3D EXPRESSIVE ANIMATED BODY MOVEMENTS FOR VIRTUAL HUMANS IN MALAYSIAN CULTURE

AHMAD SHAARIZAN BIN SHAARANI
MASLITA ABD AZIZ

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2011

ACKNOWLEDGEMENT

ABSTRACT

To be believable and human-likes, 3 dimensional (3D) virtual humans need to have goals, emotions as well as interact naturally and reasonably with their environment. They also could be capable to express their behaviour in a manner appropriate to the level of emotion they are expressing, like human do. If a synthetically generated character fails to express the required suitable emotional expression, it will most likely to break users' suspension of disbelief. 3D virtual humans are used rather than video of real person because this research is driven by the need to animate virtual humans' body movement. Thus to study on the believability of the virtual human. The context of this study is to search for the realism and believability of virtual humans that can produce animated body movement. The animation sequence techniques that have been explored are Inverse Kinematics (IK) or Forward Kinematics (FK) and Key Frame Interpolation (KFI). Malaysian culture was adapted in this research to provide initial guidelines for the local developers to create 3D animation regarding Malaysian manner of body expression. The research was focused on animate a 3D human characters that suitable for any age groups. The animated story is about a community advice that tells about how important to be polite and respect to each other.

Key Researchers:

Ahmad Shaarizan Shaarani
Maslita Abd Aziz

ABSTRAK

Bagi menghasilkan kebolehpercayaan dan bersifat seperti manusia, orang maya harus mempunyai matlamat, beremosi serta bertindak secara natural dan bersesuaian dengan keadaan persekitaran. Seperti juga manusia normal, mereka juga seharusnya mampu memaparkan perilaku yang bersesuaian dengan tahap emosi yang diterjemahkan. Jika orang maya yang dihasilkan gagal untuk menterjemahkan jenis emosi yang bersesuaian, akan menyebabkan pengguna tidak lagi percaya. Orang maya dalam bentuk 3D digunakan di dalam penyelidikan ini berbanding video kerana kajian yang dilakukan adalah bagi menilai tahap pergerakan badan animasi orang maya. Pada masa yang sama, matlamatnya adalah untuk mempelajari kebolehpercayaan pengguna terhadap orang maya. Konteks kajian ini adalah untuk menyelidik keaslian serta kebolehpercayaan terhadap pergerakan badan orang maya. Teknik animasi yang digunakan adalah *Inverse Kinematics (IK)* atau *Forward Kinematics (FK)* dan *Key Frame Interpolation (KFI)*. Budaya kehidupan rakyat Malaysia diadaptasikan di dalam penyelidikan ini bagi menghasilkan panduan asas untuk para pembangun setempat membangunkan animasi 3D berkaitan dengan kehidupan rakyat Malaysia yang dikaitkan dengan pergerakan badan manusia. Penyelidikan juga difokuskan terhadap animasi orang maya berbentuk 3D yang sesuai digunakan oleh semua lapisan masyarakat. Animasi yang dihasilkan adalah berbentuk nasihat yang menekan kepada prinsip ramah-mesra dan saling menghormati antara satu sama lain.

Penyelidik:

Ahmad Shaarizan Shaarani
Maslita Abd Aziz

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1 Introduction

At the early age of animation, it was done by hand and all of the frames in animation had to be drawn on a piece of paper. A tremendous amount of work is essential even to develop shortest animated film. There are couple of different techniques were developed for creating animation by hand.

However, the development of computer technology has driven the era in animation in which where it is today. Since the invention of software which enable an animator to developed 2D animation to the invention of software which enable an animator to develop 3D animation, the area of animation have been developed and it is used in many area of industry today.

Talking about 3D animation, people will imagine the movement of realistic character which as same as in the real life. The development of 3D animation today, makes the 3D elements useful in multiple aspects. For example, 3D animation is used for the purpose of advertisement on television, film production, video clip production, short movies and also games industry. The most popular one of the usage of 3D is in the film production.

Usually the interaction with virtual humans can create an empathic feedback from the users. Hence, designing those types of systems is not easy because it is not just using synthetic characters to create content of the story but more importantly the designers can used them to make the scene more realistic, create back-story and invoke participants' mood and empathy. According to Vinayagamoorthy et al. (2004), it is why synthetic characters must be plausible within the context of scenario. At the same time this means that synthetic characters must be perceived by the users to be an authentic part of that scenario.

The psychological states of those characters such as how they are represented and how each state changes based on context and content of the scene must be model (Garau et al., 2003). To model an affective behaviour and built believable synthetic humans is not an easy task because the users of these types of applications normally have their specific expectation of how normal people behave and respond in any specific situation or in any mood of emotions. Observers or participants will expect synthetic characters to behave in a manner befitting its' appearance and will often be disturb by discrepancies in its' behaviour (Vinayagamoorthy et al., 2005).

