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ビデオチャットを用いた日常的情報交換におけるデフォルメ映像表現の研究
－ ビデオチャットとデフォルメ表現の有効性に関する研究 －
Research of representation of deformed image in communication using video chat
--- Verification concerning effectiveness of deformed representation in video chat

田尻力也/九州大学大学院 芸術工学研究府 修士課程１年 先導的デジタルコンテンツ創成支援ユニット，三宅佑治/九州大学大学院 芸術工学研究府 修士課程１年 先導的デジタルコンテンツ創成支援ユニット，森根光春/九州大学大学院 芸術工学研究府 修士課程１年 先導的デジタルコンテンツ創成支援ユニット，柳竜馬/九州大学大学院 芸術工学研究府 修士課程１年，山崎隆弘/九州大学大学院 芸術工学研究府 修士課程１年 先導的デジタルコンテンツ創成支援ユニット，阿部由布子/九州大学大学院 芸術工学研究院，砂田向壱/ 特任教授 九州大学大学院 芸術工学研究院

Rikiya Tajiri1/Graduate School of Design, Kyushu University, Yuji Miyake2/Graduate School of Design, Kyushu University, Mitsuharu Morine /Graduate School of Design, Kyushu University, Ryoma Yanagi/Graduate School of Design, Kyushu University, Takahiro Yamazaki/Graduate School of Design, Kyushu University, Yuko Abe/ Faculty of Design, Kyushu University, Koichi Sunada, Ph. D. /Faculty of Design, Kyushu University

*1tajiriki@gmail.com, *2miyakeyuji@gmail.com

Abstract: In this paper, we conducted experiments to compare and measure how deformed representation influences on everyday communication through video chatting and besides what deformed representation is effective from 3 perspective- color, shape and texture with making deformed representation system called BDMS.

Keywords: Visual communication , Visual information , Video chat , Deformation , Stress , Human interaction , Stereoscopic effect

1. Introduction

In this day and age, progress of digital infrastructure has rapidly changed from communication using letters such as cell-phone text-messaging or chatting to image correspondence such as video chatting or E-Learning aimed to take a form. That is because grid computing improved processing ability and setting up of digital infrastructure lead to realize Mbps level communication network, and communication form is expected to develop further in the future.

At the same time, new problem is shown concerning influence on users by newly emerging communication form. In this paper, based on foregoing research which explains that new form of communication gives users stress toward image communication [1] [2], we verified reducing stress by "visual information" using deformed method which is being applied recently as a technological research. As relative research shows that deformed image to protect privacy doesn't influence on effectiveness of distributing information for remote support through image correspondence, as a result, we analyzed deformed image with verifying effectiveness of daily communication such as video chatting. In this paper, based on hypothesis for increasing efficiency of daily communication using video chatting, we conducted experiments using Pseudo Stereoscopic Effect by "Brightness to Depth Mosaic System, which is solidified and deformed image system to reduces stress of pseudo face to face communication. We extracted data of brightness from data of user's face in web camera and transformed them into data of depth and then compared between realistic image that was output solidified deformed image to both users and effect which deformed image gave user's dialogue. At the same time, we analysed subjective evaluation to verify effective "déformer" method from 3 perspective, color, shape and texture.

2. Deformed representation

"Déformer" is defined as a representation method to add exaggerated and emphasized characteristic of motif of picture or sculpture. As a technological research, it is especially used in the area of drawing map or route map to transform materials into ones which gains intelligibility by exaggerating or emphasizing them. In this paper, we used deformed representation to exaggerate or emphasize characteristic of figures and express emotion clearly, also to protect privacy by not giving detailed information.

3. Background of research of deformed representation

Before emerging image correspondence which needs massive transaction such as video chatting, user had actively had non face to face communication using digital infrastructure such as text chat, Weblog, and cell-phone text messaging. Especially, Japan is the first place of several blog contribution community classified by country and blog culture has widely prevailed in recent years.(Fig.3-1) It may be said that user who were just audience in the past have become sender and had an opportunity to communicate frequently. According to the data classified by blog user's motivation who set up blog(Fig.3-2), « self-expressing » (30.9%) is took first palace followed by « community« (25.7%) and « contribution for society« (8.4%). Originally, as we can see from derivation of « Weblog« , the situation which blog is mostly used for diary version hasn't changed.

However, It should be noted that the action through blog is taken in items needed relationship with others such as community and contribution for society. Also, user mainly taking communication have tended to focused on non face to face communication such as text chat or blog. While it is highly possible that image communication using massive data such as video chatting would improve farther, the problems which never happed with none face to face newly occur. Users tend to have resistance against face to face communication which can send expression on face clearly [1] [2]. It is expected that users in Japan can strongly feel the resistance because they are used to non face to face communication and don't have problems with it and understand text chatting as just expanded data. In the future, the service which is under the premises that is mainly image communication and is massive correspondence will be further developed. Then it may be said that reducing the resistance to face to face communication can accelerate to prevail these service.(Fig.3-1,Fig3-2)

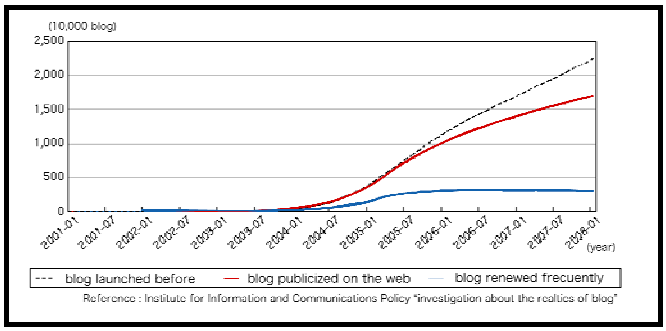


Figure3-1: Transition of the number of domestic weblog (Reference : Institute for information and communications policy , research about the actual situation of the weblog)

