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18. SUPPORTING VISUAL ELEMENTS OF NON-VERBAL COMMUNICATION IN COMPUTER GAME AVATARS

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ABSTRACT

Communication between players in networked computer games is often inadequately implemented. The games do not exploit the full potential of using different forms of communication possibilities between players, and therefore result in problems in sending and receiving messages. This paper introduces a model that describes how visual aspects of non-verbal communication (NVC) in avatars could be systematically designed. The model can be used as a guideline in the design process of more communicative avatars.

The study was conducted using a variety of research methods. The topic has been approached from both the constructive and theoretic-conceptual viewpoints. Non-verbal communication theories have been used as the framework to construct avatars for game environments and to form a model that supports the design of NVC elements into avatars.

The primary result of the work is a model that describes how to design more communicative avatars. The model introduces the aspects required when considering the designing of the visual elements of NVC. As an empirical result, the avatars based on the model determine how different elements of NVC work, and how NVC could be used in the avatar context. The results can be applied for design and construction purposes, as well as for further research into the diverse areas of avatar design.

The model describes three layers that can be used to guide the work of avatar designers and creators in supporting the visual elements of communication in computer game avatars. The model shows that designers and creators should search for the required elements of the NVC, vary these elements to form a rich set of ways to use them, and finally, personalise the avatars by selecting varied elements for separate avatars to support natural communication.

KEYWORDS

Non-verbal communication, avatar, avatar design, computer game, multi-player

INTRODUCTION

Computer games have developed considerably from their early days. Games have become more impressive in their visual, aural and technical aspects. The popularity of computer games has also greatly increased. These steps have brought modern multi-player games to the level that makes it possible to model more detailed avatars. This, in turn, provides new possibilities for communication between the players.

Generally, if players share the same physical space, they can yell and give visual signals at the top of their computer screens to convey messages to other players. However, if players are geographically separated, this is not possible. Most multi-player on-line games can convey basic information as to whether a player is crouching, running, or shooting. Still, the tools used to convey messages, such as expressions and gestures, have remained rather minimal. Some pre-recorded animation sequences and modifiable clothing have been introduced, but still the area of NVC in games is not yet even close to the potential it could achieve.

This research aims to provide tools for the design of visual NVC elements in communication between players. With NVC elements employed, players would be able to express themselves and to communicate more freely in different situations. In other words, players would gain a richer set of communication tools. NVC theories and results obtained from different research cases are used as the theoretical framework in this research. The intention was to examine how players can express NVC elements through their avatars. From this basis, a model describing the different aspects of designing NVC elements for avatars is introduced.

NVC is a wide and diverse topic, and consists of a variety of elements. It would, therefore, be an impossible task to include an exhaustive description of how all NVC elements could be supported. Consequently, only three elements have been chosen for closer discussion. These elements could be described as the visual elements of NVC, and correspond to facial expressions, kinesics and physical appearance. Movement of the eyes and the patterns of gaze are also visual elements, but are excluded from this discussion due to the limitations of the used experimental technology.

This research is primarily constructive in the sense that the avatar constructions and the model were built. As a result, the constructive research method was used. When creating the model, however, also the theoretic-conceptual method was employed. This was done in a manner in which information was generalised from different research cases as well as from the empirical material.

NON-VERBAL COMMUNICATION

Human communication can roughly be divided into verbal communication and non-verbal communication. Verbal communication includes all the verbal aspects of communication, such as words and phrases. NVC, on the other hand, includes aspects such as gestures, movements of the head and body, posture, facial expressions, direction of gaze, proximity and spatial behaviour, bodily contact, orientation, tone and pitch of voice, clothing, and adornment of the body [2]. NVC is involved in most human contact. It may reveal the true nature of emotions, provide hints on personality and work as a channel to send and receive information. NVC emerges in a variety of ways, some of which may not be even consciously thought of [2].

