

顔印象評価を用いた 3DCG 顔印象連続変形装置

3DCG Face impression continuity deformation device using Face impression evaluation

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Abstract: We collected the impression words from books about face, and beauty magazine. Then the impression evaluation using 24 face one model that was produced in 3Dimensional Computer Graphics, to give a factor determining the impression of the face. Thus, we have created a face impression continuous deformation apparatus of 3DCG facial model. In this study, we focused on the impression by the structure of the human face. So, we change the width, shape, angle and contour, such as eyebrows, eyes, nose, mouth of each part that make up the face gives, with respect to the impression of such a healthy, bright, warm, friendly. Through the production in 3DCG which model you want of research, representation can be a three-dimensional impression of the face. Then, based on the impression factor obtained by principal component analysis, we propose a system that can be formed more easily a new impression of one face.

Keywords: Face impression, Three dimension computer graphic, Facial modeling

1. Introduction

There have been a lot of past studies on face impression evaluation. In most of their studies, impression evaluation factors were derived by principal component analyses with some stimulus words for figures simply consisting of facial profile, eyebrow, eyes, nose and mouth by illustration and photos for which each expression was shot and their relationship with the parts were described. For example, Abe et al. (2008) related impression evaluation factors such as fresh by shape and placement of elements such as facial profile, eyes, eyebrow, nose and mouth, using features map determined beforehand and Kaneko et al. studied a portrait development system by which eyebrow, eyes, nose, mouth and profile were transformed. In this study, the authors produced a three-dimensional face for real expression and designed a system that newly forms a face based on impression factors. Here, we deal with positive face creation not with a face that is already made and aim at applying the technique to creation of new characters in CG production.

2. Method and Purpose of the Study

The purpose of this study is to understand the factors that determine face impression by evaluating face impression created using 3DCG, to examine the structural features of the face that influence these image evaluations, and to deduce the regularities of facial structure that provide these images. Furthermore, we create various facial models based on the regularities deduced from the basic model and demonstrate the process for proposing a template for CG facial modeling. In this study, it was possible to quantify facial modeling by creating an experimental face using CG and recording and reproducing the parameters that changed on each part of the face.

The study method consisted of studying modern perceptions by referring to books, etc. relating to beauty and faces that were targeted at young people and collecting words and phrases relating to facial expressions from

various magazines to identify image expression trends. Using these as references, we extracted stimulus words for use in the image evaluation experiment. Then, we conducted image evaluation on a 3DCG facial model using the SD method and, while determining the mutual semantic relationship of impression words by extracting the mutual correlation of impression words and factors relating to image evaluation, we also deduced the regularities from a surface anatomical perspective. Furthermore, we created a template for facial modeling from the regularities deduced.

3. Image Evaluation Experiment for Facial Models

3.1. Study of Impression Words

In order to conduct a face impression valuation, we studied impression words by referring to descriptions in magazines. Specifically, we focused on current facial expressions as expressed in magazines aimed at young people and extracted words from magazines that target women from their late teens to their forties. We studied 12 magazines; 'Be-Story', 'Bijin-Hyakka', 'Lips', 'SOUP', 'JJ', 'KERA', 'SEDA', 'MAQUIA', 'STORY', 'ar', 'BITEKI' and 'KATY'. We also studied six books relating to beauty or faces 'CUTiE Make-up 2012', 'Actress Make-up', 'With: Super Simple Cute Make-up for Adults', 'All about Make-up Method', 'Reading Faces' and 'Face Analysis'. Table 1 summarizes and classifies the impression words collected from the magazines and books. The 89 impression words were organized and classified into word groups; nouns, adjective verbs, adjectives, adverbs, and 'Other (multiple expressions)'. As a result of the classification of the impression words, we found that the magazines and books we studied, which were aimed at women, included many distinctive expressions to create a specific atmosphere.

Table 1: Impression Words Studied from Books relating to Beauty and Faces

Nouns	Adverbs
Baby face	Plump
Mature face	Soft
Mixed race face	Other (multiple expressions, etc.)
Childlike face	Elegant
Fox face	Smart image
Childish face	Refined
Lonely face	Cool beauty
Heroine face	Dependable face
Dolly face	Mature face
Princess face	Dependable-looking face
Elegant face	Haggard face
Romantic face	Grown-up cute
3-D face	Adult-like cute
Spring face	Refined and trim
Doll-like face	Cool and cute
Manly face	Healthy and bright
Pure face	Mature and gentle
Sweet face	Celebrity
Lady face	Beautiful, womanly face
Lion face	Kind and feminine
Adjective verbs	Soft and pretty
Healthy	Grown-up pretty
Neat and trim	Slightly girly
Beautiful	Neat and sharp
Natural	Graceful image
Refined	Pampered baby face
Sexy	Innocent and loved face
Generous-hearted	Cool and enchanting
Cute	Soft, sweet face
Girly	Mixed race celebrity-like face
Manish	Bare-faced fresh face
Formal	Orthodoxly popular face
Cold	Innocent and cute
Handsome	Urban beauty
Rich	Devilish doll face
Adjectives	Sexy and coquettish
Childish	Beautiful actress face
Sweet	Gentle and soft
Feminine	Cool, mature face
Cool	Self-assured adult image
Cute	Grown-up, smart image
Gentle	Sharp cool
Bright	Sharp and cool
Severe	Kind and gentle
Adult-like	
Childlike	
Gentle	

