D.R.A.M.A. - Developing Rational Agents to Mimic Actors

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Abstract

Autonomous Digital Actors are believable characters endowed with dramatic acting skills that could represent an advance regarding the authoring process of character-based animations. This article presents an architecture that covers all main requirements towards the design and development of an Autonomous Digital Actor. Although it has not been fully implemented yet, a theoretical example is presented to demonstrate its usage. It is expected that such authoring tool could facilitate the task of authoring character animations, by simplifying the knowledge and skills demanded to produce an animation, thus reducing costs and effort spent on this.

Keywords:: Computer Animation, Authoring Process, Autonomous Digital Actors, Storytelling

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1 Introduction

Authoring computer-based characters for animations means to describe the actions that characters are supposed to perform while enacting their roles in a story. This is accomplished relying on specialized hardware and software tools designed to support the development of such animations, the faster and easier manner possible (which often usually means cheaper). Modern animation productions although, have become highly demanding in terms of quality and complexity, what led to increase production's effort and costs. Thus, newer authoring approaches are been researched in order to facilitate this task.

Autonomous believable characters present themselves as a promising alternative. An autonomous character is an Artificial Intelligence-based self-animated character endowed with the ability of sensing the situation it is involved, responding appropriately, without (or at least with minimal) human interference. Based on this new technology, several novel authoring approaches have been proposed. We are interested in studying one of such possibilities: computer-generated actors.

First, it is important to establish a difference between the notion of computer-based characters and computer-generated actors: computer-based characters are digital renditions of human acting performances; they can only reproduce, in the virtual world, actions taken by someone else (an actor or animator) in the real world. Computer-generated actors, on the other hand, are computer programs especially designed to emulate very specific aspects of human intelligence to produce self-animated characters capable of autonomously performing their roles in a script.

The process for the creation of computer-generated actors (also known as autonomous digital actors or simply ADA [Perlin and Seidman 2008]) remains an open question. This paper investigates some elements that could lead to the development of the first fully autonomous digital actor. To do that, first we study the (human) art of acting, trying to infer possible requirements applicable for ADA. Then, is it studied current digital actors technology and its limitations. Following, we make a series of considerations regarding important aspects that should be considered while developing an Autonomous Digital Actor authoring system. Finally, we present and discuss a suggestion of an agent architecture for the creation of an ADA, including some experimentations with it, as well as the conclusions drawn from these studies.

2 Actors, Digital Actors and Autonomous Digital Actors

It is our understanding that performative arts are constantly reinventing itself. It all has started with the first acting performance (from ancient Greece), later, with the advent of computer graphics technology, a whole new kind of actors can now be represented digitally as especial renditions, allowing performances before considered difficult or even impossible. The next step, is to endow digital actors with the ability of 'thinking' autonomously, allowing them to deliver autonomous performances out of stories. Next sections briefly discuss this evolution of the acting performances techniques.

2.1 Actors

According to an ancient Greek legend, a man named Thespis created acting when he decided to step out of a chorus of performers and utter a series of solo lines. Before Thespis, the world had never seen a character performance before, only groups of performers singing in unison. He presented a tale from the perspective of the character instead of a third person's point of view, changing forever theater and the dramatic arts. To these days, actors are still referred as *thespians*.

"Acting is defined as the art or practice of representing a character on a stage or before cameras and derives from the Latin word *agere*, meaning *to do*"[Kundert-Gibbs and Kundert-Gibbs 2009].

In conclusion, actors are individuals specially trained to deliver enactment performances out of stories. They practice how to mimic human behavior in order to impersonate characters. There are two important lessons that any apprentice actor must learn:

- **Performance Skills**: how to use his/her body (arms, legs, face, voice, etc.) for better telling a story. There are several acting schools that suggest their own list of skills;
- **Script Analysis**: apart from studying performance, an apprentice needs to learn how to study his/her role by learning what kind of information is important to learn from the script.

2.1.1 The Art of Acting

To allow one to understand how actors learn their practice, it is necessary to look at how acting schools teach acting. Although there are many acting schools, from which one can learn the art of acting, the two most prominent ones follow the teachings of Stanislavski and Strasberg, as presented next.

