ADML: A framework for representing inhabitants in 3D Virtual Worlds

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Abstract

Last years, a new fashion over Internet and computer networks has been established: the 3D virtual worlds. Reports about Future Internet predict virtual worlds will play a major role in the configuration of the future network. They bet on those virtual environments will encompass the ability to become highly adaptive to user preferences (having into account eInclusion aspects), and they will provide a high level of interoperability. However, current 3D virtual worlds are far from cover these issues. This work is focused in providing a preliminary solution about customization and interoperability in the field of avatars representation. They are a key element in the 3D virtual worlds because using 3D avatars is a common way for representing virtual world inhabitants. First of all, nowadays there is not a way for defining all the avatar features that are important for simulating a real person, and for defining their identity. Besides, features that can be specified are usually defined in a closed and proprietary format that does not allow migration among virtual worlds. Thirdly, eInclusion aspects are not taken into account. This work proposes a preliminary framework for specifying a complete avatar identity by means of features that are not dependent on the virtual world context or interaction events. Those are appearance, personality and communication skills. Moreover, for providing a tool that describes the framework, the base for a new XML-based language –ADML– has been created. The language will allow specify avatar identity features taking into account eInclusion aspects and it will allow migration among worlds. Part of this language has been accepted into the new MPEG-V standard proposal.

CR Categories: I.3.6 [Computer Graphics]: Methodology and Techniques—Standards; I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism—Virtual reality

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1 Introduction

3D virtual worlds try to simulate the visual appearance and the interactive characteristics of the real world. They are 3D places where users interact with other users and software agents in real time, in a collaborative way.

To achieve these simulations, the sense of immersion is important from the users point of view, and for aiming this feeling, it is fundamental that the virtual world exploits the user's feeling of presence and co-presence. Presence refers to users sense that they are physically into the world, and co-presence refers to rest of users that are in the world with them [Slater et al. 1998; Slater et al. 1996].

These both feelings can be achieved by means of a 3D avatar, which can represent the user (avatars driven by the user) and even being a personification of an intelligent software agent (autonomous avatars) [Casanueva 2000]. So, 3D whole body avatars are the inhabitants of the world, creating in the user a spatial perception of all the users and software agents that are collaborating into the world. Moreover, these avatars enable, at least potentially, more communication channels with the user than traditional collaborative tools. They can, for example, complement verbal with non-verbal language through the use of avatar gestures.

Apart from avatars, 3D worlds have obtained so much importance as whole application that current reports about Future Internet written by European research platforms [Eiffel 2009; es.Internet Spanish platform of convergence to Future Internet 2009] bet on them as a common tool for interacting between users and accessing services in the near future. Following these reports, 3D virtual worlds should fulfil some features. Among others:

- They should increase the User Experience. There is still a need to design and develop novel multidirectional interfaces and interaction mechanisms, including multimodality and **"presence"**.
- They should have a high level of **interoperability** since these virtual worlds will not be unique, in the sense that many actors might create their own world (enterprises, entertainment entities, professionals or even amateur people for enjoyment). This feature is one of the most important challenges. The user could take advantage in terms of the freedom to choose different environments where they could act with no changes in terminals or ways to operate.
- They should be **adapted** to the profile, background, preferences, language, space-temporal location and even current mood of the user in a dynamic way. The adaptation to the user should be in Future Internet as a universal right not excluding anyone.

However, the current 3D virtual worlds are far from cover these issues. This work tries to provide a preliminary solution to these lacks for one of the main interaction elements in the virtual environments: the avatars. Current avatars present some limitations in the similar way presented above:

- In order to achieve a real feeling of **presence** it is very important to have a correct representation of the avatar **identity**. Popular 3D virtual worlds have a high configurability for

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avatar appearance and movements. Users can create an avatar that is completely physically different from the avatars that represent the rest of the users. However, there is no way for defining personality or communication abilities. They are two important features for simulating a person and creating their own identity. It is necessary to analyze the features that are not related with interaction flows of a concrete virtual world in order to create the avatar identity. That is, the features that compound the avatar "way of being" and the communication skills with the rest of inhabitants of any world.

- Regarding to **interoperability** capabilities, the 3D virtual world should provide avatars migration. The configurability and interaction issues are defined for each virtual world in a closed format –open source or proprietary, but are not compatible with different virtual worlds–, and do not allow **migration** from one to another. For example, an avatar created for one world can not be loaded in other world. Users should create an avatar from scratch in each world they access, using the features of configuration that each virtual world provides.

