INTERPRETING THE RELATIONSHIP BETWEEN EMOTIONS AND BODY LANGUAGE EMPLOYING MOTION CAPTURE

Ching Xiao Qian

Bachelor of Applied Arts with Honours (Design Technology) 2017
INTERPRETING THE RELATIONSHIP BETWEEN EMOTIONS AND
BODY LANGUAGE EMPLOYING MOTION CAPTURE

CHING XIAO QIAN

This project is submitted in partial fulfillment of
the requirements for degree of Bachelor of Applied Art with Honours
(Design Technology)

Faculty of Applied and Creative Arts
UNIVERSITI MALAYSIA SARAWAK
2017
DECLARATION OF ORIGINAL WORK

This declaration is made on the ................day of................2017.

Student's Declaration:

I ________________________________________________________________
-- (PLEASE INDICATE STUDENT'S NAME, MATRIC NO. AND FACULTY) hereby declare that the work entitled ___________________________________________________________ is my original work. I have not copied from any other students’ work or from any other sources except where due reference or acknowledgement is made explicitly in the text, nor has any part been written for me by another person.

____________________ __________________________
Date submitted Name of the student (Matric No.)

Supervisor's Declaration:

I----------------------------------------------- (SUPERVISOR'S NAME) hereby certifies that the work entitled -----------------------------------------------(TITLE) was prepared by the above named student, and was submitted to the “FACULTY” as a * partial/full fulfillment for the conferment of ----------------------------------------------- (PLEASE INDICATE THE DEGREE), and the aforementioned work, to the best of my knowledge, is the said student’s work.

Received for examination by: __________________________ Date:____________________

(Name of the supervisor)
I declare that Project/Thesis is classified as (Please tick (√)):

☐ CONFIDENTIAL  (Contains confidential information under the Official Secret Act 1972)*
☐ RESTRICTED   (Contains restricted information as specified by the organisation where research was done)*
☐ OPEN ACCESS

Validation of Project/Thesis

I therefore duly affirm with free consent and willingly declare that this said Project/Thesis shall be placed officially in the Centre for Academic Information Services with the abiding interest and rights as follows:

- This Project/Thesis is the sole legal property of Universiti Malaysia Sarawak (UNIMAS).
- The Centre for Academic Information Services has the lawful right to make copies for the purpose of academic and research only and not for other purpose.
- The Centre for Academic Information Services has the lawful right to digitalise the content for the Local Content Database.
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis for academic exchange between Higher Learning Institute.
- No dispute or any claim shall arise from the student itself neither third party on this Project/Thesis once it becomes the sole property of UNIMAS.
- This Project/Thesis or any material, data and information related to it shall not be distributed, published or disclosed to any party by the student except with UNIMAS permission.

Student signature: __________________________  Supervisor signature: __________________________
(Date)  (Date)

Current Address:
________________________________________________________
________________________________________________________________________________________

Notes: * If the Project/Thesis is CONFIDENTIAL or RESTRICTED, please attach together as annexure a letter from the organisation with the period and reasons of confidentiality and restriction.

[The instrument is duly prepared by The Centre for Academic Information Services]
The project entitled ‘Interpreting The Relationship Between Emotions and Body Language Employing Motion Capture’ was prepared by Ching Xiao Qian and submitted to the Faculty of Applied and Creative Arts in partial fulfillment of the requirements for a Bachelor of Applied Arts with Honours (Design Technology).

Received for examination by:

________________________________________

(Mdm. Jong Sze Joon)

Date:
ACKNOWLEDGEMENT

I am grateful to God for the good health and wisdom that were needed to complete this thesis.

I would like to express my sincere appreciation to Madam Jong Sze Joon, my supervisor, for giving sincere and valuable guidance and advices that are totally helpful to me for this research.

I take this opportunity to express gratitude to all the lecturers in the Department of Design Technology. I am very thankful to them for providing me sincere advices, recommendations and encouragement to me for this thesis.

I place on record, my sincere thank you to Mr. Lincoln, technician of Animation program for sharing expertise and sincere guidance to me along the experiment being carried on.

I am also feeling thankful to my parents for the encouragement, support and attention that they have given to me along this research.

