Conveying Expressions Without A Face

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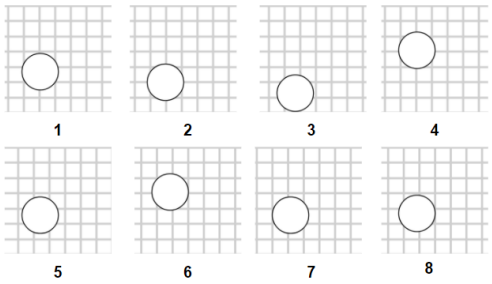

Figure 1: *Conveying expressions without a face.*

Abstract

This paper analyzes how expressions can be demonstrated by the use of movements without the presence of facial features; in this paper, few parameters such as horizontal speed, vertical speed, jump wait time, size, and gravity are applied to a circle which is animated according to certain characteristics that make up an expression. The goal of the research is to be able to model how expressions work like in an animated movie where the animated characters expression is obvious, but the character is animated from behind without the face being displayed. As a first phase of the research, we apply hand-drawn animated circle that illustrates six different expressions: sadness, anger, surprise, disgust, fear, and neutral. Then, parameters that make up the expressions are removed from the animation for further analysis regarding how the resulting animation alter the expressed outcomes. As a final phase, an automated program with the ability to change the parameters mentioned above is coded so that these animations can be produced at a better quality and higher efficiency. Experimental results show that vertical speed in combination with jump wait time play a major role in conveying expressions into figure without the presence of a face.

Keywords: animation, expression, face, object

1 Introduction

Expressions and exaggerations are essential parts of the animation world; often expression in animation is associated with the characters face and non-facial parameters such as body language, movement speed, and posture. Facial expressions are often used when the animation shows a close up highlight at the character. However, often in animated cartoon movie, the characters expressions and mood is shown through the posture and body language of the character.

Figure 2: *Animated character's expression from Toy Story with no face present.*

Figure 3: *Animated character's facial expression from Toy Story.*

When faces are not present in an animated character, few distinct and strong characteristics are applied to the character in order to show the apparent expression of the character. This concept can therefore be simplified, generalized, and applied to a simple figure such as a circle that is given those few characteristics so that a certain expression can be drawn out from the animation. Few techniques that are involved in the research process include the following: Hand-drawing basic expression: animated circles are hand-drawn and associated to basic expressions: sadness, anger, surprise, disgust, fear, and neutral; then, parameters are removed which alters the expressions of the circle. Automatic program: the program we create allows to create a constant and repetitive animation of a circle while at the same time allowing parameters to be changed

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once at a time or multiple parameters at the same time. The parameters that are involved include horizontal speed, vertical speed, jump wait time, circle radius, and gravity. This would help producing better animation as well as higher efficiency in showing the alteration throughout the animation process.

2 Related Work

Prior to deciding to focus only on the sad expression, we looked into what features define all of the six cardinal expressions.

- Sadness
  - It is an emotion that makes a person want to withdraw, stay out of the way of what has hurt them and what could further hurt them.
  - Slow. This emotion is slow because it is weighted with sorrow.
  - The weight is seen all through the body, everything droops.
  - A closed body posture was the second very important feature of this emotion. Hide behind themselves in various fashions.
  - Sunken shoulders that were pushed forward.
  - The arms were made slack instead, barely moving from side to side, in a demure fashion.
  - To extend the closed body posture throughout the character the feet were turned inward slightly,
  - Lastly the head was turned away and down. The model did not want to face you or anyone, or even the world. They were much more content in watching their feet.
- Anger
  - The angry posture was focused on stiff action. They were posted to walk aggressively, a fixed intent on moving forward.
  - The steps were more determined. The arm movements wider, rougher. The model was tensed up.
  - Stiff, wide, rough, tense movements
  - Tense
  - Sharp and focused
- Surprise
  - Strong anticipation phase
  - Reaction is fast
  - Emphasise with pause or vibration
  - Make the let down the longest of all phases
- Neutral
  - Calm movement
  - Relaxed, constant speed
  - Slacked shoulders, at level with torso
  - Head is in slow manner
  - Hand swung in time with feet, casual flow
- Disgust
  - Active muscles around the nose
  - eyes are more relaxed compared to anger
  - lowered eyebrows
- Fear
  - Freezing in place
  - escaping from immediate danger
  - focusing attention to eliminate danger.