Figure 1 describes the satellite model of the different forms of NVC elements. This model was originally constructed to analyse the elements of NVC in avatars [14]. Classifications of several authors in the social sciences and communication literature have been used in the construction of the model. The aim has been to get as exhaustive a set of NVC elements as possible.

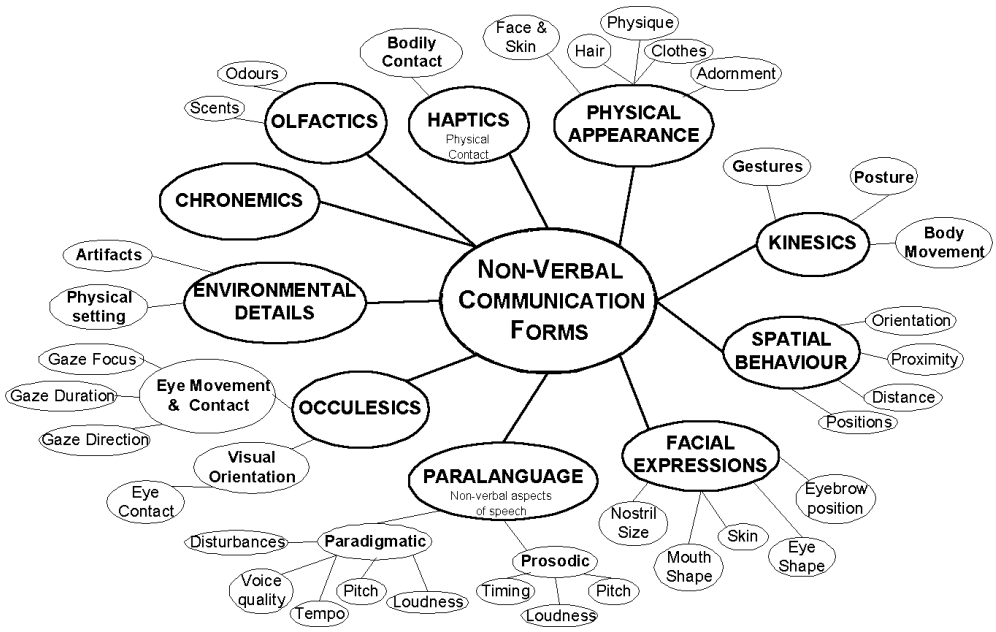

Figure 1: Different elements (forms) of non-verbal communication [14].

The satellite model illustrates the magnitude of different elements in NVC. As previously mentioned, only physical appearance, kinesics and facial expressions have been closely studied in this research. Therefore, only they are shortly described here.

Physical appearance is concerned with the forms of decoration, such as clothes and other adornment, that are entirely under the control of the wearer. It also concerns aspects partly controlled by the person in question, such as physique, hair and skin. [2] Many of these elements provide information on the personality, status, group membership and interpersonal attitude of the sender ([2]; [9]).

Kinesics includes all bodily movement except physical contact. It includes gestures, head nods, posture and movements of other parts of the body [2]. Gestures are different kinds of movements of the limbs, such as, nodding of the head or shaking of the fist. Posture is associated with an activity that is being pursued [2]. It is the state of the body in action, such as watching something intently, being puzzled, or leaning against a wall.

Facial expressions are a very expressive element of NVC. Argyle [2] claims that it is the most important area of non-verbal signalling because of the magnitude of the information transmitted. Facial expressions may be seen to be determined from the position of the eyebrows, the shape of the eyes and the mouth and from the size of the nostril [2].

NVC AND AVATARS

Early versions of avatars have been rather rigid and lacking in emotion [19]. The use of NVC elements is a solution that has been introduced both to create avatars more alive and to support the natural communication between the users. Allbeck & Badler [1] argue that, when actions and communications are the triggers to understand avatars, they should be implemented in a human-like manner.

Human NVC has been studied in the social sciences' field of Psychology and Communication. Researchers such as Argyle [2], Burgoon and Ruffner [6] and Fiske [9] have established the base of the different NVC elements. Several theories have been postulated to describe the different areas of NVC and to establish an understanding of non-verbal behaviour ([2]; [6]).