I am thankful to CMU Graphics Lab Motion Capture Database for allowing me to use the database for free. The data used in this project was obtained from mocap.cs.cmu.edu. The database was created with funding from NSF EIA-016217.
Lastly, I would like to take this opportunity to express my sense of gratitude to each and everyone who directly or indirectly have lent their hand to me in completing this research.
# TABLE OF CONTENT

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form Validation Status Report</td>
<td>i-ii</td>
</tr>
<tr>
<td>Confirmation and Supervisor Signature</td>
<td>iii</td>
</tr>
<tr>
<td>Acknowledgement</td>
<td>iv-v</td>
</tr>
<tr>
<td>Table of Content</td>
<td>vi-viii</td>
</tr>
<tr>
<td>Abstract</td>
<td>ix</td>
</tr>
<tr>
<td>Abstrak</td>
<td>x</td>
</tr>
</tbody>
</table>

## CHAPTER 1: INTRODUCTION

1.0 Background Study 1-2
1.1 Rationale and Motivation 3
1.2 Problem Statement 3
1.3 Research Questions 3
1.4 Aim and Objectives 4
1.5 Importance and Significance of the Research 4-5
1.6 Scope and Limitations 5-6
1.7 Assumption 6
1.8 Research Methods 7-8
1.9 Research Design 8-9
1.10 Definition of Terms 9
1.11 Organisation of chapters 10-11
## CHAPTER 2: LITERATURE REVIEW

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>The Psychology of Emotions</td>
<td>13-14</td>
</tr>
<tr>
<td>2.1</td>
<td>The Body Language</td>
<td>14-15</td>
</tr>
<tr>
<td>2.2</td>
<td>The Recognition of Emotions Through Body Language</td>
<td>15-18</td>
</tr>
<tr>
<td>2.3</td>
<td>Summary</td>
<td>19</td>
</tr>
</tbody>
</table>

## CHAPTER 3: METHODOLOGY

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>Introduction</td>
<td>20</td>
</tr>
<tr>
<td>3.1</td>
<td>Qualitative Method</td>
<td>20</td>
</tr>
<tr>
<td>3.1.1</td>
<td>Experimentation</td>
<td>20</td>
</tr>
<tr>
<td>3.1.1.1</td>
<td>Participants</td>
<td>20</td>
</tr>
<tr>
<td>3.1.1.2</td>
<td>The 3-Dimentional Character Model</td>
<td>20</td>
</tr>
<tr>
<td>3.1.1.3</td>
<td>System</td>
<td>21</td>
</tr>
<tr>
<td>3.1.1.4</td>
<td>Actors’ interaction</td>
<td>21</td>
</tr>
<tr>
<td>3.1.1.5</td>
<td>Procedure</td>
<td>21-22</td>
</tr>
<tr>
<td>3.1.2</td>
<td>Online Observation Survey</td>
<td>22</td>
</tr>
<tr>
<td>3.1.2.1</td>
<td>Respondent</td>
<td>22</td>
</tr>
<tr>
<td>3.1.2.2</td>
<td>Procedure</td>
<td>22</td>
</tr>
<tr>
<td>3.2</td>
<td>Summary</td>
<td>23</td>
</tr>
</tbody>
</table>
# CHAPTER 4: DATA ANALYSIS AND FINDING

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Introduction</td>
<td>24</td>
</tr>
<tr>
<td>4.1</td>
<td>Results of the Online Observation Survey</td>
<td>24-26</td>
</tr>
<tr>
<td>4.1.1</td>
<td>The Observation on Motion Capture Data</td>
<td>27</td>
</tr>
<tr>
<td>4.1.1.1</td>
<td>The Joyful Expression</td>
<td>27-28</td>
</tr>
<tr>
<td>4.1.1.2</td>
<td>The Sadness Expression</td>
<td>28-29</td>
</tr>
<tr>
<td>4.1.1.3</td>
<td>The Anger Expression</td>
<td>30-31</td>
</tr>
<tr>
<td>4.2</td>
<td>Results of Creating Animation</td>
<td>32</td>
</tr>
<tr>
<td>4.2.1</td>
<td>The Sad Animation</td>
<td>32-34</td>
</tr>
<tr>
<td>4.2.2</td>
<td>The Joyful Expression</td>
<td>35-36</td>
</tr>
<tr>
<td>4.3</td>
<td>Summary</td>
<td>36</td>
</tr>
</tbody>
</table>

# CHAPTER 5: CONCLUSION AND DISCUSSION

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>Introduction</td>
<td>37</td>
</tr>
<tr>
<td>5.1</td>
<td>Discussion</td>
<td>37-39</td>
</tr>
<tr>
<td>5.2</td>
<td>Limits and Constraints</td>
<td>40-41</td>
</tr>
<tr>
<td>5.3</td>
<td>Conclusions</td>
<td>42</td>
</tr>
</tbody>
</table>

**References**

43-44

**Supplementary Material**

44

**Appendix 1: Online Survey Form**

45-52
Abstract

Human communication is not only words but also involving body language and facial expression. Body language plays an important role in enhancing the communication in daily life. Nevertheless, body language is important to deliver the emotion more effectively. This research is carried out to study the correlation between emotion and body language through the employment of motion capture. The objective of this study is to investigate whether human body languages relate the exact emotion of a subject without facial expression. This study proposes a framework to assist animators and researchers to have a better understanding through the analysis of emotional state and body language of the character in animated films. The experimentation has been conducted by using motion capture system to capture a number of predefined motions of actors. However, the experiment was failed due to some limitations. Therefore, it was continuing by taking the data from online motion capture library and the data were analysed thoroughly. The survey was carried out in this study as well. The results indicated the importance of the body language and emphasise the key features of the body that could be useful to associate with the emotions.