- Users should be able to adapt the avatar to their preference and needs. **eInclusion** aspects are not taken into account and only a small number of virtual worlds enable some alternative communication channel for access by people with disabilities. These alternative channels would allow avatars representing inhabitants with disabilities interact with avatars representing inhabitants without disabilities. It is because if the communication skills of an avatar could be defined, the rest of them could act in consequence.

For dealing with these problems, this work proposes a preliminary framework that defines a complete avatar identity, having into account eInclusion aspects and providing a migration model between virtual worlds. Moreover, since the avatar is one of the main interaction elements in virtual words, this framework will provide also a support mechanism for virtual world interactions, including interaction between users with disabilities.

The work is structured in this way. In section 2, a discussion about features that we consider important for the definition of the avatar identity are shown.

Situation about eInclusion aspects in current virtual worlds are explained in section 3. The conclusion is eInclusion is poorly taken into account in virtual worlds. And the cases that implement it, only deal with concrete disabilities, but not with general eInclusion issues. We propose to allow specify eInclusion through the definition of the avatar communication skills. These communication skills are the main natural communication channels that enable the human senses, like the hearing (input channel) and speaking (output channel) regarding the hearing sense.

In Section 4 we review the state of the art in virtual worlds and in markup languages for representation of avatars in order to find a solution for these lacks. Moreover, we study the main communication channels that are used in multimodal interaction with virtual worlds.

Since we do not find any definition which covers all of these features, in Section 5, we propose a preliminary high level XML-based language in order to achieve the avatar migration between virtual worlds. We define the main features that should be defined for the avatar identity: appearance, personality and communication skills (having into account eInclusion aspects).

This language, called Avatar Definition Markup Language –ADML– describes the features defined by means of a set of tags. In this way, users could have a virtual identity, based in the physical, psychological and communication features they decide and it will be applicable in the virtual worlds they choose.

ADML tries to provide a standardized framework for defining an avatar identity and providing support interactions in virtual worlds through the representation of avatars. It might also aid in improving immersion sense in any virtual world, representing the features that conform identity. A part of ADML has been accepted by MPEG Consortium in the new MPEG-V draft standard [MPEGV 2009], and while the remainder of ADML is pending evaluation. All of the technical aspects of which the language is composed are explained in section 6. Finally, section 7 presents the conclusions and future work of this research.

2 Avatar identity

The problem for defining the avatar identity is to determine what features are important for obtaining a good representation of the inhabitant, and define them in a way that allows the avatar to be migrated between different virtual worlds.

Humans are composed by 'body and mind' [Carolis et al. 2002] so, an avatar that has these human factors would be represented more or less faithfully a real person identity. Body features are related to appearance and movement capabilities. Mind features are related to emotion, mood and personality.

In general, personality affects the generic way of perceiving the world by a specific person, emotion is a punctual modifier of the personality that depends on the environmental conditions, and mood is a medium term between personality and emotion that has greater duration than emotions. It is provoked by an addition of emotions [Kasap and Magnenat-Thalmann 2007; Gebhard 2005].

It should be noted that body and mind are not separate features, for example the emotional state can affect the movement execution. A happy person walks in a different way to a sad one.

Current popular 3D worlds have very advanced body features, the avatar has a lot of configurability options for appearance and it is able to execute a wide number of movements. Apart from this, many research experiments have been done taking into account the personality and emotions of avatars [Kshirsagar 2002; Arya and DiPaola 2007; Strauss and Kipp 2008]. The problem is to select which of these features can be specified as not depending on the virtual world.

Movements are very dependent on inhabitant interactions and virtual world context. The idea of this work is to define features that provide a framework for including interactions, but not the interactions themselves. Therefore, from the body aspects point of view only appearance features will be defined.

Taking into account an avatar modeling a user or even a software agent, while personality is something directly attached to a an avatar and defines its way of perceiving any virtual world, moods and emotions are very dependent on the context of the virtual world. For example, if there is a game in a virtual world that consist on finding the key of a box and one avatar finds it, it will have a happy emotion or mood modifying its base personality. If in the same world –or in another one– a game consists of keeping the key and avoiding someone stealing it, the avatar with the key will have an fearful emotion.

For this reason, in this work we have decided not to include emotion and mood features in the identity of the avatar. They are very dependent of exact goals and environmental conditions that can differ from one world to another –or within the same world–, and it is within their own world where they should be defined.

Therefore, the non dependent features that will be defined in this work for specifying the avatar identity are appearance and personality.