One way to support natural-looking NVC has been developed in the field of traditional animation. Animators have studied motion and developed animation to its present state [11]. The gestures, postures and facial expressions of contemporary animated characters are very natural, and the animated characters display emotions and movements that seem realistic. The techniques that were developed by the animators have brought the characters to life. The animated characters have, thus, been given unique personalities, and they have given the audience the feeling of being alive ([11]; [15]). Traditional animation is based on eleven fundamentals that were not tied to a particular medium and could, therefore, also be used in 3D computer animation [11].

Avatars have also been studied in different fields. The area of computer graphics and interactive techniques has studied the different aspects of avatars. Research has been conducted, for example, on the simulation of virtual humans. One of the goals has been the creation of virtual humans who look, move and behave as similarly as possible to human beings [13]. Agents, and especially autonomous agents, research has been interested in creating virtual, human-like agents that can communicate with each other and with human participants ([7]; [1]). Collaborative Virtual Environment (CVE) research has also included aspects where avatars have been studied in the context of NVC. The various studies on avatars (embodiments) are related to issues such as channelling information on the environment and the avatars to the users [4].

In the area of computer game research, and in the related literature, different kinds of design guides have been introduced to explain how games could be designed. These design guides also point out different aspects concerning the design of an avatar ([16]; [17]). The design guides, however, mainly concern aspects such as the avatars' appearance and their characteristics. They do not try to explain how NVC could be designed in the avatars.

As a result of the research conducted in these diverse areas, the NVC of the avatars can be constructed relatively well. The possibilities for the avatar's facial expressions have been well studied and natural expressions can be created. These expressions can be modelled both artificially as well as by generating them from a real human face ([5]; [12]). Kinesics - probably being the most utilised part of NVC in human-like computer game avatars - has accordingly been well studied. The tools and methods to model the natural-looking movement of the avatar's body and different limbs already exist ([10]; [3]). In addition, the physical appearance of avatars has also been studied extensively. All aspects of physical appearance, such as physique, clothing and equipment, can be modelled relatively well. The human body can be modelled with varying levels of precision, and muscles can be attached to it to create natural-looking movement [8].

Although avatars' NVC can be modelled and animated to seem natural and realistic, problems still occur. Virtual environments have some characteristics that complicate the implementation and use of the NVC elements. These are, for example, the size of the avatars and the field of view (FOV) [18]. These characteristics set demands for the implementation of

NVC elements. For example, gestures conveyed by hands may not be noticed by others as the avatar may be too close to the camera. Or, contradictory facial expressions may not be seen as the avatar may be too far away from the camera. The use of certain solutions may also cause problems. This is the case, for example, when tracking the user's face for facial expressions in real-time. The user's body often resides in a totally different space than the one in which the avatars appear. This may cause the expressions to be affected by other aspects than the stimuli coming from the virtual environment itself [19]. As a result, unwanted or distracting cues may occur. Even though these characteristics may prevent the use of NVC in exactly the same manner as it is used in real life, they do not prevent the use of NVC elements [18].

CONSTRUCTED AVATARS

In order to be able to construct a model, information on avatars' NVC was required. Existing research cases provided a useful source of information, but a more practical and empirical viewpoint was also desired. For this reason, different avatars were constructed. The avatars were constructed for two environments, both of which offered players a game setting. In both of the games, players also had the possibility to participate in the action outside of the designed game. The first game environment was called **Tuppi3D** and the second was named **Virtual Live Action Role-Play (V-LARP)**. Figure 2 illustrates a few examples of the avatars in the game settings.

The avatars were constructed with the intention to implement as many NVC elements as possible, in order to establish if they would influence the game and the communication between the players. Design and implementation of different NVC elements were conducted using the cyclic development technique. After adding an element to an avatar, it was tested in the game environment. Depending on the results of the test, it was then either accepted, changed or removed. This was done in order to obtain evaluated information for the construction of the final model. Most of the emphasis was on implementing different ways to support the elements of kinesics, facial expressions and physical appearance. However, instances of other elements were also present.

