Towards Virtual Actors - The Next Step for the Entertainment Industry

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Abstract

Autonomous Digital Actors (ADA) represent the next step for the entertainment industry in the sense that they are new kind of virtual characters endowed with self-animation capabilities delivered by artificial intelligence techniques. There are many substantial open questions related to the development of virtual actors. This article introduces the subject ‘virtual actors’ and describes an experimental authoring tool, called CREACTOR. We are developing this tool for studying which AI techniques can be used to design and implement behaviors of ADAs.

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1 Introduction

In [Perlin and Seidman 2008], the authors foresee that “3D animation and gaming industry will soon be shifting to a new way to create and animate 3D characters, and that rather than being required to animate a character separately for each motion sequence, animators will be able to interact with software authoring tools that will let them train an Autonomous Digital Actor (ADA) how to employ various styles of movement, body language, techniques for conveying specific emotions, best acting choices, and other general performance skills.”

Our ongoing research aims at developing virtual actors. Virtual actors are a kind of believable characters [Reilly 1996]. A virtual actor is an analogy to a real actor, which autonomously, and by its independent interpretation of the situation, can perform its role according to a given script, as part of a story [Iurgel and Marcos 2007; Iurgel 2008].

Virtual actors must exhibit a behavior similar to real actors, which means, they must be able to play roles specified according to guidelines; but also they must be able to use their own previous experiences, adapting their performance to new contexts. Besides that, they should also be capable of understanding abstract commands from a director/animator who could inform them about desired behaviors in a particular situation.

The ability of characters to improvise and get guidelines from a director represents a new approach on authoring characters for the production of 3D-movies. Through this new approach, it should be possible to speed up the process of creation of animation films populated with synthetic characters, because those characters are able to decide about most of the acting performance by themselves, reducing the time and effort needed for animation.

We are developing an authoring framework, called CREACTOR (see figure 1), that is an experimentation platform for exploring different solutions and processes. The actors are implemented as talking heads. CREACTOR focuses on providing a broad number of features and modules that are at first implemented in a shallow way. Future steps shall then identify the most important dependencies and possible enhanced solutions on the level of the modules.

The expectation is that this kind of tool will simplify the authoring process in such a way that unskilled animators will be able to create 3D animations with a higher quality than current animation tools allow.

2 Virtual Actors

A real actor is someone capable of expressing dramatic actions (theatrical skills) based on a script. A virtual actor is a believable character capable of understanding its role from an annotated script and, by interpreting the situation, to propose an appropriate behavior (acting performance) for it. This performance could then be corrected/improved by the animator.

Next sections aim at explaining our actors/humans metaphor, how acting students learn how to act (this process had inspired us to propose our method for creating virtual actors), and then how to implement virtual actors.

2.1 (Virtual) Actors vs. (Virtual) Humans

An actor has abilities that a normal person does not have, for instance, an actor can play a role.

Virtual humans are, according to Thalmann & Thalmann [Thal-
mann and Thalmann 1993], “a visualization of the simulation of the behavior of realistic human beings”. So, in other words, virtual humans try to replicate as accurate as possible real persons. There are three levels of modeling concerning the development of virtual humans [Thalmann and Thalmann 2005]: (1) realistic appearance modeling, (2) realistic, smooth and flexible motion modeling and (3) realistic high-level behaviors modeling.

Virtual actors, on the other hand, are a different (simpler) approach towards the creation of embodied autonomous characters capable of performing specific roles in a story. They are, for that matter, a specialization of virtual humans. A virtual actor should be capable of:

- performing a given role based on a knowledge base that describes it (e.g. playing a surgeon);
- understanding a script that contains all the utterance and actions that must be played during a scene of a film (e.g. performing a brain surgery);
- interpreting the context of a scene being played and, by doing so, deciding (suggesting) the most appropriate behavior to perform (e.g. displaying an anxious face due to complications during the procedure);
- getting suggestions (from the director) that could modify/improve its behavior during the performance (e.g. playing the scene as a bad temper doctor).

2.2 Acting Schools

There are basically two different acting schools [Roberts 2007]:

Method Acting: it is a method proposed by Konstantin Stanislavsky that states that to develop a role, an actor should “use his or her own emotional experience and memory in preparing to live a role”. This approach develop roles from the inside out and means to decide 'what are the characters' motivations for the scene?'.

Theatrical Acting: as opposite to method acting, this approach claims that developing a role requires learning a series of positions and facial expressions inferred from the script. This approach relies on an answer to the question ‘what are the appropriate behaviors for this scene?’.