3 Status of eInclusion in virtual worlds

According to a report published in 2007 by Gartner, an major IT marketing consultancy, 80% of active Internet users will have a "second life" in virtual worlds by 2011 [Gartner 2009].

This growth projection, without having a clear focus of this kind of application to eInclusion issues may be problematic. It might provoke a new digital divide for people, who because of some disability, are not able to use virtual worlds.

There have been recent initiatives for improving the accessibility current virtual worlds, by means of external devices and plugins. Hansen has compiled the most meaningful in [Hansen 2008]. Other researchers [Trewin et al. 2008b; Trewin et al. 2008a] have studied the possibility of developing accessible virtual worlds, evaluating their effectiveness in a multiuser game. It is because the technological similarity between them. In their work, they have studied specific technologies for the disabled that have been implemented in 3D environments. The work is divided into two groups: exclusive developments for disabled people and developments for the general public, taking eInclusion into account. In their work, they explain the necessity of researching the second group of applications to avoid the digital gap. They conclude that although there exist some directives for managing disabilities in a virtual world, they are not implemented.

Among the small number of accessibility works, an noteworthy development is [Atkinson et al. 2006]. They implemented AudioQuake, an adaptation of the famous Quake game for the blind.

In any case, it can be observed there is a lack of mature implementation of technologies that allow eInclusion in virtual worlds. The existing initiatives are recent. As a practical example, the accessibility section of the Second Life Web site currently provides some advice for people with very specific disabilities [Life 2009].

Usually, disable users should find themselves tools that help them use virtual worlds. Moreover, for each virtual world those wishing to access the world, should find compatible third party tools, for a complex environment that has been initially designed for people without disabilities.

This work takes this aspect into account, allowing the inhabitant to specify the communication channels that the avatar enables for communication. By means of this specification, inhabitants can reflect their disabilities in a virtual world through their avatar. Then the rest of avatars and the own virtual world can adequately adapt its inputs/outputs in it's design.

4 State of the Art

This section presents a review of the state of the art in fields related to this work. As previously explained, the concept of this work is the definition of features that help to provide an avatar identity in a standardized way and in which creating a framework where interactions can take place. The state of the art has been divided in three sections, a brief review of the features of current virtual worlds, communication issues in virtual worlds and the status of markup languages that allow the definition of avatar features. The act of reviewing markup languages is due to the fact that it is a key factor in guaranteeing migration: an open and high level language that can be easily parsed by any world.

4.1 Virtual worlds issues

The act of developing virtual worlds is akin to a new fashion. Several virtual worlds for general purposes exist all over the Internet, such as Second Life, IMVU, There, Lively and a long etc. This trend is being extended to more closed communities; a good example is Home [Home 2009], a virtual world developed by Sony for their PlayStation 3 customers.

From a developers point of view, several tools for facilitating the creation of a virtual world have appeared. These tools are not only focused on the 3D graphical part of the development, but on the behavioral aspects of avatars, objects and the world itself also. Good examples of these tools are Havok [Havok 2009], a powerful game engine that is currently used for creating virtual worlds too; Multiverse [Multiverse 2009], focuses on creating virtual worlds; and SimBionic [Simbionic 2009], focuses on facilitating the creation of behaviors in a virtual world.

The ability to configure an avatar that represents the user and distinguish it from others, is a key factor in current virtual worlds. In fact, according to some studies, when users access virtual worlds, they spend a considerable amount of time in designing their avatar [Cheng et al. 2002; Anderson et al. 2001]. Almost all popular virtual worlds allow a broad appearance configurability. In cases such as Second Life, users can specify features as specific as nose width or eye color. Additionally, the avatar can be further personalized with models and accessories developed by third parties, some for free and others commercial. The only negative aspect is the lack of a standard for configurability that forces the users to create an avatar from scratch for each world they access.

4.2 Communication channels

As differences of other systems for computer mediated communication, such as traditional text-based chats, virtual worlds allow the simulation of the principle communication channels between people. Representation with an avatar can allow simulation of verbal and gestural communication and, through the use of peripherals like haptics, other senses like touch can be stimulated.

As Schroeder points out [Schroeder 2002], to obtain a complete sensorial simulation, there even exist peripherals that allow the use of the senses of taste and smell, although they are at a prototype stage and have not yet had satisfactory results. Following his studies, the absence of these two senses causes a shortcoming in multimedia richness and an absence of cues in interpersonal interactions. However, currently it is not technologically possible to avoid this. Moreover, although there exist differing related opinions, some studies, such as [Robertson et al. 1993], conclude that, with current graphical and sound hardware improvements, 3D environments running on desktop computers, can be easier to use than complex immersive environments. This is due to users are accustomed to these systems and the physical and psychological stresses that can cause immersive environments are reduced.