Of course, all of these items apply mostly to human forms, but our plan initially was to convert the various human aspects of these descriptions of human expressions to ones that could be applied to just a ball. Thus, we chose the features that were more general, rather than ones that applied to a specific part of the human body, such as the face or the arms.

3 Approach and Methodology

The approach to this problem was as follows. We decided to isolate which features correspond to what emotion. Looking at the related works, we decided to focus on the sad expression, and manipulate various aspects of the speed of the ball that we animated. We animated a single ball.

We chose to manipulate the following variables:

- Speed X - the speed with which the ball moved in the x-direction.
- Speed Y - the initial speed with which the ball jumps off the ground (which correlates with height that the ball jumps).
- Jump Wait - the amount of time that the ball waits (in frames)

These animations were generated with software that we created to increase accuracy of the manipulated variables.

All possible permutations of the selected values for the manipulated variables were generated, and then all possible pairs of each generated image were created, for a total of 8 images, and $\binom{8}{2} = 28$ pairs. The reason we compared each image to each other image is so that we could isolate and control for other variables more easily.

The question that was posed is "Pick the GIF that you find has sadder expression".

For each of the 28 pairs, we requested that the question be answered by 10 different people. The reward for each answer was 1 cent, for a total of $2.80 reward, plus fees.

The test took approximately 6 hours to complete, with an average time of 1 minute 47 seconds per assignment.

4 Results

4.1 Hand-Drawn Animation

Several hand drawn animations that were created before the software that generates animation was created provide good results in conveying expressions without the presence of a face. The hand drawn animation involves a circle that is animated to convey an expression (such as neutral, sadness, etc.) through an action of bouncing. However, unlike the animations produced by the software, animations in hand drawn animation possess parameters that are not very precise and consistent; meaning that the parameters are not uniform for all expressions generated. Besides the speed that does not have good precision, hand drawn animation does not have

good effect that reflects the result of bouncing such as squash and stretch. With this being said, it would not be possible to generate good results from the experiment that involves changing the parameters that determine expressions of the animation. Hence, good and reliable results cannot be drawn.

4.2 Software-Generated Animation

With the help of software that allows to modify determining parameters to generate the animation, more reliable outcomes can be generated. The software generates animation of a bouncing circle with modifiable parameters including horizontal speed, vertical speed, jump wait time, circle radius, and gravity (note that for this project, circle radius and gravity are kept constant). As part to drawing results of the experiments, 8 animations are created with various parameters. Variations of the parameters include horizontal speed, vertical speed, and jump wait time. Figure 4 below shows the 8 animations along with the parameters that construct them.

Image	Speed x (pixels/frame)	Speed y (pixels/frame)	Gravity (pixels/frame/frame)	Jump Wait (frame)	Circle Radius (pixels)
1	1	4	0-3	10	50
2	1	4	0-3	50	50
3	1	4	0-3	500	50
4	1	8	0-3	10	50
5	1	8	0-3	50	50
6	20	4	0-3	10	50
7	20	4	0-3	50	50
8	20	8	0-3	50	50

Figure 4: *8 animations with parameters that construct them.*

The goal of generating these 8 animations is to determine which animation has the saddest expression, and what parameters contribute the most to conveying sadness. In order to draw the results, each animation is paired with all the other animations (in total generates 28 animation pairs), and a user study is conducted using Amazon Mechanical Turk. The user study involves 10 people where each person will choose which animation has sadder expression for the 28 animation pairs. Figure 5 shows the result for each animation pair, showing how many people select one animation from the pair to have sadder expression.

Hence, from results shown in the previous table, a rank table showing animations and how many times each animation is selected to be sadder than other animations can be generated. This is shown by the table below.

From the results obtained from Figure 4 and Figure 6, a few key ideas about parameters that contributes to conveying sadness can be drawn out. Firstly, based on the sadness rank, it can be seen that animation 3 with the longest jump wait time of 500 frames is ranked first, followed by animation 8, 7, and 2 with jump wait time of 50 frames. Secondly, from the rank table, it can also be seen that animation 3, 7, 2, 6, 1 in descending rank have common parameter in which speed y is 4 pixels/frame. This order is just interrupted with the presence of animation 8 (speed y of 8 pixels/frame) as second in the rank after animation 3. Lastly, horizontal speed does not really have an obvious pattern in the rank table since animation 3 as the saddest has speed x of 1 pixels/frame, followed by speed x of 20 pixels/frame for animation 8 in the second place. This not obvious trend goes on until the bottom of the rank table. In order to determine which parameter (horizontal speed, vertical speed, and jump wait time) have the greatest impact in conveying sadness in faceless animation, each parameter is isolated and the vote count for variation of each parameter is calculated. The results are shown by figures 7-12.