Keywords: Body Language, Emotions, Motion Capture
Abstrak


Kata kunci: Bahasa Gerak-geri, Emosi, Motion Capture
CHAPTER 1
INTRODUCTION

1.0 Background Study

Body language is a significant aspect of communication and relationship. It reveals one’s feelings and meanings to the others. In the past few decades, body language has been studied broadly. Walt Disney is one of the companies that have established numerous studies on body movement, not limited to human motion but also animals’ motion. The twelve principles of animation can be used to enhance their character animation: squash and stretch, anticipation, staging, straight ahead and pose to pose, follow through and overlapping action, slow in and slow out, arc, secondary action, timing, exaggeration, solid drawing and appeal. These twelve principles help the animator to has a better understanding and enhance the character body movement in the animation.

Nevertheless, neglecting the emotions and personalities of the character might happen if one is focusing too much on making the character alive due to the deadline or ignorance. To reveal the emotions successfully through the body movements that acted by the character in the animation is very difficult. This is because even messages are hard to be delivered accurately through speech, not to say only body gestures. Misunderstanding always occurs between human. Therefore, delivering the correct emotions to the audience through body movement in an animation is very important. This could lead
the audience to understand the focus of the whole story throughout the animation.

There are many acting games that can be seen on the television entertainment show which the players need to deliver few words or meaning through their action without any speech or lips movements. The players always spend up to few minutes to deliver the exact words successfully or they don’t even get to deliver the words to their own team player. But here again, body language is important to support the speech and the facial expression in order to deliver messages and emotions. The concept of this game is applied similarly to this research.

This research is to examine the effectiveness of an emotion being recognised from the 3D character model’s motion without speech and facial expression. The real-time reaction will be recorded by motion capture according to the situation given. This is to study the direct body movement that given by the human based on the emotions given. This research will concentrate on studying the details of the body movements in order to investigate the key features for every emotion given.
1.1 **Rationale and Motivation**

The motivation of this study is to investigate the emotions based on the human body movements through a real-time system called motion capture.

1.2 **Problem Statement**

There are many animations have been produced these days. However, many of them did not pay attention to create an effective emotion through animating the character body movement. Those animated characters have the same body movement in expressing the same emotion. For example, looking downwards with a bent body is the typical sad body gesture that the animator loves to animate a sad character. Therefore, an experimental investigation is conducted to explore the key features of the human body movement for different emotions without the distraction of facial expression and speech.

1.3 **Research Questions**

i. To what extend can the emotion be perceived and communicated through body language?

ii. How to recognize the association between emotions and body language?

iii. Which specific movement should be used to enhance each emotion?
1.4 Aim and Objectives

The aim of this research is to study the correlation between emotion and body language through the employment of motion capture. The goal is to investigate whether human body languages relate to the exact emotion of a subject without facial expression and speech. As well as determining the key features that play important role in order to express the emotion effectively through body movement.

There are few objectives stated below to achieve through the research.

i. To identify the effectiveness of body language on the emotions.

ii. To investigate the implication of emotions on audiences through body language.

iii. To examine the key features from the natural body movements that reacted directly from the actors.

iv. To propose a framework to assist animators and researchers for further use or study based on the result.

1.5 Importance and Significance of the Research

The findings of this study will give many benefits to the animators considering that body language plays important role in the animation in order to deliver the emotions effectively. The increases in the animation demand provide a huge motivation to the animator to create effective emotional animation. Therefore, transforming the results into applications will be able to train a better future animator. Furthermore, this study will help the
researchers for further discoveries. Thus, the animation will have a lot of improvements.

1.6 Scope and Limitations

This research was conducted to determine the correlation between the emotions and the body language through motion capture. Facial expression and lips sync were not part of the subject matter. This study only focused on the full body movement.

The aspects of emotions for this study were the three main emotions: joy, sadness and anger. Two actress and two actors were invited for this experiment. They were all student from Universiti Malaysia Sarawak (UNIMAS) with different ages, context, races, weight and height. The survey was conducted through the online survey form. The respondents of the survey were not limited to the student from Universiti Malaysia Sarawak (UNIMAS).