Therefore, there exist various prototypes that are focused on exploiting the communication channels that can be enabled through the senses of hearing and sight.

Regarding the sense of hearing, a pioneering and representative case is the prototype developed by DiPaola and Collins in 2002 [DiPaola and Collins 2002]. It was called OnLive Traveller and is a 3D environment for voice-chatting. In this environment, users are represented by avatars that are 3D talking heads. To obtain a better illusion of immersion, the voice of each user causes the avatar lips to be animated and synchronized with the speech.

Regarding the sight sense, almost all existing commercial virtual worlds that base the user representation in an whole body avatar allow the user expressing gestures with his/her avatar in a explicit way. More advanced studies are focused in the automatization of these gestures and their emotional coherence. It is said, not to launch gestures more or less appropriated to the context in a explicit way, but gestures that conforming the non verbal language of a speech. So for example, the Miralab center has develop studies for generating non verbal language with emotional influence [Egges and Magnenat-Thalmann 2005].

4.3 Description of avatars

This section describes the current existing high level tools for describing avatars. The review is focused on markup languages, as they are the high level tools that create an abstraction layer over specific application features and they make migration easier. Current markup languages have been analyzed, both at a research level and a market level. The key points looked for are those pertaining to the three main aspects we have defined as requirements for modeling a user: communication abilities, appearance and personality. Table 1 presents a summary comparing some of the markup languages reviewed. This review of languages was initially compiled by Ortiz [Ortiz 2008] and it has been updated and completed for this research. They are classified by the set of parameters defined below:

1. Goal of the markup language (Goal): For each markup language, the main goal for its creation is analyzed.
2. Facial animation coding possibilities (F.A.): The possibility of tagging facial expressions, as gestures or complex facial animations, is analyzed.
3. Corporal animation coding possibilities (B.A.): The possibility of tagging body (corporal) movements of virtual characters is analyzed.
4. Emotions tagging possibilities (Emot): For each markup language the possibility of indicating emotions and the intensity of each emotion is analyzed.
5. Dialog capabilities (Dial): The possibility of tagging dialogs between two or more avatars is analyzed.
6. XML-based (XML): Another aspect analyzed was if the markup language is or is not XML-based. XML is proposed as a standard for structured information exchange between different platforms. This feature is important for guaranteeing the future viability of the selected markup language.
7. Ability for coding the avatar appearance (App): The language should be able to define the appearance of an avatar (hair color, skin, clothing, etc.)
8. Coding of the avatar's personality (Per): Personality is one of the main characteristics that a markup language should include in order to model a user. It should not be confused with emotions or moods. Personality is a global modifier of these attributes.
9. Ability for coding eInclusion features of the user (Acc): Possibility of defining special features or disabilities of the user. It is an important feature in order to provide access to all groups of user types.

As result of the review based on the criterion summarized in table 1, some conclusions have been drawn for each inhabitant feature:

- Appearance: Almost all languages do not allow the codifying of the appearance features of the avatar. HumanML [Brooks and Cagle 2002] does allow it, but it is very focused on visual representation and communication, and it does not allow the codifying of the two other avatar features proposed in this work.
- Personality: Only CML [Arafa and Mamdani 2003] and MPML [Ishizuka et al. 2000] allow the codifying of the avatar personality. Moreover, MPML uses as personality attributes model, the Five Factor Model [McCrae and John 1992], as is proposed in this work. However, both languages do not take into account the other two features for representing the avatar.
- Communication skills: this aspect is closely related to eInclusion. A complete avatar identity should support the specification of special features or disabilities in order to adapt the interfacing model to their abilities. Only one of the reviewed languages supports this –EMMA [Baggia et al. 2009]–, although it does not support the remaining two features.

As a general conclusion, there is a deficiency in markup languages that model a complete avatar identity. Although there exist very complete languages that allow some of these features to be specified, no markup language that fulfils the three proposed features has been found.

5 Concept underlying ADML

The proposal for describing the set of features defined in previous sections is the specification of a new, XML compliant, high level markup language, called ADML –Avatar Definition Markup Language–. This language will provide support for defining appearance, communication skills and personality features for avatar identity specification.