From the results shown by the tables and figures on the previous

Image A v Image B	Image A	Image B
1v2	1	9
1v3	1	9
1v4	8	2
1v5	6	4
1v6	3	7
1v7	5	5
1v8	1	9
2v3	1	9
2v4	9	1
2v5	9	1
2v6	5	5
2v7	5	5
2v8	0	10
3v4	9	1
3v5	9	1
3v6	10	0
3v7	8	2
3v8	7	3
4v5	1	9
4v6	3	7
4v7	0	10
4v8	2	8
5v6	2	8
5v7	1	9
5v8	3	7
6v7	4	6
6v8	3	7
7v8	3	7

Figure 5: *Results of each animation pair showing how many people select an animation to be sadder from its pair.*

pages, it can be seen that vertical speed plays a major role in conveying sadness where user study shows that 70.7 percent animation that moves slower are considered to have conveyed sadness. Compared to the results of horizontal movement (from Figure 7), vertical movement plays greater role in conveying sadness. Besides that, it can also be seen that the slower movement rhythm can be closely linked with sadness; this is shown through jump wait where one animation with jump wait time of 500 pixels/pixels/frame is enough to generate 21.8 percent of the overall vote for sadness resulting from jump wait time. Furthermore, jump wait of 50 pixels/pixels/frame generates 53.6 percent of vote for sadness. For the expression of sadness in a person, jump wait time can be seen as an analogy that a person tends to stay still in position longer when they are sad. This is consistent with the results which shows that vertical movement speed and jump wait time (both related to movement in the vertical direction) have large impact in conveying sadness when compared to movement in the horizontal direction.

Rank from Saddest (Animation)	Vote
3	61
8	51
7	40
2	38
6	34
1	25
5	21
4	10

Figure 6: *A rank table showing animation number and vote count of being sadder than other animations.*

Speed x (pixels/frame)	Vote	Percentage
1	155	55.4
20	125	44.6

Figure 7: *Difference in horizontal speed and vote count for its impact in conveying sadness.*

5 Conclusion and Future Work

This project has demonstrated a simple program that allows for the generation of animation that conveys expressions without the presence of a face. The program allows for modification of five parameters including horizontal speed, vertical speed, jump wait time, circle radius, and gravity. The results obtained from user study have shown that vertical speed in combination with jump wait time have created a big impact in conveying expressions of animation without the presence of a face. The outcomes of this project might be useful to be utilized in future projects which involves animating objects into a story/movie. In the past, several objects have been animated and made into a movie. An example of this would be the cartoon animation in the movie Cars where cars are animated. However, faces are still present in the animation.

6 Citations and References

References

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Speed y (pixels/frame)	Vote	Percentage
4	198	70.7
8	82	29.3

Figure 8: *Difference in vertical speed and vote count for its impact in conveying sadness.*

Jump Wait (frame)	Vote	Percentage
10	69	24.6
50	150	53.6
500	61	21.8

Figure 9: *Difference in jump wait time and vote count for its impact in conveying sadness.*

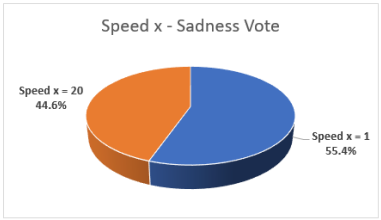

Figure 10: *Graph for difference in horizontal speed and vote count for its impact in conveying sadness.*

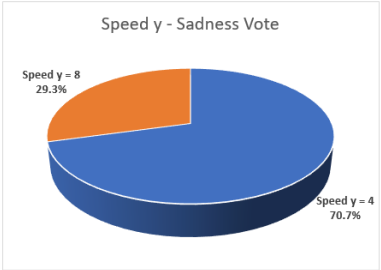

Figure 11: *Graph for difference in vertical speed and vote count for its impact in conveying sadness.*

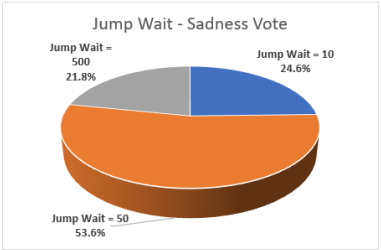

Figure 12: *Graph for difference in jump wait time and vote count for its impact in conveying sadness.*