order to be moved it (resp. to be resized), appear the interval (in red)of possible object position (resp starting or ending times) and the set of other objects (in green) firmly attached to the selected object.

Our first experiments in order to prototype these ideas show us that finding an efficient technics to maintain the consistency of a set of constraints when the value of a variabe is modified is not so simple. Especially when the capability to control the "distance" between

Figure 4:

the last and the new solutions is a major objective in the context of the application. This is our case, since when the author modifies a solution by continuous deplacements he expects that the reactions of the other objects are also continuous. A lot of research teams work on this subject (). Some propositions (delta blue), namely local propagation approachs, have real-time performances but are not complete. Others (), namely global approachs, are complete but seems to be too slow to be used in our interactive context. Every one provide the user with some ways to control the selection of the new solution when several are possible.

We have developed an "ad'hoc" algorithmic to handle the dynamic behaviour of our view with only controlable and fixed duration objects. It is based on the topological particularities of our temporal set of constraints (represented by a Direct Acyclic Graph). We obtain with such algorithm good time performances but first we have to proove its completeness and second it not obvious to extend it in order to take into account flexible objects. This is why we decide to test another solution based on the adaptation of a global algorithm taking into account all the particularities of our application.

4 Conclusion

In this paper, we would like to aware the research community on intelligent visual interfaces of a challenging problem : visual interfaces which really ease the specification of temporal constraints. Such paradigm of specification are used for multimedia documents with great potential but also in other problematic of temporal planification as : task project, robotic mission and so one. However, it needs to be associated with powerful visual interface in order to be really easy to use by every-one. We listed in this paper the main requirements of what we consider that will be a powerful visula interface for such appliation. We also described the first proposition we made in the Madeus authoring environment which has to be largely developped in the future. This proposition seems to be convincing from the visual point of view but no so simple to make effective, since it raises non trivial algorithmics problems. Let us note in order to conclude that the problematic presented in this paper about the design of a powerful interface for temporal specification based on constraints is only a part of a whole problem : the design of a visual interface which takes into account each aspect of a multimedia document : hierarchic decomposition, spatial organisation, hyperlinks, ...

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