Being XML-compliant, as a standard for representation of information, allows the development of tools that make the language easy to use, due to the widespread for XML information management in available programming libraries and tools.

ADML is thought of as being adaptable to current virtual worlds. The specification is independent of graphic libraries, geometrical formats, etc. providing the possibility of adapting the specification to its own feature set.

It is divided into three main fields already referred to: communication, appearance and personality features.

5.1 Communication abilities (tag 'communication')

Notation	<communication>
Definition	Element that defines the avatar communication skills
Children	<speaking>, <hearing>, <sight> and/or <gestural>
Attributes	–
Appearing	Always as child of root element <adml>. It can not be appear as child of other elements

This section of the language describes the avatar communication skills. That is, it defines the way that avatar is able –or want– to communicate with other avatars.

The way of communicating is characterized by the input and output abilities that it has. This specification is not only suitable for defining input/output preferences but for defining possible disabilities that can affect the inhabitant the avatar is representing. For creating

Languages	Goal	F. A.	C. A.	Emot.	Dial.	XML	App.	Per.	Acc.
HumanML	Representation	No	No	Yes	No	Yes	Yes	No	No
CML	Animation	CFML	CBML	Yes	No	Yes	No	Yes	No
AML	Animation	Yes	Yes	Yes	No	Yes	No	No	No
APML	Dialog	Yes	No	Yes	Yes	Yes	No	No	No
GESTYLE	Speech animation	Yes	Yes	Yes	No	Yes	No	No	No
MPML	Presentation	No	MPML-VR	Yes	No	Yes	No	Yes	No
MURML	Planning	No	Yes	No	No	Yes	No	No	No
VoiceXML	Dialog	No	No	No	Yes	Yes	No	No	No
RRL	Dialog	Yes	Yes	Yes	Yes	Yes	No	No	No
VHML	Animation	Yes	Yes	Yes	Yes	Yes	No	No	No
EARL	Emotion representation	No	No	Yes	No	Yes	No	No	No
GESTICON	Animation	Yes	Yes	No	No	No	No	No	No
XSTEP	Animation	Yes	Yes	No	No	Yes	No	No	No
AIML	Dialog	No	No	No	Yes	Yes	No	No	No
DAMSL	Dialog	No	No	No	Yes	Yes	No	No	No
EmotionML	Emotion representation	No	No	Yes	No	Yes	No	No	No
EMMA	Multimodal Sys. Comp. Communic.	No	No	No	Yes	Yes	No	No	Yes
X3D/HAnim	Representation & Animation	No (only support)	No (only support)	No	No	Yes	No	No	No

Table 1: *Summary of main features of markup languages studied*

a language that provides eInclusion, these attributes must be specified. As shown in the state of the art review, only one language that implements these features was found.

ADML focuses these input/outputs to the communication channels defined in a section before. They are speaking and gesturing as input channels, and hearing and sight as output channels.

ADML includes a tag called 'communication' for defining disabilities. These disabilities are grouped by the communication channel that affects and the level of disability. So, exists subtags for defining communication skills in hearing, sight, speaking and gesturing. An attribute value specifies availability of the channel: enable, medium or disable, where medium indicates restriction in the use of this channel.

For example, a hearing value to enable, indicates a normal communication through this channel. A disable value is no communication, and medium implies communication with difficulties. Speaking slowly and louder to that avatar could be necessary.

5.2 Appearance (tag 'appearance')

Notation	`<appearance>`
Definition	Element that defines the avatar appearance
Children	Appearance modifiers. Ex: `<hair>`, `<eyes-color>`
Attributes	Required: `avatar-package`, basic package of avatar appearance Optional: `nick`, avatar name
Appearing	Always as child of root element `<adml>`. It can not appear as child of other elements

The idea behind the appearance tag is to provide a set of subtags and attributes that allow the definition of the avatar's appearance in a generic but extensible manner. Different XML-based languages that can be found in the state of the art, allow the definition of different avatar features, such as emotions –VHML–, movements –AML–, etc. But none of them have been found to allow the definition of appearance features in an independent way. To enable this, the ADML language is completely abstracted from features that might only be applicable certain virtual worlds. The goals that ADML attempts to meet are as follows:

- Independence of geometrical formats. In the sense that the avatar specification is not attached to specific geometrical formats such as obj, 3ds or proprietary formats.
- Migration of an avatar to any virtual world. Each virtual world engine should be able to represent a specific avatar with the same appearance.
- Extensibility. Ability to support proprietary appearance features or accessories.