Avatars were used both to provide information for the construction of the model presented in this paper and as a means to evaluate the model. Varying sets of elements were implemented to the different avatars, in order to differentiate them from each other. In order to obtain information on how the NVC elements work, avatars were tested in the game setting. Small user tests were conducted to find out whether NVC elements were used during the game play. In addition to this, more detailed information was obtained from thorough video analyses. The cyclic development technique, the user tests and the

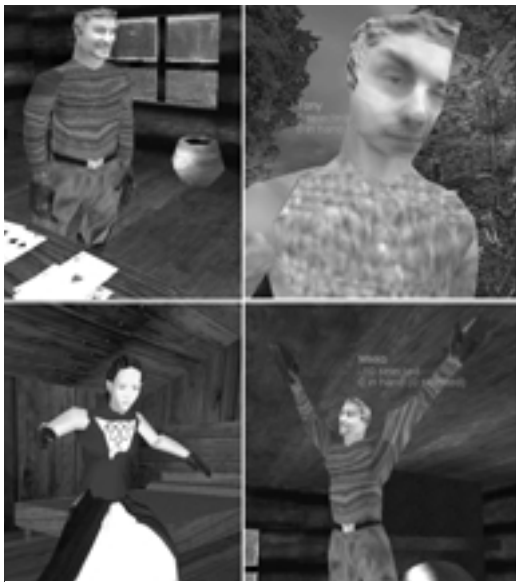

Figure 2: Facial expressions: laughing, blushing, and lifting an eyebrow and some of the kinesics implemented on avatars.

video analyses provided a good base for information gathering and evaluation of the model.

THREE-LAYERED DESIGN MODEL

The constructed avatars and the studied research cases gave reason to believe that by taking certain issues into consideration, more communicative avatars could be constructed. It was noticed that adding different elements of NVC to a game environment resulted in players having increased opportunities of conveying and receiving messages. Another point that quickly became clear was that by varying these elements, even richer and more subtle messages could be sent and received. This is the primary reason why a model to guide the design of avatars NVC was constructed. Figure 3 illustrates the model, which can be used to support the design of more communicative computer game avatars. The model consists of three layers, which correspond to elements of NVC, varying the elements, and personalisation. The design process begins at the bottom layer of the upside-down pyramid from where it proceeds in the upward direction. The issues concerning the design process and the meaning of the layers are discussed in more detail in the following sections.

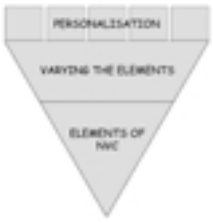

Figure 3: Three-layered design model

Elements of Non-Verbal Communication

The elements of NVC form the first layer of the model. The elements of NVC refer to the different elements of NVC, such as waving a hand or smiling. On this first level of the model, different elements of NVC are chosen. This means that the designer has to decide what kind of basic requirements the game and the players state for the avatars' NVC. When compared with the satellite model, this means that the different elements are first chosen from the highest level and then from the deeper levels of the satellite model. Figure 4 illustrates the three-layered model and its relationship to the satellite model.

Figure 4: Elements of non-verbal communication in the created model and in the satellite model

To provide a clearer picture of what the first layer means, a hypothetical situation is described. When avatar designers are starting their job on the avatars' NVC, they would first need to examine the different NVC element groups, such as physical appearance, kinesics, and facial expressions. These groups can be used as guidelines to aid in deciding which elements could be used. Designers should give a lot of thought to this level, as it builds the avatars' basic set of NVC elements. The design can be started from the general level, from which it can proceed to the more detailed levels. Designers could begin the process by brainstorming as to which kind of kinesics would support the avatars' NVC in this particular game. In other words, they could concentrate on the kinds of movements and gestures players need to see and control. They should, for example, consider whether having the possibility to wave a hand, crouch or stare would enable positive communication results between the players.