Constantin Stanislavski: a Russian actor and director, was a legendary acting teacher whose lessons are still today being followed by acting students worldwide. He developed a method for acting considering the following statements [Stanislavski 1937; Stanislavski 1950]:

- **Imagination and Emotions**: imagination is a powerful source of emotions. A performance without emotions makes it look artificial;
- **Concentration and Relaxation**: an actor should focus his/her attention exclusively on the performance and, an actor should learn how to relax his/her muscles to foster believable movements while performing;
- **Objectives, obstacles and actions**: a performance can be explained as objectives (what motivates characters to act?), obstacles (what stops him/her from getting his/her objectives done?) and actions (what does the character

to achieve his/her goals?). Stanislavski points out to be careful not to try to detail too much the performance. Only the most central elements should be described (the general idea);

- **Emotion Memory**: an actor should remember his/her own previous experiences and the emotions involved in those (not trying to mimic others), which should allow him to retrieve specific behaviors, if needed;

- **Sense of Truth**: truth on stage is anything that the audience can rely on, which is not the same as to replicate the real world. An actor should start deciding how to perform 'from the inside' (role character's point of view) and avoid, by all means, overacting (adding too much acting details);

- **Adaptation**: being able to adjust actor's performance regarding changes of other actors or the surrounding environment;

- **Unbroken Line**: is a line of action that relates all moments throughout the entire play.

Lee Strasberg: a former student of Stanislavski, and co-founder of Actor's Studio (one of the most prestigious American acting schools), developed "The Method", which is (according to Strasberg himself) a continuation of Stanislavski method. 'The Method' relies on the following fundaments:

- **Relaxation and Concentration**: following Stanislavski, Strasberg also stresses the importance of preparation before acting, including being relaxed and focused, for believability;

- **Sense Memory**: an actor should remember objects and sensory experiences, like, for instance, how was the sensation when drinking a cup of coffee (considering all five senses);

- **Emotion Memory**: unlike sense memory, emotion memory recalls emotional experiences from actor's past, instead of trying to force emotional reactions;

- **Characterization**: an actor should know how to create a character, both physically and psychologically, using the sense and emotion memory for that;

- **Character's Drives**: when preparing for a role, method actors should fully understand their characters in order to perform them believably. Therefore, they are guided to 'answer' questions like "who is the character"? "What does he want"? "Why does he want it"? "How is he planning to achieve his/her goals"?

2.2 Digital Actors

For centuries, the only way for enacting stories was through live acting performances (performed by actors). It was only in the 20^{th} century, with the advent of synthetic characters that this hegemony has started to fade. Synthetic characters are handmade animated characters that exist only in the story world (they do not have a physical representation in real world). The first synthetic character ("Gertie – The Dinossaur") dates from 1914 (see Figure 1 on the left). Later on, with the advent of computers, this technology has evolved, not in terms of concept, but in terms of form, into digital actors.

Digital actors can be found in the literature, been referred by several different terms like synthespians (as in synthetic thespians), virtual humans or believable characters, all relating to similar definitions: a computer-based virtual character capable of delivering acting performances in digital space. Digital actors are renditions of real actors' performances (designed with the assistance of dedicated software or captured by special devices) transported to animated characters, so they seem to behave just like us (human beings).

In 1984, the world watched the first fully computer-generated short film: John Lasseter's "*The Adventures of André & Wally B.*" (Figure 1 on the center). Back then, all characters were all manually animated relying of special authoring software. Lately, in 2001, the first photorealistic character (Dr. Aki Ross from the movie "*Final Fantasy: The Spirits Within*" by Hironobu Sakaguchi has emerged (Figure 1 on the right). It was the first time that a character has been designed to appear in multiple movies as different roles.

Figure 1: *(left) First animated character (center) First fully computer-generated character (right) First photorealistic reusable character*

Nowadays, technology has evolved to the point that it allows compositions of human actors performances with digital actors ones. There are several examples of digital actors interacting with humans in the movies industry: "Jar Jar Binks" in Star Wars, "Dolby" in Harry Potter, "Smeagol" in Lord of the Rings, and many others. In all these cases, the process to produce such apparent interaction, follows the same steps: first, all individual performances are recorded separately (including the actors playing the performances for the digital characters), and then they are all combined into a realistic performance using sophisticated authoring softwares. One key aspect in this process relates to how to create digital performances suitable for the later composition. Next section discusses this process.