The motion capture system used was the optical-passive motion capture. This is a technique used to record the body movement by tracking the retro-reflective markers that stick on every important part of the body with the infrared cameras. Although the tools used were not the latest technology in this day and age, but it is sufficient for this study. Figure 1.0 Scopes and Limitations of the research are shown below:
1.7 Assumption

There are a few assumptions to be made:

i. Different people will show different body language for the same emotion.

ii. People with different background, context, gender, races, weight and height shows different body movements to show the same emotion.

iii. The motion capture system used shows unstable results for first few trials due to the first attempt.
1.8 **Research Methods**

The research method used in this research was both qualitative and quantitative methods. The research method used in this research is divided into two parts; they are the experiment by using motion capture and the online observation survey. In this case, the survey was categorised under qualitative and quantitative method. This is because it is considered as an interview via online survey form and it also involves the numbering as well. It is more towards on obtaining the opinion from the observation of the audiences.

This method was carried out to determine whether the audience able to relate the body movement to the desired emotion and they were asked to give reasons to support their observation. Therefore, many information were able to gather at this stage.

Two female students and two male students from Universiti Malaysia Sarawak (UNIMAS) were asked to carry out the experiment using optical-passive motion capture. They were asked to react according to the given situation. The data collected from the motion capture was mapped into a 3-Dimensional character model without any facial expression and speech. This is to more focus on the body movement.

However, due to the time consuming and the failure in arranging the experiment. The study was then continuing by using online motion capture
library. Three most suitable data were selected and used in the online survey form according to the emotions that had been set in the beginning of this study.

The survey was created by using Google form because there were many videos needed to be shown in the survey. The survey form was classified into three parts: the personal information, the observation on motion capture data and the observation on the animated animation.

There were four questions asked in the personal information section, three videos were taken from the online motion capture library were shown in the observation on motion capture data section and two videos were taken from “The Mist” were shown in the observation on the animated animation. The data was collected from 35 respondents and analysed in chapter 4.

1.9 Research Design

*Figure 1.1* shows the flow chart of the research design. Literature review on previous works related to this research is studied. A research is carried out to make some minor improvements in order to enhance the character body movements in the animation. Motion capture is the main technique used to capture the body movements. The data is then mapped into a 3-Dimentional-character model. An electronic survey together with the mapped animated 3D character model will be carried out. This survey is to test whether the audiences can relate the body movements to the desired emotions and collect
the feedback for every answer that is chosen based on the audience’s observation. Next, an analysis of the key features will be carried out. The result will be used as a guideline to enhance the character emotions in the animation.

1.10 Definition of Terms

Body language - the process of communicating non-verbally through conscious or unconscious gestures and movements.

Motion capture - a process by which a device can be used to capture patterns of live movement; the data is then transmitted to a computer, where simulation software displays it applied to a virtual actor.
1.11 Organisation of Chapters

This study consists of five chapters. Chapter 1 is the Introduction. This chapter consists of background study, rationale and motivation, problem statement, research questions, aim and objectives, importance and significance of the research, scope and limitations, assumption, research methods, research design, the definition of terms and the organisation of chapters. This chapter is to introduce the research topic by identifying the purposes and the methods in order to investigate new findings. This gives a clearer picture to the researchers on what and why is he or she doing this research. Figure 1.2 shows the organisation of the chapter.

Chapter 2 is the Literature Review. There is few sub-topic are discussed in this chapter. They are the psychology of emotions, the body language and the recognition of emotions through body language. This chapter is to study the subject matter thoroughly by reading the related works that had been done by the past researchers and the professional. This chapter enables the researchers to refined or makes improvement from the past researchers.

Chapter 3 is the Methodology. Qualitative and quantitative methods are the method used in this research. The qualitative method consists of two categories: experiment and online observation survey. This chapter is to help to investigate the correlation between the emotions and the body language through motion capture. It also helps to obtain more details information from the observation of the audiences.
Chapter 4 is the Data Analysis and Findings. This chapter consists of results and solutions. This chapter is to analyse the data obtained from the survey form and provide solutions and recommendations to achieve the objectives of this research.

Chapter 5 is the Conclusion and Discussion. In this chapter, conclusion and discussion is discussed. This chapter is to conclude the entire research that had been done after data collected and discuss the future application for the improvement in animation.

Figure 1.2 Organisation of Chapters
1.12 Summary

In conclusion, body language is an important element in delivering effective emotions. This study is to investigate the emotions based on the human movements through motion capture. Many animators tend to neglect to put more spirit into the body movements. Thus, observing the key features of the human body movement for different emotions without any distraction of facial expression and speech is needed.

The objectives of this study is to identify the effectiveness of body language on the emotions, investigate the implication of the emotions on the audiences through body language, gain deeper understanding of the role of the body language and examine the key features from the natural body movements that reacted directly from the actors. This study only focuses on observing the full body movement that reacted based on three main emotions: joy sadness and anger, using motion capture. The results obtained from this research can propose a framework to assist animators and researchers for further use.