Method acting seems to point to a more 'accurate' acting performance since the actor spontaneously reflects his/her body postures, facial expressions and voice intonation according to the emotions being felt. As a consequence new situations should not mean having to learn new behaviors.

In theatrical acting, an actor must know everything about the role being played in order to be able to act believably. That means that new situations require new information about appropriate responses.

2.3 Virtual Actors Requirements

Loyall [Loyall 1997] proposes a set of requirements in order to achieve believable characters, that certainly should also be applied to virtual actors. The actual set of requirements needed for the creation of a virtual actor will depend on the acting approach adopted. This is the list of requirement of Loyall:

- From the artistic point of view:
  - Personality: Loyall cites Thomas and Johnston (two important Disney animators), who said that being able to represent different actions for different characters in the same situation is one of the most important aspects of promoting the illusion of life.
  - Emotions: every character should express (and maybe has) emotions based on its own personality.
  - Self-motivation: the character should act as if it comprehends what and why it is doing.

Change: To be believable, a character should grow with time or life experiences. However, this growth should be related to the character’s personality and to the story.

Social relationships: characters must comprehend how to interact with other characters and treat each one differently.

Consistency of expression: To promote believable actions, all communication channels (facial expressions, body posture, etc.) should be simultaneously connected to each other to produce a coherent result.

- From the autonomous agents' point of view:
  - Appearance of goals: every agent should have goals (purposes) that will motivate its actions and decisions.
  - Concurrent pursuit of goals and parallel actions: every living creature is able to perform several different actions simultaneously.
  - Reactive and responsive: every time an agent perceives an event it should react to it. Reactive behavior is natural and quite common today in classical digital entertainment applications. However, it is not enough. An agent should respond to events based on some sort of cognitive consideration.
  - Situated: agents should be prepared to change what and how they are doing in response to the unfolding of situations.
  - Resource bounded (body and mind): every person has physical and mental limits.
  - Existence in a social context: a character should know and respect social conventions, laws, rules, cultures, etc. of the world it is immersed into.
  - Broadly capable: characters should be flexible enough to support a significantly large set of actions.
  - Well integrated: its actions should be performed in a smooth, realistic manner.

3 Preliminary Results

The project is devising an authoring framework for interactive, adaptable, situation aware, partly autonomous virtual actors (cf. also [Jurgel and Marcos 2007]). The animator/director shall direct virtual actors by providing them with the text to speak, explaining the dramatic situation (using concepts of an ontology and GUIs for this); the actors will try to infer the appropriate expressions, animations, and the timing (our work is related to [Perlin 2003] and [Mateas and Stern 2003], though Perlin focuses on scripting methods and Mateas on maintaining a plot structure). CREATOR, the authoring framework, is an experimentation platform for exploring different solutions and processes. It focuses on providing a broad number of features and modules that are at first implemented in a shallow way. Future steps shall then identify the most important dependencies and possible enhanced solutions on the level of the modules.

The authoring process is a cycle in which three professionals are involved (refer to figure 2):

Script Writer: is the person responsible for writing the script. It is a limitation of this work that it only considers conversational behavior.

Acting Teacher: is the person responsible for creating all characters’ acting skills, in other words, creating the knowledge that allows virtual actors to know how to behave in any given situation during the performance, for a specific domain.

Animator/director: is the person responsible for adjusting the actors’ performance according to the desired outcome.

All professionals could/should interact with each other, making this process iterative (as represented by the dotted lines). The goal is
that the number of cycles should be small enough that to justify its use in place of the ‘traditional process’.

3.1 Step #1: Script Annotation

First, script writer writes a script of the scene, as a series of speech sentences, represented in figure 2 by the tuple \( \text{speech}_{1}, \ldots, \text{speech}_{N} \). These sentences should then be performed by the actors during step #3. However, to be able to accomplish that, they should be capable of analyzing and understanding the meaning of each sentence. Specifically regarding analyzing sentences, the system will try to infer an adequate annotation (semantic/pragmatic) for each sentence. It is not an easy task, and we are approaching the problem through very simple heuristics. We were inspired by the A.L.I.C.E. bot\(^1\), and its Artificial Intelligence Markup Language (AIML).