2.2.1 The Art of Digital Acting

The technology used to develop digital actors is becoming very sophisticated and keeps in constant evolution, to the point that, nowadays, it is possible to produce simulations nearly indistinguishable from real humans performances. According to Thalmann & Thalmann [Thalmann and Daniel Thalmann 2005] there are three levels to consider when modeling a virtual human, each one representing a challenge for engineers of each field:

1. **Appearance Modeling:** the visual representation of the actor's body should be as close as possible to real humans. This means to study novel techniques regarding computer graphics and geometric modeling, in order to model aspects like skin, hair, eyes, clothes and others (see Figure 2).

Figure 2: *(left) Synthespian Project (center) Kaya Project (right) Hair simulation*

2. **Realistic, Smooth and Flexible Motion:** ideally, digital actors should be able to move indistinguishably from humans. Traditionally, computer animators have solved this problem with *motion capture*. Motion capture is a technique that uses special devices capable of recording tridimensional human performances, and transport these informations to animated figures, so they can perfectly mimic the performances. Figure 3 illustrates the actor Tom Hanks wearing a motion capture suit during a recording session, for the production of the movie "Polar Express" by Robert Zemeckis, and also the final animated character mimicking his performance.

3. **Realistic High-Level Behavior:** digital actors must be able to convincingly mimic human behavior (e.g., decision making, emotions, problem solving and improvisation). This, possibly, is the most challenging goal to endow in a computer-

Figure 3: *Motion capture session vs. the final product*

generated being. Digital actors work as digital puppets, meaning that they have no intelligence skills and are unable to decide proper acting performances for themselves during a scene or movie. It is up to the animators to make these decisions for them, on each and every action, via authoring systems.

2.3 Autonomous Digital Actors

It is important to notice that, despite all breath taking performances these virtual actors can deliver, they are in fact, an illusion, because virtual actors cannot decide for themselves how to perform. They lack *agency*.

Agency means that an artificial character would have the ability of making its own decisions without (or at least with minimal) human intervention. Digital actors endowed with some level of agency are called autonomous characters. Computer game industry has the leadership in using such technology. In games, non-player characters (NPC) are autonomous characters capable of performing specific tasks within game environment. They are common ground for decades now, and have become very sophisticated in terms of emulating complex behaviors. Players interact with them as if they were any other player. Animation industry, on the other hand, currently relies mostly on autonomous characters as digital extras, that are background characters with no direct relevance for the story being told, like soldiers in the armies of the battle scenes in Peter Jackson's The Lord of the Rings trilogy.

Iurgel & Marcos [Iurgel and Marcos 2007] have suggested the term 'virtual actor' as "*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*".

Later, Perlin & Seidman [Perlin and Seidman 2008] have foreseen 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*".

2.3.1 The Art of Autonomous Digital Acting

In this article, the terms virtual actors and autonomous digital actors have been used indistinguishably. Other than that, we focused the research mainly on "talking heads", that are characters capable only of expressing action through their heads (facial expressions, gaze, head movements and blinking, along with speech and lip sync). Peter Plantec [Plantec 2004] presents a list of seven essential concepts in face acting:

1. **The face expresses thoughts beneath:** character's emotional display are dictated by its own inner emotional states. Autonomous digital actors should have a way to convincingly emulate human cognition to infer appropriate emotions in every dramatic situation.

2. **Acting is reacting:** every facial expression is a reaction to something, which means that after sensing the environment (inferring current dramatic situation), an emotional reaction is determined. Ortony et al [Ortony et al. 1988] argue that this 'something' that one should react to, are, in fact, the perception of events, objects in the environment and other agent's actions.

3. **Know your character's objectives:** knowing character's goals leads to determining appropriate (plausible) reactions it can take on every situation. Without that, choosing an action might be let on chance, which is not believable nor appealing to the audience.

4. **Your character moves continuously from action to action:** in order to maintain the illusion of life and the illusion of self-consciousness, an actor should always be performing an action, even if she is simply waiting for something to happen. People are never still. They may be producing only very subtle movements like shifting their gaze or blinking, but they will never be completely frozen. In character animation, to achieve this, according to Disney's 12 principles of animation [Thomas and Johnston 1981], a character should/could exaggerate such movements without the concern of losing believability.

5. **All action begins with movement:** as established before, people can not be at perfect still. This remains valid even when one is only performing mental actions like calculating or imagining. Everything should reflect in the character's body. The audience should always be able to infer that something is going on in the character's mind by their attitude.

6. **Empathy is audience glue:** empathy represents how the audience relates with the character. If made properly, it is possible to drive the audience to nurture feelings toward a virtual character.