1.2 Problem Statement

In 3D animation development, the most critical problem is to create a good character which could attract users' attention. The character being developed should suitable with the story line and could bring the message of the story. The weaknesses in character design can cause the story will not be understandable and the message of the story will not be reached by end users.

In the rapid development on animation, most of the animation being created focuses on comedy, wars and happening stories. There are less of animation story which focuses on moral value. Thus, in developing this project, focus were given in developing a story which conveyed a moral value which is suitable with the target users.

Nowadays people rarely care about politeness and respect. Most people might be forgotten to teach their children how to be polite and respect to other person. Adult should show a good manner for young people. That is one of the objectives of this research, with this 3D animation, users should realize how important to respect each other. Besides that, 3D animation is becoming more popular especially for children. This channel can be used to educate them as for example show them the good manner and Malay traditional culture like politeness and respect others.

1.3   Project Goals

One way to realize believable behaviour and understanding the emotional state of virtual characters is from observing virtual characters' body movement. However, the animation of the body addresses so many technical challenges. The process requires multiple parts of the body to be animated. All the body parts must be synchronised and coordinated. So far, a variety of approaches have been used to animate virtual characters. There are still challenges to create animated body movements of virtual characters that can illustrate visually realistic or life-like human characters that act and behave exactly like actual humans.

The goals of this project are to develop 3D animation short stories that have a moral value and can be emotionally entertaining whilst educating people. The entire story is bought to audience in a simple 3D animation story. In addition, this research aims to provide a way of creating synthetic characters that can express emotions. It is hope that, this dynamic virtual human can sufficiently induce users' believability.

1.4   Objectives

In developing this 3D animation there are some objectives that would like to be achieved. It is hopefully that list of objectives for this project will help to achieve the goals of this project. The objective of this project as stated below:

i. To search for realism and believability of animated virtual humans in local Malaysian scenario.

ii. To address the issue whether users could recognise certain body movement patterns from virtual humans as well as study the level of responses and empathy.

iii. To highlights the important of gesture and body movements that may be more significant than visual realism of any animated 3D scene.

1.5   Scope

This project is focusing to animate a 3D animation that suitable for any age. These animations are about a community advice that tells about how important is being polite, respect and each other. This project shows the moral value such as the character attitudes. From the short movie 3D animation, people might be more awareness to mutual cooperation, well-mannered and polite in person.

1.6   Main Contribution of Research

Among the contributions of this research is to address the issue whether users could recognise certain emotions from virtual humans as well as study the level of responses and believability. The question raised here is why it is necessary to study this phenomenon? Since 1980's Disney and other cartoonist have disclose that emotional expressions are necessary substrates for producing plausible characters (Thomas and Johnson, 1984). A few researchers have argued that incorporating emotions in characters is essential to create intelligence and reasoning (Minsky, 1986; Picard, 2003). For example, Minsky (1986) expressed that it is impossible to implement intelligence without emotions.

On top of that, Picard (2003) has argued the inclusion of emotions and affective behaviours may contribute to a richer interaction and give impact on the participants' ability to interact in an intelligent manner. The perception of innate emotions and behaviours in virtual humans is important to impart a sense of unique characteristic and genuine responsiveness to it (Vinayagamoorthy et al., 2005).

Another factor that highlights the important of this research is that gesture and behaviour may be more significant than visual realism of the characters. Bailenson and Blascovich (2004) have argued that "the visual realism of an avatar is only important in that it allows for the generation of social behaviour, and that the important of the avatars behaviour realism far outweighs visual fidelity in

some application". In other words, although visual realism is important to convey certain aspect of virtual humans, it is what the characters' does will convey more information. To support this, Nowak and Biocca (2003) have reported a higher sense of co-presence while interacting with a less humanoid representation. In order to evoke an emotional response in subjects and increase the believability, the appropriate behaviour of characters is more critical than a visual likeness to the human form.

CHAPTER II

LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

This chapter will describe about literature review and project methodology for the whole process of animation. A methodology for the development of multimedia products has focused on what is being developed with less attention to how the product is developed.

2.2 Non Verbal Interaction

Although verbal communication is an important aspect of social interaction, it is not the primary interest in this study. Thus, listing the numerous types of information that can be exchanged using the verbal channel would be beyond the scope of this research.