An important aspect for a language that attempts to be independent of a particular virtual world is that it is not attached to geometrical formats. Each virtual world has its own geometrical format for defining the avatar's components. In some cases, it is a proprietary format, and in others, it is an open format. However, in any case, it differs from one virtual world to other. The approach for solving this dependence is to describe the appearance of the avatar by means of identifiers instead of geometrical files. To accomplish this the following steps should be taken:

- Define a set of specific avatar base models, for example, a Man, a Girl and a Child. These models will have a common hierarchical ID associated to them. In the case of this example, they might be: `generic.humans.male`, `generic.humans.girl` and `generic.humans.child`. These IDs will have a geometrical appearance associated to them that will consist of only the human –or cartoon– shape, without clothing or accessories.
- Any ADML-compliant virtual world will contain the geometrical representation for these models. It does not matter which is the geometrical format, but the visual representation needs to be the representation defined for this ID.

- A set of modifiers that acts on any base model is defined, for example, `eye-color` or `height`. The possible values of these modifiers are, in the same way as the base models, a set of specific and generic values. This allows a vast range of possible avatar configurations.
- Additionally, a set of accessories is defined for clothing, jewellery, etc. in the same way.
- Any world can extend these models and accessories with its proprietary equivalents following the notation of the hierarchical IDs.
- If a virtual world has to load an avatar that contains proprietary models of another world, it can load the closest standard model. As an example, it may be defined: `second-life.humans.child`, and Second Life would load its proprietary model. The other virtual worlds would convert it to `generic.humans.child`

The philosophy of this approach is the similar to the MIDI (Musical Instrument Digital Interface) format for sound and digital musical instruments. The MIDI specification defines, –apart from the duration of a note, volume, etc– 128 basic sounds by means of identifiers. For example, the ID 0 corresponds with the piano sound and it is the responsibility each MIDI compatible device to recreate this sound when it receives a '0' as a Piano, irrespectively of the quality of the receiving device or its sound bank programming. In this way, a MIDI compliant score will sound similar on any sound card, or MIDI device, when it is reproduced. Moreover, each sound card could define its own set of sounds extending, these '128'. Translating this philosophy to the virtual world, an avatar defined by means of ADML would have a similar appearance in any Virtual World in which it is shown, with more or less the same quality depending on the profile of the graphic engine.

5.3 Personality (tag 'behavior')

Notation	`<personality>`
Definition	Element that defines the avatar personality
Children	`<openness>`, `<conscientiousness>`, `<extraversion>`, `<agreeableness>` and/or `<neuroticism>`
Attributes	Optional: `name`, name of the personality configuration
Appearing	Always as child of root element `<adml>`. It can not appear as child of other elements

This tag defines the personality of the avatar. This definition is based on the OCEAN model [McCrae and John 1992]. OCEAN – or Five Factor– model is the computational personality model that is currently the most widespread and tested. It defines a set of characteristics that personality is composed of. It is said, a combination of these characteristics is a specific personality. Therefore, in ADML each avatar contains a subtag for each attribute defined in OCEAN's model. They are: openness, conscientiousness, extraversion, agreeableness and neuroticism.

Furthermore, a value from -1 to 1 shows the level of each of these factors for the final modeling of the personality.

The purpose of this tag is to provide the possibility to define the avatar personality that is desired, and that the architecture of the virtual world can interpret as the inhabitant wishes. It would be able to adapt the avatar's verbal and non-verbal communication to this personality.

6 Technical Details: An Example

In this section, the format of an ADML file is explained. Below is an example of a simple avatar specified in ADML:

```
<adml "http://www.vicomtech.es/DTD/adml.
    dtd">

  <communication name="my-channels">
    <sight value="medium">
    </sight>
    <hearing value="disable">
    </hearing>
  </communication>

  <appearance nick="David" avatar-package
      ="generic.humans.child1">
    <hair name="my-hair" id="generic.
        complements.hair1" material="
        generic.materials.black">
    </hair>
    <eye-color id="generic.materials.blue
        ">
    </eye-color>
    <complement name="my-bag" id="generic
        .complements.bag2" material="
        generic.materials.leather.red">
      <complement name="my-chain" id="
          generic.complements.gold-chain"
           material="generic.materials.
          gold">
      </complement>
    </complement>
  </appearance>

  <personality name="my-personality">
    <conscientiousness value="0.5">
    </conscientiousness>
    <extraversion value="-0.75">
    </extraversion>
  </personality>

</adml>
```

With regard to communication abilities, the avatar is telling the virtual world it has poor vision and that it is deaf. Regarding the senses that are not defined in this tag, they are supposed that have no related disabilities. Therefore, the virtual world and the rest of avatars could act consequently and change the default behavior of its communications channels. For example, it can show the auditory channel by means of text and write display the text in a large and high contrast font.