7. **Interaction requires negotiation:** being able to display compelling emotional reactions is the most important element that an autonomous character should present. By failing in displaying emotional reactions properly (with their body, voice and decisions), the interaction with humans are doomed to boredom and disinterest.

2.3.2 Requirements for Autonomous Digital Actors

Considering all previous studies (regarding actors and digital actors), we propose a list of requirements that any agent should be able to perform in order to act as an autonomous digital actor [Silva et al. 2010]:

1. **Autonomous Script Interpretation:** is the ability of extracting informations regarding what is expected to perform via interpreting the script. This can be divided into two moments: first, the actor reads the script to learn his dialog lines and actions from scene descriptions; second, relying on script interpretations techniques he constructs his character by combining these interpretations with previously trained acting knowledge;

2. **Acting Knowledge:** to expressively perform any role, actors need knowledge. They need to understand what it means to act like some specific character, or what it means to experience some particular situation. For instance, acting techniques like emotion and sense memories could be used to represent acting knowledge;

3. **Dramatic Performances:** Analogously to human actors, autonomous digital actors need to be able to act expressively. Character animation techniques are used to emulate these skills, like facial expressions, body postures and voice intonation.

3 Project D.R.A.M.A.

Project D.R.A.M.A. (Developing Rational Agents to Mimic Actors) has as its main goal, creating an autonomous digital actor capable of delivering acting performances relying on acting techniques inspired on real actors' practice. Current version of the system considers the following steps (Figure 4):

1. First, a script describing the scene to be played, the set, the characters (including their personality traits) and the plot is written by a script writer (possibly the animator itself);
2. Then, the script is submitted to a series of ADA (known as the 'cast') that should interpret it, making individual acting performances suggestions for each script unit, relying on previously trained acting knowledge for that;
3. The third step is the rehearsal. It is when all individual acting performances are combined to produce a suggested timeline for the plot;
4. Finally, the fourth step is to translate the resulting timeline into animation commands for an animation engine of choice, thus, producing a animation film.
5. Eventually, the animator can send criticisms back to the cast, indicating parts of the timeline that are not according to his/her expectations. Agents can learn from these feedbacks, making their suggestions more accurate in the future (current version will only consider reinforcement learning, thus, criticism are of the form like/dislike).

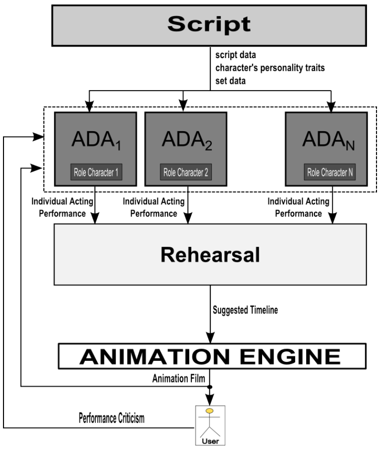

Figure 4: *General View of Project D.R.A.M.A.*

Regarding the construction of the agents, a detailed architecture has been proposed (refer to Figure 7 at the end of this paper) and it is currently been implemented as a proof of concept. Next sections explain, in detail, each of it's components.

3.1 Script

The script is a structure that describes the following elements: the plot, the script analysis and the set.

Plot: contains all the descriptions regarding the actions to be taken by the cast while enacting the scene. It is subdivided into *script units*. A script unit represents any elementary enactment a character can take to perform, like speak, laugh, run, fall, throw something, and so on. They are represented by a tuple of the form (TYPE, ACTOR, TARGET, TEXT) where: *type* indicates the nature of the script unit; *actor* is the name of the ADA performing the script unit; *target* represents to whom the intended action is directed and *text* is the utterance being spoken. The only supported script unit is `speak`, where a character say a sentence.

In order to exemplify plot representations, an excerpt from a brazilian comic strip called Monica's Gang (Figure 5) is used as test case: a script unit that summarizes this frame could be: (speak, Monica, Jimmy Five, "Look, Jimmy Five! A rainbow").

Figure 5: *Excerpt from a Monica's Gang comic book*
Source: www.monica.com.br

Script Analysis: way before starting acting their roles, actors prepare for their characters by studying the script, trying to understand the plot. To do that, they rely on script analysis techniques [Waxberg 1998; Thomas 2009]. One of such techniques is *action analysis*, where key aspects are extracted from the script in order to summarize it, like the theme of the plot, the time and place where the story takes place among others. In our system, script analysis is represented by a record describing a few aspects that agents use to determine the current dramatic situation during the deliberation phase. At this point, it is up to the script writer to write this script analysis record manually.

