Ontology–based annotation of narrative segments

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Abstract. This paper illustrates the project CADMOS (Character-centred Annotation of Dramatic Media ObjectS).[1] The goal of CADMOS is to implement and evaluate the impact of the semantic annotation on the production process of narrative audiovisuals. The annotation is based on two computational ontologies of characters and story respectively.
The first step of the project will consist of devising a character-based annotation schema and annotating a reference corpus of dramatic media objects. Then, the project will test the utility of the annotation production through two pilot works, one original production and one production from archived footage. We will also develop a web-based software platform to annotate and access the archived objects.

Keywords: media annotation, narrative annotation, storytelling, ontology

1 Introduction

Storytelling is a pervasive activity across all cultures and ages. In western culture, storytelling has taken many different forms, from fairytales to tv fiction, surviving the transformations occurred to media. Esslin [9] speaks of "dramatic media" for those media that display characters performing live action, such as cinema and videogames. The importance of storytelling has been acknowledged by studies in all disciplinary fields, ranging from literary criticism [12] and semiotics [25], to aesthetics [6] and psychology [5].

Particular interest has raised the formalist Proppian model [25], that lends itself to straightforward translation into computational systems. For example, [16] have employed the Proppian model for automatic motif classification in stories; in the Opiate system [10], it is the basis for the generation of story worlds; more recently, the Amicus project[2] has employed it for automatic motif discovery in digitized fairy tales.

In story generation, the use of structuralist models like Propp's or Greimas [14], must be traded off against the constraints posed by interactivity, which is

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[2] http://amicus.uvt.nl/

not easily reconciled with the use of story templates. To cope with interactivity, digital storytelling has resorted to the paradigm of artificial characters, a line of research dating back to the pioneering work of Hayes-Roth on theatre improvisation [17]. Characters, in their computational version of BDI agents [4, 26, 7], are at the core of a number of storytelling systems [2, 21, 29, 1], where the story originates from the intentional behavior of the individual characters, possibly constrained by a drama manager, a specialized module that shapes the characters' interaction according to the author's direction [19, 29].

The CADMOS project aims at designing an annotation schema that accounts for the two–fold contribution of story and characters to narrative audiovisual segments. The first step of the project consists in devising a character-based annotation schema and annotating a reference corpus of dramatic media objects. Then, the project will test the utility of the annotation production through two pilot works, one original production and one production from archived footage. In order to assist the annotation process and to improve the correctness of the annotation, the project will develop a web-based software platform to annotate and access the archived objects. The annotation module relies on a computational ontology of story and character; the latter includes the description of processes and emotions.

In this paper, we first shortly survey the relevant literature on story in computational systems, then we describe the CADMOS project and illustrate the approach through an example.

2 The two axes of storytelling

According to literary studies [24], storytelling develops along two orthogonal axes, which characterize each story: characters and plot. A story contains a series of incidents, called plot, made of characters actions and, sometimes, unintentional, or naturally occurring, events. The plot can be recursively segmented into units, that in cinema usually form three layers, respectively called 'scenes', 'sequences' and 'acts' [18].

In drama, the medium through which the story is conveyed to the audience is given by the characters. A powerful instrument of identification [6], characters contribute to the emotional engagement of the audience, giving rise to what Coleridge termed the "suspension of disbelief". According to scriptwriting manuals (such as [20]), successful plots put characters' values at stake, emotionally engaging the audience through the struggle of the characters for restoring their values. Typically, plots are organized in such a way that incidents put at stake values of increasing importance, until a climax of characters struggling, after which conflicts tend towards a resolution. For example, in Ian Flemings 007 saga movies, the hero Bond must defeat an arch-villain who threatens the human kind; as he devises a clever plan to do neutralize his antagonist, the value at stake, initially limited to the "security of the country", becomes increasingly higher as an effect of the counter attacks of the antagonist, with a climax that invariably ends with the removal of the threaten. On the other hand, the mechanism of identification

[6] requires characters to exhibit a certain stability of behaviour. So, while the plot forces the character to react to the events by adapting her/his behaviour to the context, she/he must as well stick to her/his established long-term goals. For example, Bond may be distracted from saving the country by the temporary need to "save his own life", but then he immediately turns back to his long-term goal as soon as he feels safe again.

Beyond literary studies, a number of information processing and artificial intelligence approaches provide a theoretical background narrative annotation. In the field of computational storytelling, the need to model the characters behaviours has led to the exploitation of the paradigm of intelligent agents [3]. A well-known paradigm is the BDI framework, where an agent consists of Beliefs about the world, Desires (to be translated into goals to be achieved), and Intentions (i.e. action plans for achieving goals). This model has proven effective both for the encoding of character behavior (for example in strategic behavior, common in fictions and videogames) [21], and for the narrative analysis [11]. Recently, this behavior-oriented framework has been augmented with a model of emotions [23] and the moral values [8] to cope with more storytelling issues.