The appearance, as defined for the avatar, is of the default model; child. This model has a default hair model, so all virtual worlds compliant with ADML would load the same model for this appearance. It is could be the same case for defined accessories.

For personality, it defines a specific personality in the OCEAN model style. The factors that are not defined are set to the neutral value '0'. This is a way of telling the virtual world that the personality should modify the movements of the avatar accordingly, if it is able to do so.

7 Conclusions and Future Work

In this work, the forecasted importance of virtual worlds as near future tools has been explained. However, some shortcomings in the current use of virtual worlds have been detected.

Current virtual worlds do not allow configuration of all of the features that create a complete avatar identity. Moreover, virtual worlds, and the interactions that occur in them, are designed in a closed model, without possibility of exchanging definitions with other virtual worlds. This is also the case with the definitions of avatars. They are defined in a closed format and there is a lack of an easy method to migrate them to other virtual worlds. Finally, possible user disabilities can not be specified and therefore a new digital gap could appear.

A set of physical and psychological features for describing an avatar's identity have been defined and possible user disabilities have also been taken into account.

These features are not dependent on virtual world context or interaction events. They are appearance, personality and communication abilities. This set of features provides a framework where interactions in virtual worlds can take place, due to this, it allows representation of the principle components of interaction in the virtual world.

To allow the application of these features to virtual worlds, the base of a new language called ADML –Avatar Definition Markup Language–, has been defined. Some parts of this language has already been accepted into the new MPEG-V draft standard and the remaining parts are at an evaluation stage for acceptance.

The advantages of this language are as follows:

- Provides a tool for defining the avatar identity. An identity defined in this way will be:
  - Independence of virtual world characteristics. The language provides a framework for specifying features that are not virtual world or situation dependent.
  - Independence of graphical formats. The language does not define 3D objects through their graphical representation, but it defines them by means of a set of tags.
- Provides eInclusion features. The language provides the possibility of specifying disabilities in a virtual world. Thus, the virtual world would be able to adapt its inputs and outputs to these disabilities.
- Migration. The XML structure and the independent characteristics provide a direct migration of an avatar, defined by ADML, between different virtual worlds.

The authors current work is focused on improving the tag definitions and designing a more proper architecture for virtual worlds that makes the integration of ADML easier, and consequently, the definition of an avatar identity.

References

ANDERSON, J., ASHRAF, N., DOUTHER, C., AND JACK, M. 2001. Presence and usability in shared space virtual conferencing. *Cyberpsychology and Behaviour 4*, 2, 287–305.

ARAFA, Y., AND MAMDANI, A. 2003. Scripting embodied agents behaviour with cml: character markup language. In *IUI '03: Proceedings of the 8th international conference on Intelligent user interfaces*, ACM, New York, NY, USA, 313–316.

ARYA, A., AND DIPAOLA, S. 2007. Multispace behavioral model for face-based affective social agents. *J. Image Video Process. 2007*, 1, 4–4.

ATKINSON, M. T., GUCUKOGLU, S., MACHIN, C. H. C., AND LAWRENCE, A. E. 2006. Making the mainstream accessible: redefining the game. In *Sandbox '06: Proceedings of the 2006 ACM SIGGRAPH symposium on Videogames*, ACM, New York, NY, USA, 21–28.

BAGGIA, P., BURNETT, D. C., CARTER, J., DAHL, D. A., MCCOBB, G., AND RAGGETT, D. 2009. Emma: Extensible multimodal annotation markup language. *W3C Recommendation 10 February 2009*.

BROOKS, R., AND CAGLE, K. 2002. The web services component model and humanml. *Technical Report, OASIS/HumanML Technical Comitee*.

CAROLIS, B., CAROFIGLIO, V., BILVI, M., AND PELACHAUD, C. 2002. Apml: A markup language for believable behavior generation. *Embodied conversational agents - let's specify and evaluate them! held in conjunction with AAMAS02*.

CASANUEVA, J. S. 2000. *Presence and co-presence in collaborative virtual environments*. Master's thesis, University of Cape Town, Department of Computer Science.