For the example before (Monica's Gang comic book), one possible script analysis record could be: theme (conversation), time (during the day at present time) and place (outdoors).

Set: contains all descriptions regarding the environment in which actors perform their actions. In terms of implementation, a set is a data structure that enumerates all components within the scene, like buildings, objects, lights, cameras, etc., with which agents can interact. Level design techniques similar to what is used by computer games designers can be used. One particular technique that are being investigated in this domain is *smart objects*. Smart objects are a special kind of object that stores informations regarding its functionality and physical attributes to assist agents to interact with them [Fernandes et al. 2012].

In our example, the set is composed by only two objects: a grass field and a rainbow. A list of possible performable actions for the grass field object could be: stand, walk or seat; and regarding the rainbow could be: stare or point at.

3.2 Agent Architecture

The core element of Project D.R.A.M.A. is its agent architecture, that describes the agent's deliberation process. Our proposed solution follows the traditional perception-deliberation-action process commonly used by computer game development industry [Byl 2004], although several adaptations have been proposed, as described next.

Perception: the first step in every agent architecture, the perception means sensing agent's surrounding environment, transforming recognized inputs into *percepts*. Percepts are sensed inputs associated to semantic information, so the agent can use them to deliberate. We are proposing to subdivide perception into two submodules:

1. **Script Data Annotation Module:** it is expected that virtual actors are capable of autonomously interpreting the plot, inferring proper enactments for each script unit. This interpretation is achieved by sentence annotations. Sentence annotation is a common approach used to reduce the inherent linguistic complexity on natural language processing. It means to associate meaningful pre-processed tags to sentences, so agents can use these tags instead of having to cope with the natural language complexity. In the CrossTalk installation [Baldes et al. 2002], the authors suggest a list of dialog act tags [Gebhard et al. 2003], to annotate sentences for their characters. We adopted their list in our system, as illustrated

in the following example:

Monica says "Look, Jimmy Five! A rainbow!"
`admire(rainbow)`

It is under development an experimentation of an automated approach for script units annotations considering illocutionary acts as annotation tags. Preliminary result of these studies were presented in [Magri et al. 2012].

2. **Environment Sensing Module:** emulates all actor's senses to allow it to perceive changes in the surrounding set it is acting into. These sensors traverse the set looking for three kinds of percepts: actions of agents, consequences of events and aspects of objects. All these percepts are then passed to four belief revision functions (BRF) and to the personality submodule, so it can infer a list of plausible actions used on the deliberation phase.

   In our running example, both agents (Monica and Jimmy Five) should be able to sense all objects in the scene. Jimmy Five should also listen what Monica is saying.

Personality: our proposed personality model follows Reiss Motivational Profile [Reiss 2008] and is the part of the system responsible for mapping specific character's traits (from the script analysis record) with basic desires, to determine a list of goals and respective satiating level. The integrator function integrates a series of information gathered from inner states (emotions and goals), relationships with other characters and actions inferred from the smart objects repository to produce a list of actions that would be considered as coherent for the given personality. This, will later be filtered by the filter function (as explained next).

In our example, the agent Monica may consider staring at the rainbow a coherent action because it has curiosity as a personality trait.

Deliberation: once the incoming script has been interpreted on both script annotation and environment sensing modules, the deliberation phase takes place. It is responsible for inferring plausible actions, considering the personality aspects of the character being played. The solution suggested is based on a modified version of the EBDI architecture [Jiang et al. 2007]. EBDI agents (emotion-belief-desire-intention) are deliberative agents that reason considering a series of *beliefs* about the current status of the surrounding environment, producing special inner states out of their interpretations of the inputs called *emotions*. In addition, they have their own list of *desires* in terms of goals to achieve, and by combining all other three components agents are able to infer *intentions* that are commitments to achieve specific goals.

The deliberation process starts with three belief revision functions (msg-, story- and sensorial-BRF) receiving those percepts produced at the perception phase. The msg-BRF is responsible for determining beliefs from messages (conversations) between characters, the story-BRF updates the belief set with those detected from the script analysis record and the sensorial-BRF determines all new beliefs learned from sensing the environment. These beliefs are then passed to the reactive-EUF (emotion update function) responsible for eliciting primary reactive emotions. The resulting beliefs and emotions are then combined into new beliefs in the input-BRF function. The cognitive-EUF processes secondary emotions, that are emotions we experience after thoughtful deliberation of the situation being experienced.