We employ a simplified markup language that tries to match keywords to sentences. The AIML tags were renamed as follows:

- config: enclose an entire document
- annotation: marks an unity of annotation, i.e., one possible type of action performable by the character.
- keyword: a sentence (keywords) that, if matched, indicates that this annotation should be used

The following incomplete code exemplifies the annotation language in use. Each keyword is evaluated considering a non case-sensitive criteria using whole words only; however, it is possible to use the wildcard “*” within each keyword to overcome this issue.

```xml
<config>
  <annotation name="admire">
    <keyword>!"</keyword>
    <keyword>wow</keyword>
    <keyword>amazing</keyword>
    <keyword>incredible</keyword>
    <keyword>awesome</keyword>
    <keyword>cool</keyword>
  </annotation>
  ...
</config>
```

Each speech sentence will enclose an ‘annotation DNA’, that represents how often the sentence is related to each possible annotation, creating a semantic map of the given annotation. For example, let us say that the sentence ‘Hey Mickey’ matched the annotations greeting and complaint and no other. The system will then understand that this sentence means one of these two meanings and has to decide for one of them.

In our case, what is being used for choosing between possible meanings is a weighted random choice. This means that the system will choose randomly but will take the amount of times the sentence were tagged with a particular annotation as a weight to increase the chances of choosing it. So, if a sentence is tagged twice as greeting and just once as complaint, there are 2/3 odds that the system will consider it as a greeting.

Another way of (theoretically) increasing the confidence in the computer’s choice is to associate a degree of confidence for each pair <annotation, keyword>. This degree would represent how sure we are that the keyword relates to the annotation. So, this degree could then be used instead of the occurrences counter approach described before.

3.2 Step #2: ADA Specification

This step is responsible for defining ‘how’ it should do it. In other words, how a character behaves when it (for example) is insulting or mocking another character.

It is important to notice that the set of rules that compose the repertoire of behaviors that a character has, is what enables it to play a role in a given story.

So, these rules must be designed in such a way that they should be modulated by the character’s individuality (personality traits and inner emotional state).

3.3 Step #3: Directing the Performances

CREACTOR shall enable the author to define the performance at various levels of abstraction. These definitions range from abstract commands from a director to specific changes at the level of the body of the virtual actors. The authoring process shall be iterative, because of the necessity of constant visual feedback of the creative work; assisted, because of the manifold alternative steps that the author can take at every moment; and, in a later step, dialogic, in the sense that the system shall be able to urge the author to provide additional information about his/her intentions, in order to enable the system to complete underspecified animations autonomously.

As an example of our current work, we present here the concept of “AI-tweening”, that serves also to illustrate the intended authoring process: CREACTOR assists the author by indicating that the user first needs to define the main plot points, and then to specify the desired behavior of the virtual actors for these plot-points. The system then produces an estimation, based on AI-knowledge, of intermediate behaviors. This is the process of “AI-tweening”. For instance, between an angry and a calm behavior, the system inserts a “cool down”-transition. The autonomous generation of “AI-tweens” serves as basis for the author to further enhance the animation. In a future step, the system shall be able to actively gather additional required information, asking for instance whether there is a turning point that causes the anger to disappear, or whether it is a gradual fading away.

3.3.1 Coherence Analyzers

There are two types of analysis under AI supervision: vertical coherence means that an author should maintain coherence between high and low level commands, after changes of a single command...
Horizontal coherence means that the transitions between behaviors (over time) will "make sense" based on a specific set of rules that denote how a virtual actor should behave.

As an example, let us consider that the user changes a command from happy to sad. Hence, the character’s face will autonomously correct its setup, and possibly the autonomous interpretation of the situation, to match the new input.

Horizontal coherence works similarly on character’s behaviors over time. Thus, from a plot that expresses anger at the beginning of the film to another one that expresses calmness at the end, the system will insert plots that would represent a “cool-down” transition. Analogously to vertical coherence, any changes would cause autonomous adjustments in between the plots.

4 Conclusions

The entertainment industry constantly evolves aiming at creating more appealing believable characters. Autonomous digital actors (ADA), that according to [Perlin and Seidman 2008; Iurgel and Marcos 2007], represent a new way to create and animate 3D characters, should be capable of interacting with animators and displaying behaviors that will significantly simplify the authoring process of character-based animations.

This article has presented an overview regarding these autonomous digital actors (here called simply virtual actors). It is defined virtual actors, explained the metaphor recurring to real actors/humans, listed the major requirements (according to the literature).

Finally, an ongoing research on the design and implementation of virtual actors was sketched, and we have discussed an authoring process that consists of three steps. A preliminary tool called CREACTOR was implemented. It aims at serving as exploratory environment for testing hypothesis raised during the research. However, at this point, the system only considers manually annotated scripts and rule-based AI-tweening. The current AI-tweening allows only for limited behavior suggestions.

The next steps include the implementation of the autonomous textmining-based annotation module and the knowledge database and reasoning rules.

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References