3.2. Creating a 3DCG Model

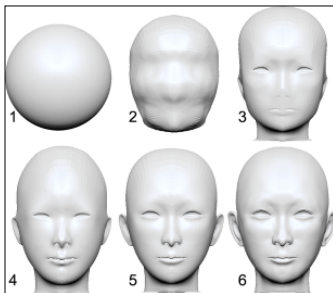


Figure.1: Creation Process for the Basic Model

We created a 3DCG facial model by expressing three-dimensional coordinate data as mesh data using a method for creating the face whereby the polygons in the sphere are increased while the positions of the parameters are changed for each part of the face. By using 3DCG to create the face, rather than a photograph or drawing, it was possible to quantify each part of the face and record the transformation process from the basic figure. It was also easier to capture the subject as an object using animation.

In the experiment, we created a total of 24 facial models by moving the positions of the parameters for each part of the face from the original basic facial model. The main parts of the face that we changed were the 'eyebrows, eyelids, the

medial angle of the eye, auricular points, nostrils, the nasal point, the apex of the nose, the subnasal point, the mouth and the gnathion. Other changes were also made to the flesh on the cheeks and chin. Fig.2 shows the 24 models created for the image evaluation experiment using the aforementioned method.

3.3. Image Evaluation Experiment for a 3DCG Facial Model

21 students aged between 18 and 26 (average age: 20.6) studying art engineering and having CG modeling experience were selected as the subjects of the experiment.

In regard to the image experiment conditions, the subjects were shown front-facing still images for 10 seconds each and then shown animated images of the faces rotated 45° to the left and 45° to the right for approximately 75 seconds on a 52 inch monitor. They completed a survey while viewing the images.

We referred to words and phrases selected from magazines, etc. and to academic journals and theses for the impression words used in this experiment. We also conducted a five-step evaluation using 18 pairs of these impression words together with their antonyms.

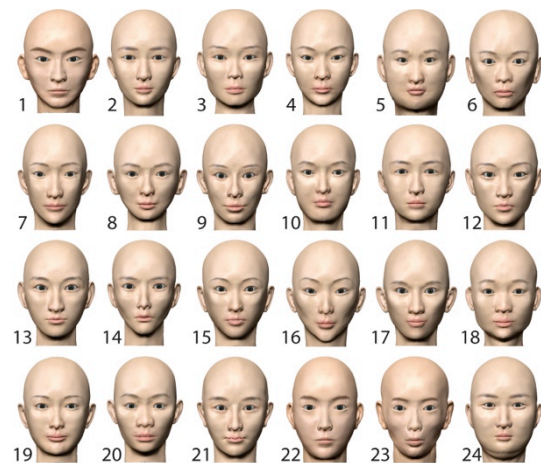


Figure.2: All Models for the Image Evaluation Experiment

4. Production of the main component different face model based on the face impression evaluation



Figure.3: Basic model of 3DCG face impression continuity deformation apparatus

We scanned the face of women in their 20s with a (referred to as digitizer below) Color 3D Digitizer

3030RGB/PS of Cyberware's. The recreated in the polygon surface of the model was produced in the basic model of the impression conversion device. Figure.3 shows the Wire-frame showing a configuration of a polygon models and textures stuck to the basic model and the basic model recreated in the polygon surface from the left.

When a production of the device, there is a hallmark feature of the underlying, chose the axis of the person who is easy to be left impression decisions impression is easy. The following is a feature of the shaft, which is based.

The characteristics of the shaft of the good feeling of the principal component 1, because the angle of the mouth rose, large eyes, face tendency is small are prominent, and the axis of the positive direction. The characteristics of the axis of a feeling of weight of the principal component 2, because the face is so many big plump, trend mouth is small seen outstanding and with the axis of the minus direction. The characteristics of the shaft of the power of the main component 3, cheekbones and jaw are fishing eyes protruding eyes while large, the tendency lips thicker are prominent, and the axis of the minus direction.

Using the characteristics of the principal component axes determined above, the deformation the base model as shown in Figure1 was produced in the model including the features. Figure 4 is intended as an example, showing the process of modeling the three principal components.

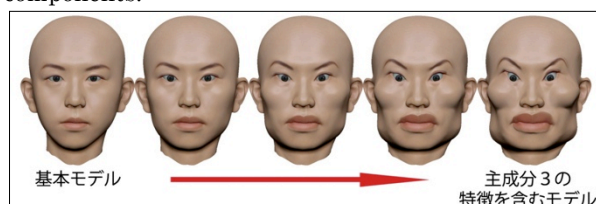


Figure.4 Production program of the model include features

Figure 5 shows a model that contains the characteristics of the principal component 1, 2, and 3.