The core function of the deliberation phase is filter. This function gets as input, current beliefs (B), emotion (E), desires (D) and intentions (I) sets to combine them (according to previously trained sets of rules) to produce new intentions:

$$I_{new} = E_{current} \times B_{current} \times D_{current} \times I_{current}$$

Following, these new intentions are used by the planning submodule to create 'plans' as a series of plausible actions (that come from the list of coherent actions established by the personality module).

Resulting from the deliberation phase is a list of preliminary plans of actions, that will be adjusted, at the rehearsal phase, to match other ADA suggestions in a suggested timeline as described in section 3.3. Continuing our example, the deliberation phase performs the following steps:

1. the msg-BRF takes previously annotated script unit (speak, Monica, Jimmy Five, "Look, Jimmy Five! A rainbow!", admire) and translates it into a belief. E.g., `say[Monica, Jimmy Five, admire];`
2. the story-BRF generates the beliefs list for the script unit record. For instance: `[theme, conversation]`, `[place, outdoor]` and `[time, present, day];`
3. the sensorial-BRF updates the agents beliefs, like for instance: `[object, rainbow]`, `[agent, Monica, speak];`
4. reactive-EUF may suggest that Monica is experiencing "joy" after has spotted some object she admires;
5. the input-BRF may suggest a new belief like `[rainbow, curious]` to denote that it consider seeing the rainbow as curious;
6. then, the filter function gets as input those beliefs and emotions previously determined, along with previous intentions to determine that the agent's next intention could be "demonstrate happiness";
7. finally, planning selects the following sequence of actions: "perform(stare, rainbow)", "perform(point at, rainbow)", "display(happy face)" as a suitable plan to satisfy current intention. This plan is the result that will be passed for acting in the next phase.

Action: after the agent has deliberated a list of preliminary plans of actions, it is time to translate each action into individual acting performances. A performance means a list of actions considering temporal relations and dramatic elements. Progression line is a script analysis component that describe temporal relations between actions in the plot. This description is responsible for expressing which sequences of actions is coherent to the story being told. The progression module is responsible for ordering plans of actions that they would better fit the progression line. Following, the voice intonation module considers commands for TTS (Text-to-Speech) tools to elicit emotional voice intonation aspects regarding the dramatic situation being enacted. Finally, the timing module suggests appropriate timing attributes for each action in the suggested progression line. This module is responsible for determining aspects like: when to start a given action, how long it should last, pauses, etc., all regarding the dramatic techniques being considered.

The final result of the deliberation phase is the individual acting performance, that is a non-linear animation data structure describing a series of actions and respective timing attributes. Next, the rehearsal phase combines several of such individual performances (coming from different ADA), translating actions into animation commands in a structure called a 'timeline'.

3.3 Rehearsal

In dramaturgy, rehearsal is the phase where actors practice their enactments together, planning the best acting choices for each action. To do that, they first propose their own performances and then, combine them according to the script and director's guidelines.

The rehearsal phase for the Project D.R.A.M.A. architecture, takes as input a series of individual acting performances (made by several ADA agents) and combine them into a suggested timeline. This is accomplished in two steps: first, the structure module is responsible for searching behavioral patterns on pairs of actors' performances. Whenever such patterns are detected, the system checks if any adjustment in the actions parameters (like voice intonation, face expression, timing, etc.) is necessary. For instance, Jimmy Five should react differently to a Monica's criticism than it would if it was Smudge criticizing. After this, an animation translator built specifically to work with a given animation engine translates each suggested action into animation commands to produce the final timeline.

This resulting timeline is ready to be load in the selected engine for rendering as described next.

3.4 Animation Engine

The result of the deliberation process is a list of animation commands suitable for rendering in a given animation engine. For the purpose of this research, Autodesk™Maya™has been selected for rendering. In Maya, non-linear animations are dealt by the Trax editor as a series of animation 'clips'. Our solution consists of modeling each character and associated list of clips. Then, a plugin written in Python is responsible for loading the resulting timeline allowing the engine to render the final animation.

Figure 6 illustrates the characters used for testing the system and associated timeline been exhibited in the Trax editor.

Figure 6: *Maya Plugin and resulting animation built in Trax Editor*

4 Conclusions

Autonomous digital actors are self-animated characters capable of suggesting animations relying on specialized knowledge for that. This paper presented a research project that aim at studying the requirements and development process for that.