CHENG, L., FARNHAM, S., AND STONE, L. 2002. Lessons learned: Building and deploying shared virtual environments. In *The Social Life of Avatars: Presence and Interaction in Shared Virtual Environments and Scientific Visualisation*, R. Schroeder, Ed. Springer, 90–111.

DIPAOLA, S., AND COLLINS, D. 2002. A 3d virtual environment for social telepresence. In *in Proc. Western Computer Graphics Symp*.

EGGES, A., AND MAGNENAT-THALMANN, N. 2005. Emotional communicative body animation for multiple characters. In *Proc. First International Workshop on Crowd Simulation (V-Crowds'05)*, 31–40.

EIFFEL, 2009. European future internet portal. http://www.future-internet.eu/, retrieved in January 2009.

ES.INTERNET SPANISH PLATFORM OF CONVERGENCE TO FUTURE INTERNET. 2009. Future internet. technical report. *AETIC*.

GARTNER, 2009. Gartner press release. http://www.gartner.com/it/page.jsp?id=503861, retrieved in January 2009.

GEBHARD, P. 2005. Alma: a layered model of affect. In *AAMAS '05: Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems*, ACM, New York, NY, USA, 29–36.

HANSEN, S. 2008. Virtual worlds: Synopsis of user interfaces and accessibility initiatives. In *Proc. of 14th Australasian World Wide Web Conference, AusWeb*.

HAVOK, 2009. Havok home page. http://www.havok.com, retrieved in January 2009.

HOME, 2009. Home home page. http://www.homeplaystation3.com, retrieved in January 2009.

ISHIZUKA, M., TSUTSUI, T., SAEYOR, S., DOHI, H., ZONG, Y., AND PREDINGER, H. 2000. Mpml: A multimodal presentation markup language with character agent control functions. *WebNet*.

KASAP, Z., AND MAGNENAT-THALMANN, N. 2007. Intelligent virtual humans with autonomy and personality: State of the art. *Intelligent Decision Technologies 1*, 1-2, 3–15.

KSHIRSAGAR, S. 2002. A multilayer personality model. In *SMARTGRAPH '02: Proceedings of the 2nd international symposium on Smart graphics*, ACM, New York, NY, USA, 107–115.

LIFE, S., 2009. Second life accesibility. http://wiki.secondlife.com/wiki/Accessibility, retrieved in January 2009.

MCCRAE, R., AND JOHN, O. 1992. An introduction to the five-factor model and its applications. *Journal of Personality 60*, 2, 175–215.

MPEGV, 2009. Calls for mpeg-v. http://www.chiariglione.org/mpeg/working_documents.htm#MPEG-V, retrieved in January 2009.

MULTIVERSE, 2009. Multiverse home page. http://www.multiverse.net, retrieved in January 2009.

ORTIZ, A. 2008. *Avatars for emotional interaction*. PhD thesis, University of the Basque Country.

ROBERTSON, G., CARD, S., AND MACKINLAY, J. 1993. Nonimmersive virtual reality. *Computer 26*, 2, 81–83.

SCHROEDER, R. 2002. Copresence and interaction in virtual environments: An overview of the range of issues. In *Proceedings of the 5th Annual International Workshop: Presence*, 274–295. Bibliografa: aspectos sociales de mundos virtuales.

SIMBIONIC, 2009. Simbionic home page. http://www.simbionic.com, retrieved in January 2009.

SLATER, M., USOH, M., BENFORD, S., SNOWDON, D., BROWN, C., RODDEN, T., SMITH, G., AND WILBUR, S. 1996. Distributed extensible virtual reality laboratory (devrl). *Virtual Environments and Scientific Visualisation*, 137–148.

SLATER, M., STEED, A., MCCARTHY, J., AND MARINGELLI, F. 1998. The influence of body movement on subjective presence in virtual environments. *Human Factors 40*, 3, 469–477.

STRAUSS, M., AND KIPP, M. 2008. Eric: a generic rule-based framework for an affective embodied commentary agent. In *AAMAS '08: Proceedings of the 7th international joint conference on Autonomous agents and multiagent systems*, International Foundation for Autonomous Agents and Multiagent Systems, Richland, SC, 97–104.

TREWIN, S. M., LAFF, M. R., CAVENDER, A., AND HANSON, V. L. 2008. Accessibility in virtual worlds.

TREWIN, S., HANSON, V. L., LAFF, M., AND CAVENDER, A. 2008. Powerup: an accessible virtual world. In *ASSETS*, ACM, S. Harper and A. Barreto, Eds., 177–184.