All the three visual NVC elements can be first divided into sub-elements and then into the different elements of these sub-elements. The sub-elements of kinesics are, for example, waving, pointing or shaking a fist. Accordingly, the sub-elements of facial expressions are, for example, smiling or raising an eyebrow. Finally, the sub-elements of physical appearance would be the shape of the body or the type of clothing used by an avatar. With each element, one has to take into consideration whether the element in question could support the communication between the players and whether it is essential for the game.

Varying the Elements

The second layer of the created model is built by varying the elements. In other words, this means the different ways that can be used to express the elements chosen in the first layer. At this stage, the different parameters that can shape the element should be considered. An example of this could be speed and trajectory of the hand to obtain different ways to use the "wave" element. Compared with the satellite model, this means that the instances of each chosen element are multiplied. Figure 5 illustrates the second layer of the constructed model and how it affects the elements chosen from the satellite model.

Figure 5: Varying the elements in the created model and its equivalent in the satellite model.

To illustrate the variation of the NVC element, the hypothetical situation started in the last section is now continued. When the animator has selected the NVC element to be used in the avatars, the NVC element needs to be varied in order to create natural-looking actions among the avatars. Different variations can be considered on the basis of the different parameters that alter the instance of an element. These parameters can, for example, be the speed of movement, the trajectory of movement, or the angle between various body parts. These parameters need to be recognised and then modified. For example, if the 'wave' element is chosen, the next stage is to consider the different kinds of 'waves' that can be produced by altering the different parameters such as the speed and trajectory of the arm and hand. Occasionally it may also be beneficial to think in terms of emotional movements. A wave of the hand could be varied to be an angry wave, a happy wave and so on. However, in the end, this variation results in changes in the parameters that shape the movement of the hand, such as speed and trajectories. Another example can be illustrated using facial expressions: if an element is a smile, the mouth could then be varied to result in different nuances, such as a happy smile or a mysterious smile. Also, when considering the physical appearance, aspects such as choice of different kinds of clothing can be considered, or it may simply be the case of creating avatars with different-shaped bodies. Finally, when all the elements have been varied, the animator will have a versatile set of elements that can be implemented into the avatars.

Personalisation

Personalisation forms the third layer of the created model. Personalisation means that avatars have a unique way of communicating using the visual aspects of NVC. When compared with the satellite model, this means that, after varying an element, a certain number of variations could be chosen for use with an avatar. For example, when it

is possible to wave a hand in ten different ways, some of these ways could be implemented to Avatar A and some to Avatar B. Different avatars could have partly the same elements but not exactly the same ones. This could be used to ensure that the communication between the players is natural. Figure 6 describes the third layer of the created model and how it can be seen alongside the satellite model.

Figure 6: Personalisation in the created model and its equivalent in the satellite model.

An example of personalisation is provided to complete the hypothetical situation. After the animator has obtained a versatile set of elements to be used in the avatars, it is time to implement them. On this layer in the model, the animator has to decide the kind of elements to be put together. The created set of elements works as a library of expressions and movements from which natural and communicative avatars should be constructed. Different instances of certain elements need to be implemented to different avatars. The basic rule for personalisation is to create groups of instances in a manner in which separate groups are not too similar to each other. It should also be remembered that instances in one group create the visual outlook and personality of one avatar's NVC. Therefore, the instances should be designed in a manner in which the player can use them naturally and intuitively for communication with other players.

Evaluation of the Model

The created model has evolved based on the constructions and the NVC theories. The avatar constructions were designed for game environments, with the cyclic developmental process of the NVC elements. Video analyses and small-scale user tests were used to gather the data from constructions. The created constructions illustrated the existence of the NVC elements. The constructed avatars had either the same amount or a higher amount of visual aspects of NVC in real-time as most of the cut scenes presented in computer games. The first two layers of the model have a solid base in both the literature as well as in the results of the constructions. It has been verified that the first two layers do, in fact, result in richer and more natural communication forms, even with a low level of support.