Nonverbal activity is an important dimension of social interaction. Psychological studies have concluded that more than 65 percent of the information exchanged during a face-to-face interaction is expressed through nonverbal means (Argyle, 1988). Body postures and movements, facial expressions, gaze and tones of voice augment spoken messages and give substance to social interaction. The use of the body in interpersonal communication has been studied in psychology under the name of "Nonverbal Communication". The definition of this field is based on exclusion: one defines nonverbal communication as the use of the whole set of means by which human beings communicate except for the human linguistic system and its derivatives (writings, sign language, etc.).

However, in many cases, nonverbal communication is not used by itself but jointly with verbal communication. For instance, nonverbal signals can be used to underline the importance of a given sentence or to indicate that the speech is over. In contrast, there is a type of signal which is still independent from language: the affective expression. Researchers have demonstrated that nonverbal signals do not need any verbal expression in the task of communicating emotional messages, and that they are able to express in a powerful way feelings that would be very difficult to express using the linguistic system (Cassell et al., 2001).

2.3   Bodily Emotional Expression

Human has the skills to perceive the actions, intentions and emotions of other people. Studies shows that emotions are best expressed by facial expression (Ekman et al., 1972), yet studies also show some body gestures are devoted to convey affective states (de Gelder, 2006; Romano, 2005; Atkinson et al., 2007). As an example, a gesture of a man standing with raising fists could be easily seen in a football match after a favourite team scored a goal. Observers will understand that the person is happy because of the victory. This is an example of natural and general way to express joy and the same for other universal gestures that could be clearly understood by others. It is apparent that bodily cues could lessen the ambiguity while communicating affects (Argyle, 1988).

Another remarkable human social skill is the ability to recognise another's emotions through body posture even if seen from far and when vocal cues are absent and the facial expression is difficult to be seen (Grezes et al, 2007; Walters and Walk, 1988; Brownlow et al., 1997; Dittrich, 1993). For example observers may be alarmed when seeing a person seeking for cover while running with body bend forward (Grezes et al, 2007). This indicates a strong fear signal and illustrate that body posture is capable to express a person's mental state in order to invoke an emotional response to others. This is because human are sensitive to the signals

made by others and conduct their own behaviour through these signals (de Gelder, 2006).

This quality may be explain from the point of view that human bodies are large objects which possess multiple degree of freedom (Montepare et al., 1999) and have much more to offer than text or spoken language (Kipp, 2004). De Gelder (2006) present an exemplar that a fearful face could signal a threat but no added information could be gained as where the threat comes from and what action to take by the individuals fearing for their safety. Instead, terrified body gesture indicates a danger signal and provides information on ways to cope with it (de Gelder, 2006). Bodily cues act as valuable indication not only of the intensity of an emotion but in some situations may act as more dominant source of information in the perception of affect (Ekman and Friesen, 1974) which suggests that human bodies may regard as ideal channels for emotional communication.

A person may display gestures without the conscious intention to communication affect (Bull, 1987) is another statement to support body gesture as ideal emotional communication channel. Normally, human pay less conscious attention to the control of posture than facial expressions especially in a social context (Vinayagamoorthy et al., 2004). It can be considered an adaptive advantage to be able to interpret others emotional displays, nevertheless Coulson (2004) views that there are still challenges in recognizing emotion in body posture as body posture is consider one of the weak nonverbal communication.

The emotional state of synthetic character is defined through values for each of its emotional categories. It is necessary that this emotional state to be expressed through all available channels such as speech, facial expressions as well as body expression. It is not suitable if the characters would smile, but at the same time his/her body posture shows in a different way. However, the systematic manipulation of gesture and body expression of emotions remains a challenge for any research.

2.3.1 Believable Emotional Characters

Human synthetic character originates from artificial human, which was initiated in Artificial Intelligence. The artificial human emerges from the progress in computer graphics and character animation (Witkin and Kass, 1988; Badler et al., 2000; Thalmann and Moccozet, 1998) to imitate human as virtual beings living in simulated environment. This has been the dream of Woody Bledsoe to build a computer friend as he point out during his speech in 1985 in American Association of Artificial Intelligence Presidential Address (Bledsoe, 1986). The dream is also shared by character animators in pursue to find the essence to simulate the characters and reconstruction that essence from the point of view of the artist or scientist (Bates, 1994). In turn synthetic characters are used in many computer applications in order to invoke peoples' responses that perform specific behaviour.

In order for the human synthetic character to invoke peoples' responses, it must represent affective behaviour and emotional feedback (Schroeder and Cowie, 2006; Thomas and Johnson, 1981). The character should eliminate lack of meaningful expression or inconsistencies between appearance and behaviour (Garau et al., 2003). Lack of expressiveness led users to judge the character as 'cold' (Schroeder and Cowie, 2006). Studies within virtual environment have suggested that the more visually realistic the representation gets, the more naturalistic user expect the synthetic character to act (Garau et al., 2003; Tromp et al., 1998).