For moving vector to emphasize features, rather than a human face to be real, which are face containing character elements. Therefore, it is considered to be unnatural. However, it is possible to determine the model after conversion is called the target model to limit the amount of conversion by using the Blend shape.

Therefore, it is possible from the vector of each part of the base model in the axis of the three-dimensional on conversion to vectors that represent each impression gradually and it is possible to propose the impression converter.



Figure.5 Model including the main component Special Features

3.2.Configuration of the impression conversion device

3.2.1. Configuration of "Blend shape"

Blend shape is constructed as follows. Define linear convex union of one that is in the base n vectors of the face model, but in this case, each vector corresponds to Blend shape of one. Each Blend shape is the face of one model, including the texture and geometry.

Blend shape of all that is configured to have the same mesh. Therefore, coordinates of the vector V that belong to Blend shape model can be described as follows.

$$V = \sum_{i=1}^n \alpha_i V_i$$

And we use the face shape is vectorized.

For the group for the purpose of analysis and face shape of all, I a, b, and c vertices in the face that defines the set. And we can define group vector P next. three elements a, b, and c to determine the variable P of the target model.

$$P = \{a_{n1}, b_{n2}, c_{n3}\}$$

3.2.2. Menu of 3DCG face impression continuity deformation apparatus



Figure.6 Menu of 3DCG face impression continuity deformation apparatus

Impression conversion device was deformation the basic model prepared in Figure 3.

Then, using a model of the three gave the changes as shown in Figure 5 was produced by be applied to Blend shape. Figure 6 shows the menu of the impression conversion device. c represents the main component 3 b is the main component 2, a is the principal component 1. Conversion of face model can you move the bar or or enter a number in the column that are referred to as 0.000.

3.3.The result of the operation of the impression conversion device

Figure 7, using the menu of the impression conversion device in Figure 3-4. It is impressive conversion result was changed in increments of 0.500 for each item.

Numeric value of each item is 0.000, the initial screen of the menu, represents the base model.

In this study, we aimed at the output of the human face realistic. For model including the characteristics of the main component different in Figure 3-3 is not the face of a real human, I will limit the amount of conversion decided -1.000 to 1.000 the numerical range of the device.

It is believed that the target model 1.000 applicable to characteristics of the shaft underlying that described in 3.1., Results as expected have been brought.

However, in the target model intended to -1.000, vector of each part is deformed exactly the opposite of 1.000 numerically. It is believed impression appears therefore, but is not a natural face.

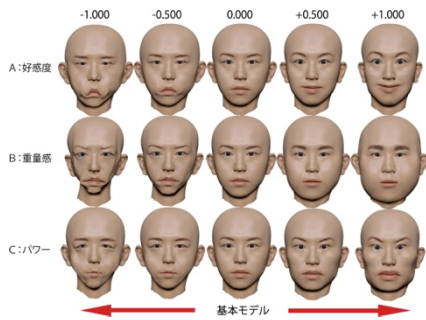


Figure.7 Examples of face model by impressive conversion device

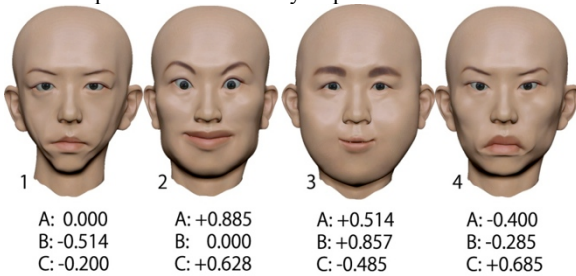


Figure.8 Examples of face model by impressive conversion device

Figure 8, not one item. Shows the face model extracted by entering a number in the two or more items of A · B · C.

No. 1 is the impression there is no sense of weight and power.

No. 2 is the impression that there is power and good sensitivity.

No. 3 is the impression no power there is a feeling of weight and favourability, No. 4 shows the results thing that produced assuming the impression that there is power there is no sense of weight and good sensitivity.

Conclusions

In Experiment 1, in order to examine the trend of expression on the face of the current, we collected impression words of 87 clocks from the book or magazine of 18 books.

We could be classified into five of noun-adjective verb, adjective, adverb, multiple representation. From trend magazine for adults, there are many expressions that contain more than one meaning became apparent to magazine for young people and that the unique representation is often in magazines. In Experiment 2, to perform an impression evaluation was conducted a survey using a five-step evaluation of the SD method. And, by the production in 3DCG not a photo or picture of the target experiment, allowed to quantify the each part of the face, deformation is possible. In addition, We considered expression can be a three-dimensional impression to have the face of the original experiment is possible with a more realistic target. In addition, experimental face model of twenty-four, was produced by deforming 3DCG than one model. The questionnaire with impression words of 18 pairs and face model of 3DCG of 24 that was produced, and the classification into three main component 1 "favorability", principal component 2 "heavy", principal component 3 of "power". Then, the assumptions about the law of perspective from a kinematic body surface anatomy

and visual information, and analyzed the face model of another major component.

Then, let applied to Blend shape model that includes features basic model, from the impression of the original base model, we have proposed a impression transfer device which can convert gradually to each impression.

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