3 The CADMOS project

The typical workflow of linear storytelling productions relies upon the informal documents drawn up by the author, namely the "character bible" [28], which reports the characters' typical attitudes, personality and behaviours, and the "screenplay", organized into scenes. The production process yields the audiovisual assets corresponding to the scenes through a series of specialized phases (pre-visualization, shooting or computer graphics generation to post-production). Each phase is supported by specific software, but the lack of a formal annotation from the beginning introduces a semantic gap between the final audiovisual segments and their narrative content. An effort in this direction is represented by the EU-funded ANSWER project (http://www.answer-project.org/), which aims at defining a formal language for script and scene annotation and developing tools for automatically generating a pre-visualization based on the annotations.

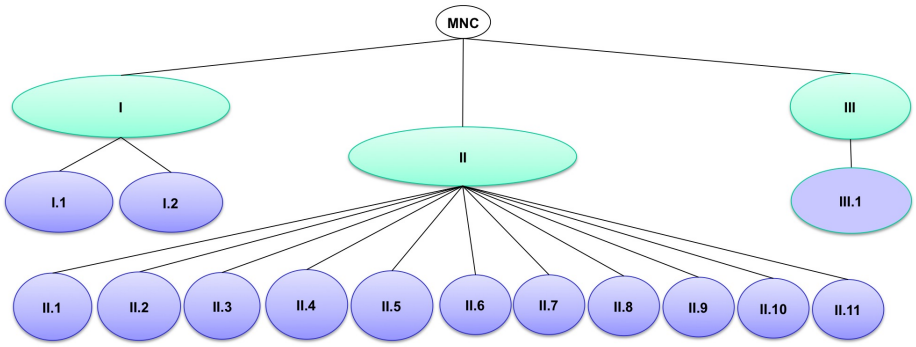
This semantic gap between the narrative work – as conceived of by the author – and the media objects that represent it hinders the achievement of some automation scenarios that would affect everyday situations for production companies. For example, in education or edutainment, it is common to resort to fictional material; for example, a history programme about the Roman empire usually includes segments from films or TV series that concern that era. Another scenario: every day, broadcast companies produce reels that illustrate the highlights of their programming by assembling selected segments; the search for such segments is effectively improved by a rich annotation that includes the characters they involve and the narrative role these segment cover in a story. The automatic editing of trailers and advertising material, then, will benefit from the narrative annotation of scenes.

The goal of the CADMOS project is to bridge the semantic gap between the creation of a media object and the role it plays in the story. The project will introduce a high-level, unifying schema for annotating a storytelling artefact. This formal language will rely on the central notion of character, described in terms of long-term goals and related behaviours. The annotation language will retrieve content terms from an ontology-based terminological base and the annotation process will be carried out through a web-based software platform. The resulting annotation will be validated by a story engine, which tests the consistency and coherence of characters goals and actions within the story advancement. The analysis perspective will be addressed through the development of a semi-automatic annotation process that will suggest the annotator an effective semantic labelling based on the narrative structure; the annotated corpus will be explored through an interface for the search of segments and proposal of re-use.

The production perspective will take advantage from the design and implementation of a novel workflow, derived by the current practices in new media (as surveyed by the NM2 EU-funded project, http://www.ist-nm2.org/), for carrying out annotation-enriched productions from scratch (producers of premium content), and the design and implementation of an interface for search and retrieval of annotated archive material for carrying out productions based on repertoires (content aggregators). The workflow and the interface will be applied to the production of two pilot projects, respectively. In the analysis perspective, the idea is to reconstruct the annotation of current archived stories with a semi-automatic method that individuates the possible relationships between the high-level story annotation and the low-level features of the media object (audio and video signals, speech recognition, etc.). This perspective is relevant for content aggregators, for the effective retrieval and re-use of narrative media objects, and heritage curators, for effective archival and categorization of significant opuses.