Effective communication is essential for synthetic characters to interact with a human. One of the recipes for the synthetic characters to effectively interact is the ability of the characters to illustrate believability or life-like (Nayak and Turk, 2005). The synthetic character should be able to be perceived as a living character even though the character is fictional

(Nayak and Turk, 2005). Believable is present when the engaging characters have the capability to capture our attention and leave a lasting impression (Rickel, 2001). Despite being aware that synthetic characters were computer generated, up to some extend, people will believe and respond to them as social actors even in the absence of complex interaction (Garau et al., 2005). Through this engagement the characters could take advantage of the interaction because the connection may possibly reach the level of affecting.

The vision of believability or illusion of life has been explored actively in literature, theatre, film, radio drama and other media (Bates, 1994). Disney animators are one of the groups who made great strides since 1930's (Thomas and Johnston, 1981).

Another element to believability is the synthetic characters' ability to communicate emotions. Emotions are an essential part of our lives, they influence how we think, behave and communicate with others. When the synthetic character lacks emotional expressions, it is regards as indifference towards the human. Therefore, it is important that characters express their emotional state.

2.4   Project Methodology

The purpose of this sub-chapter is to analyze, identify and make conclusion based on the researches that related to the animation that has been developed. Methodology is one of the ways to produce a sequence of flow to make the project appropriate on the track as in the timeline. The steps for developed the project are as follows:

i.   The first phase is planning the idea on how the animation would be look like and then search the info about courtesy and the good manner in Malaysia.

ii. The second phase is analysis in which user requirements are studied and structured.

iii. The third phase is design in which the characters in the short movie animation and make a storyboard to perform the project. It is involved the preparation of storyboard and characters. It is also consider the impact of text, graphics and any audio.

iv. The fourth phase is animation in which the characters modelling were animated based on the storyboard.

v. The final phase is integration in which all the scenes were integrated together. The product was produced after all the processes have completely done.

In particular, Multimedia Development Process (MDP) approach has been implemented in this research. This methodology has three main important stages:

i.   Pre-Production

It is a process of intelligently mapping out a cohesive strategy for the entire multimedia project including content, technical execution and marketing. Based on the goals and objectives, hardware, software and user participation are defined. The following activities:

- Generate the idea on what are going to be animated in 3D
- Development of budget control system
- Selecting of all teams involved in the multimedia application process
- Contracting recording studio
- Software acquisition and installation
- Planning the research work of the content specialists
- Development of the multimedia application outline, scripts, storyboard and schedules

- Coordination of legal aspects of production

ii.   Production

Once all the pre-production activities have been completed, the multimedia application enters the production phase. Activities in this phase include:

- Content research
- Interface design / modeling the character
- Graphics development
- Selection of musical background and sound recording
- Development of computer animation
- Production of digital video
- Authoring

iii.   Post-Production

In this phase, a complete picture is inserted together with the sound and voice element into short movie 3D animation. The sound lips sync combination and synchronized by digital also was done in this stage. The multimedia application enters the alpha and beta testing process. Once the application is tested and revised, it enters the packaging stage. It could be burned into a DVD or published on the television.

2.5 Conclusion

This short movie animation has overcome problems from the current animation. The project is more entertaining and gives moral value to the audience. It is to make users aware about the body movement of good manners and how to respect the older. Besides that, we are using the new software to synchronize with the technology growth. It is also easy to deliver because our project is produce by the advertisement. The next chapter will discuss about the requirements analysis.

CHAPTER III

ANALYSIS

3.1 Introduction

Analysis is an activity performed during the requirements phase. The activities of analysis are focused on the problem domain and concerned with assuring the correctness and completeness of the requirements. The purpose of the analysis phase is to understand the user's requirements and the problem domain.

To develop the project, the software, hardware and user requirements need to be identified. The software requirements that were used to develop the project are Microsoft Office Word 2007, Adobe Photoshop CS4, Autodesk 3D Maya 2010, Sound Forge and Adobe Illustrator CS4. The hardware requirements which were needed to develop the project are a set of personal computer, printer, scanner, digital versatile disc recordable (DVD-R), camera and video cam.

To get the user requirements to develop the project, the interview were conducted to the target users and make an observation. In addition, finding and searching method via the internet were used to get the information about courtesy and polite. The result was analysed to make the design for the project.

3.2 Current System Analysis

The current system is a related system or product that produces 3D short movie animation. BoBoi Boy, Kacang and Culik are example of the current system or product that related to our project. BoBoi Boy and Kacang (Figure 3.1 and 3.3) are produce as animation series while Culik (Figure 3.3) is produces as short movie animation. The current analysis includes the storyline for the related system or product. Storyline is a summary of the story to describe the whole of the story in briefly.