It has been presented a literature review about the art of acting including important acting techniques that inspired the development of the system architecture. Also, a study regarding current digital actors technology is presented. This study allowed the modeling of a group of characters and a plug in for an animation engine. Finally, a list of requirements for autonomous digital actors has been proposed, where it has been established that there are at least three main components that every ADA needs to display: autonomous script interpretation, acting knowledge and dramatic skills.

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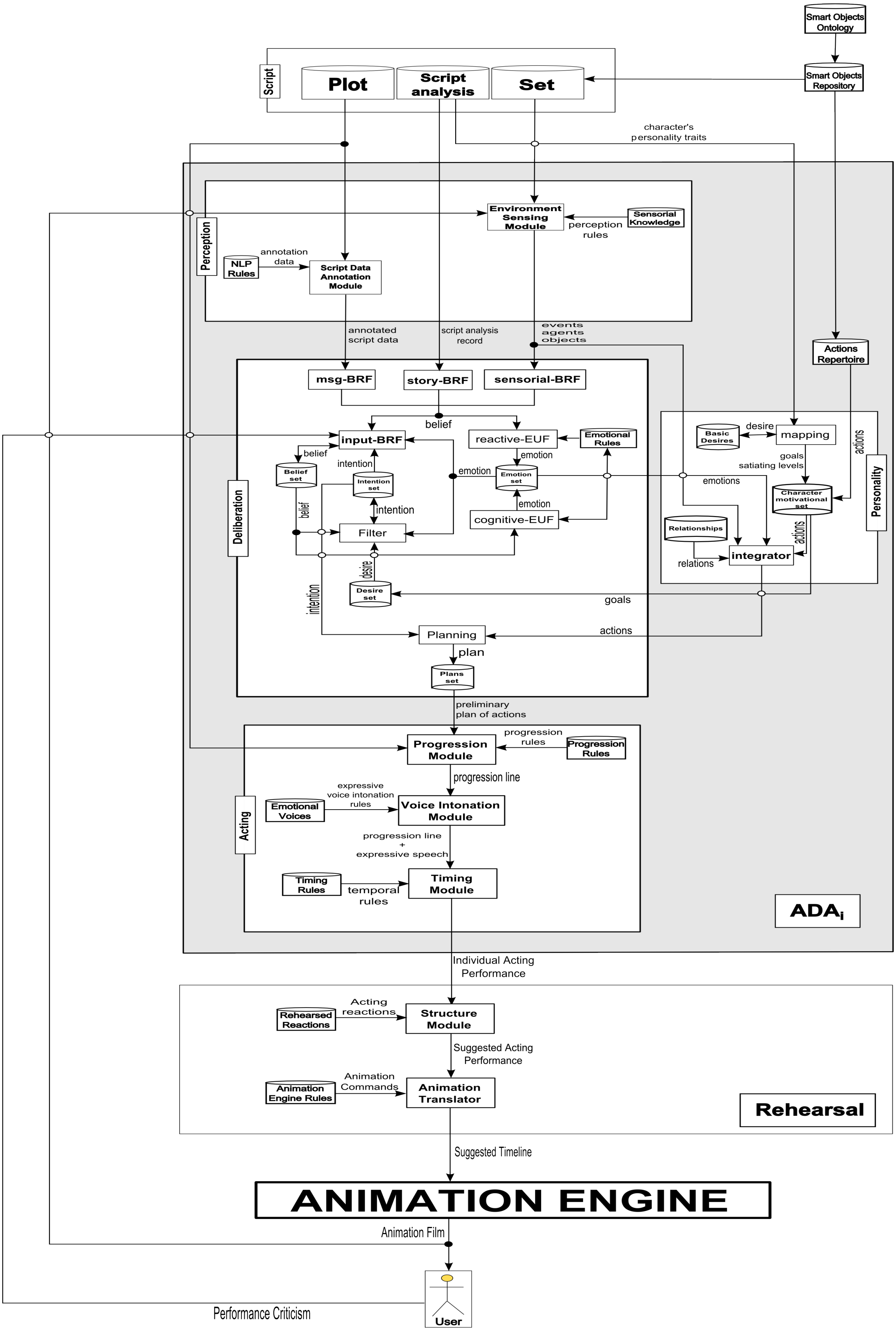

Figure 7: *Project D.R.A.M.A. Overview*