4 Story-based annotation of Media Objects

Media objects are assumed to be part of a sequence of segments that form a story, be it a linear artifact or, in non-linear storytelling, the output of an interactive session. Each object is a *narrative unit*, that contributes to the story advancement by bringing about changes in the story world and affecting the characters' state. The annotation schema of a narrative unit features three main components: *story structure*, that accounts for the role of the unit in the story; *character*, that represents the state of the characters participating in the unit; *world state*, that declares what are the pre-conditions that must hold in the world for the unit to be displayed (or for the character's actions to be executed) and what are the effects that hold after the unit is displayed (i.e. the effects of the characters' actions). In order to illustrate the three components, we resort to a Pixar animation short movie, "Mike's new car", based on the characters Mike and Sulley of the feature film "Monsters Inc.". In this short, set in the parallel monsters' world, Mike, an insecure monster who always tries ways to improve



I. Mike presents his new car to Sulley

I.1. Mike convinces Sulley to get on the car

I.2. Sulley explores the car, Mike checks the car

II. Mike tries to govern the car (but fails, at the end)

II.1. Mike starts engine
II.2. Mike can't fasten belt, Sulley succeeds
II.3 Mike can't get back into the car
II.4 Mike can't close the cover
II.5 Mike remains closed in the engine
II.6 Mike escapes the engine
II.7 Mike re-enters the car
II.8 Car rebels
II.9 Sulley destroys the mirror
II.10 Mike fights off Sulley from the car
II.11 Mike leaves with the car to destruction

III. M gives up his new car

III.1. Mike tells to go back to the old car

Fig. 1. The plot tree of the example story, Mike's new car.

his self–confidence, has bought a new car, and he is proud to present it to Sulley. Sulley, a successful self–confident character, assists Mike in his troubles in trying unsuccessfully to govern the rebel car. The sequence of occurring incidents is in Figure 1.

4.1 Proposal of an annotation schema

The first component of the annotation schema represents the plot tree. In Figure 1 we can see the plot tree of "Mike's new car". The plot is represented through the Gorn address notation and there are no restrictions on the number of tree levels and the number of units at each level. The example plot consists of three acts (I, II, III), subdivided in 14 scenes. Scenes are characterized by the unity of action, with specific goals characters try to achieve.

The second component of the annotation schema contains the description of characters (the characters' "bible" in scriptwriting terms). In order to limit the arbitrariness of the description, the template for annotating the characters relies on a well-established formal framework for intelligent agents, the BDI model cited above [3]. So, the annotation of characters accounts for the main components of this model, namely Beliefs, Desires (here, goals), and Intentions (here, the action plans a character is committed to for achieving her/his goals). In the annotation of a story, actions (and goals, as their originating, motivational source) have different levels of granularity across the plot tree. At the highest

- **Unit Id**: a string;
- **A set of characters**:
  - **Character**: a character instance. The instance of a character is characterized by its static properties (name, profession, age, appearance, scale of values, etc. as defined in the character ontology.)
  - **Character's goal**: the instance of an action in the ontology of action types. It represents the character's active goal (a goal of actional type).
  - **Goal achievement**: a boolean. It expresses whether the goal is achieved or not in the drama unit.
  - **Character's action**: an action instance (a high–level action, except for the elementary drama units). May correspond to the character's goal or be an instance of a lower level action than the goal (the displayed action is often a part a the overall action to which the character's actional goal refers).
  - **Values at stake**: a list of value instances. They represent the character's values at stake.
  - **Emotions**: a list of emotion instances, i.e., the character's current emotions in the drama unit.
- **Level**: the level of the unit in the plot hierarchy.
- **Children Drama Units**: a list of lower level drama unit instances.
- **Description**: a string containing the natural language description of the content of the drama unit.
- **Preconditions**: a set of ground formulae describing the world state when the drama unit begins (formally, a string).
- **Effects**: a set of ground formulae describing the world state when the drama unit ends.

Fig. 2. Proposal for a character–based annotation schema.

levels of the plot, characters' goals tend to persist, while low–level, immediate goals tend to be continuously modified in reaction to the plot incidents. Similarly, at the highest levels of the annotation, characters' actions can be described as complex actions, that incapsulate sequences of simpler actions at the lower levels – in the same way as the action "dating" includes "inviting somebody out", "reserving a table", etc.. In our example, in the first act Mike's goal is to introduce his new car to Mike and this goal is achieved along two scenes, with more specific goals: the first in which Mike invites Sulley to get on board and the second in which Sulley explores the car freely.