The third layer, which emphasises the personalisation of the NVC elements, can also be justified from the literature as well as from the results of the constructions, as it was possible to show that it did, in fact, result in creating the avatar to be more distinguishable and recognisable. It also prevents exactly similar actions from appearing simultaneously in different avatars. However, some further research is still needed to determine to what extent the different elements should be personalised for the avatars. The personalisation of the avatars' NVC elements was, however, found to be important in creating consistent and distinguishable avatars.

When considering how the model presented fits into the actual design process, a few points are need to be scrutinised. The created model does not show the designer how to implement the work. It does not suggest using certain solutions for certain kinds of problems. This aspect may be considered as a weakness of the model. The nature of the model is more general. It attempts to provide the designer with the

tools that guide the process along a certain path. The model indicates the issues that the designer should consider. During the research, it was noticed that the approach presented in the model is capable of pointing out aspects to be consider when designing support for the avatars' NVC. Therefore, it can be said that the constructed model can be applied to the design of more communicative multi-player game avatars.

DISCUSSION

The presented model offers a tool for designing NVC for avatars. Few aspects about the model and the design process should, however, be considered. The NVC model is based on the non-verbal behaviour of real human beings, which takes things, such as the body and the sense of touch, for granted. Virtual environments, on the other hand, have their own special features and limitations. The responsibility of taking these into consideration is left to the designer. The nature of the game also has a crucial part to play. The question on what should be implemented is also left to the designer to decide. It should be noted that all multi-player games are not built around the need for communication. In some games, it may be sufficient to be able to see the avatar of another person. Some games, in contrast, could benefit from the possibility to communicate with the full repertoire of NVC elements.

When comparing the constructed avatars to avatars in computer games, it must be noted that communication between players in networked multi-player games is often not supported to the extent that it could be. Messages, in some instances, can be sent and received, but only a few elements of NVC are usually supported. Most currently available new games have begun to have more elements of NVC implemented into them. Elements such as changing of clothes, transformation of the body and facial expressions have been appearing increasingly. However, NVC elements are often used mainly for decorative purposes. Avatars may gesture and convey facial expressions but often the player has only little control over them. When using the model it should be remembered that NVC should be designed not only to be visible but also to be usable by the players. In this way, the communication possibilities between the players can be enriched and the NVC of the avatars supported.

CONCLUSIONS

This research project introduced a three-layer model to construct visual aspects of NVC for avatars in multi-player computer games. Using the model in the design process of avatars can result in players having an enriched communication possibility when interacting amongst themselves. Players could have more opportunties to express their desires, and it would also permit communication of subtler and more versatile messages. The use of the model can also result in making the avatars more distinguishable, recognisable and natural in the use of NVC.

The created model was used to support the visual aspects of NVC and, therefore, does not take all NVC elements presented in the satellite model into consideration. Some similarities may be found in the other elements used in this model but the model was not tested on those elements. The satellite model is also not used to consider all the characteristics of virtual bodies but is geared mainly for human-based NVC. The satellite model can, however, be used to support human-like NVC, which is of great use to support the weak areas of communication in computer game environments.

The results of this research are significant for designers of avatars for multi-player computer games, as they illustrate the possibilities of the visual aspects of NVC in improving avatars. For the same reason, designers of different types of virtual environments can also benefit from the results obtained.

Further research is, however, required to determine how the model fits in with the design process of avatars. The model should also be tested in the design process to find out whether its layers are valid and utilisable. The third layer of the model was found to be important in making the avatars using NVC elements more distinguishable, but further research is required to determine to what extent the different elements should be personalised in the avatars. The NVC elements characteristic to virtual environments should be studied to find out natural ways of supporting NVC in avatars. The players are not able to control all the different aspects of NVC simultaneously when playing the game and, therefore, research should also be conducted to create methods that would support the players' control and use of the NVC elements.

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