As pointed out in Section 2, emotional and moral aspects must be accommodated into a rationally-inspired model, in order to account for the dynamics of actual characters. So, the annotation of the characters also accounts for the evolution of their emotions and values at stake. Finally, characters' actions can be successful or not in reaching goals; depending on their outcome, and on the outcome of the others' characters' actions, characters may feel *emotions* such as hope, fear, or shame. Cognitive studies have pointed out the relation between intentions, i.e., action plans, and emotions [13]: according to the cognitive framework proposed by Ortony, Clore and Collins [22], emotions stem from the

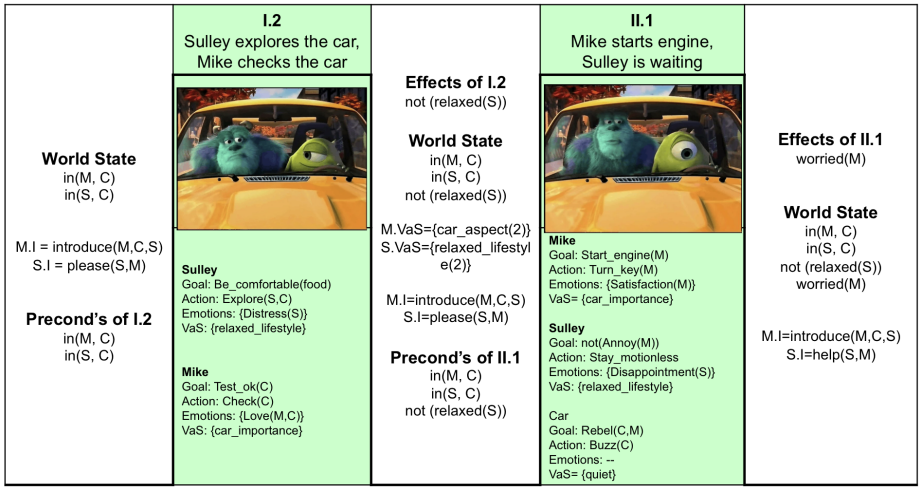


Fig. 3. An annotation excerpt from the example story. Notice that preconditions and effect of adjacent segments must match for story validation.

appraisal of one's and others' actions based on a combination of self-interest and moral evaluation

The third component of the annotation schema is given by the dynamics of the world state along the story. This component accounts for the narratologists' claim that plot incidents must be causally connected to each other as a very precondition for story construction [27]. In the annotation schema, this feature applies only to the elementary narrative units, i.e., where actual actions occur and actual preconditions and effects can be traced. Here, the annotator is required to detail out the actual changes brought by the characters' actions in each narrative unit, in order to track the causal connections among the individual story segments. The annotation of the state of the world before and after a certain unit also accounts for the audience's point of view, by recording their actual preconditions and effects as displayed in the narrative.

Figure 3 shows the dynamic change in the world state in going from scene I.2 to scene II.1 (according to the segmentation provided in Fig.1). Three characters, Mike (M), Sulley (S), and Car (C), are involved (given its intentional rebel behavior, the car is also a character). Before I.2 is played, both Mike and Sulley are *in* the Car; Mike's intention is to *introduce* the car to Sulley, while Sulley only tries to *please* Mike. These are valid preconditions for I.2. In I.2, the starter of the action is Sulley, who is *exploring* the car in the attempt to be more comfortable, while Mike is *testing* the car's functioning. Mike's value at stake is the "importance" of his car, questioned by Sulley's skepticism, while Sulley's value at stake is his "relaxed lifestyle". At the of I.2, Mike gets angry with Sulley and this makes Sulley not relaxed. Both characters *in* the car and Sulley

not relaxed are the preconditions of the scene II.1. In this scene, Mike *starts* the engine, Sulley *stays* motionless, and Car rebels to Mike by *buzzing*. Mike, who is satisfied because of engine started, becomes *worried*, and his new value at stake is his "self confidence". Mike changes his intention from introducing the car to Sulley to trying *governing* the car, while Sulley will try to *help* him.

In Figure 2 we recollect a possible annotation schema based on the characters' behavior. Notice that, while the annotation schema is intrinsically committed to formal models of story and character as described above, the same does not hold for the description of environment and the characters' actions: each story world is likely to require its own domain ontologies to describe how things and characters behave in it, and what type of values characters care for.

5 Conclusions

This paper has presented the project CADMOS, for the annotation of narrative audiovisuals. We have presented the motivations for this work as well as a proposal for the annotation. The project will also assess the impact of annotation on the production process. The approach proposed by the CADMOS projects specializes the canonical view of semantically annotated media production process [15] into the storytelling realm. According to the perspective of canonical processes in semantically annotated media production, the semantic annotation is the companion to the definition of a well determined and specified workflow for ensuring the communication among applications and assets in media production. Here, we propose to extend the semantic annotation to the narrative features of media assets, according to a theoretically-based and semi-automatic process of formal annotation. This annotation will enable the interoperability among the processes that create new narrative content and the content aggregators, with benefits for the reuse of existing assets and for the creation of new (and already annotated) ones.

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