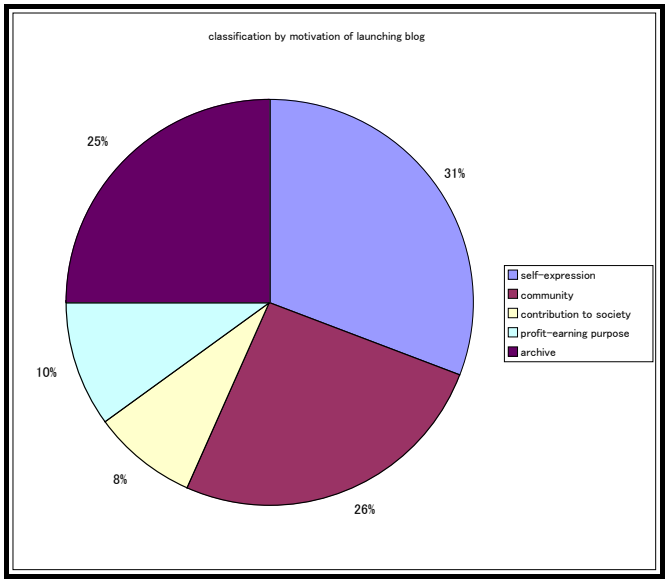


Figure3-2: Classification about weblog establishment motive (Reference : Institute for information and communications policy , research about the actual situation of the weblog)

4. Present condition of digital infrastructure in Japan

In Japan broadband internet by DSL system began to infiltrate homes in the first half of the 2000s. As a result environment of Mbps level communication began to be improved for homes as well as business use and the number of broadband contracts exceeded 2million in 2006. (Fig4-1)

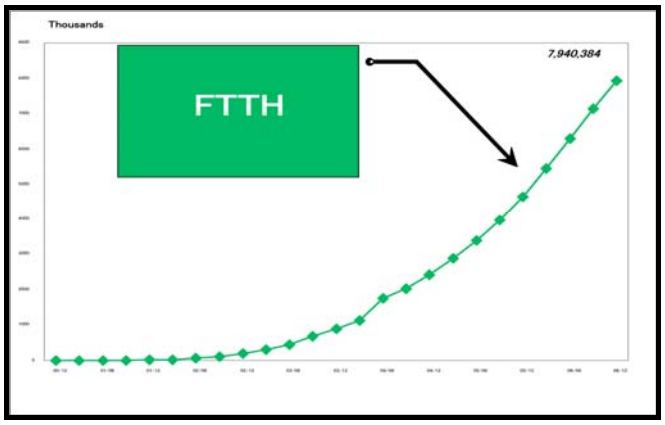


Figure4-1: Transition of the number of broadband service members (Reference: Report data of Ministry of Public Management, Home Affairs, Posts and Telecommunications)

Furthermore regarding household penetration rate, it reached 84 % in 2007 (Fig4-2) and about 4/5 of the Japanese is living in the broadband environment.

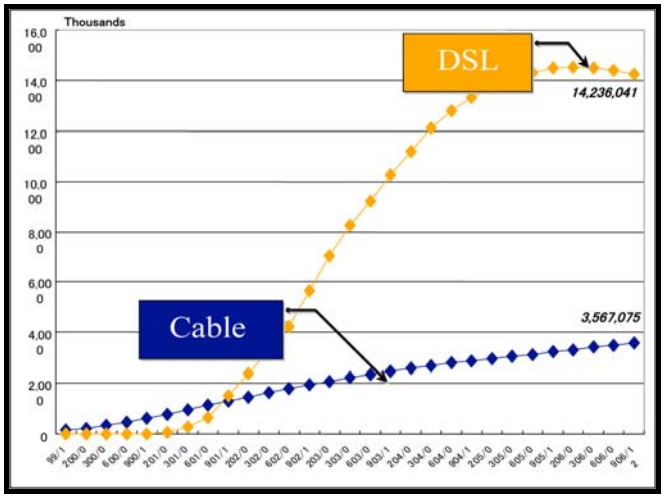


Figure4-2: Transition of the internet penetration and prevalence rate in household and broadband prevalence rate in household (Reference: 2007 White Paper Information and Communications in Japan)

Then the internet radio broadcasting and moving image distribution service have been started as a result of improvement of broadband environment in each home. At the same time, the number of distribution has grown rapidly and in 2006 it reached the twice of it in 2004. (Fig4-3)

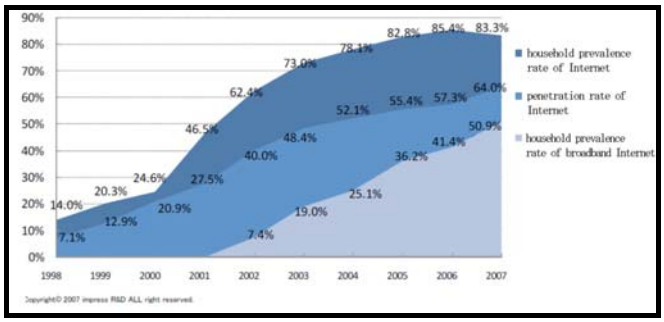


Figure4-3: Household prevalence rate of Internet and Penetration rate of Internet and house hold prevalence rate of broadband Internet (Reference: Information and Communication in Japan 2007)

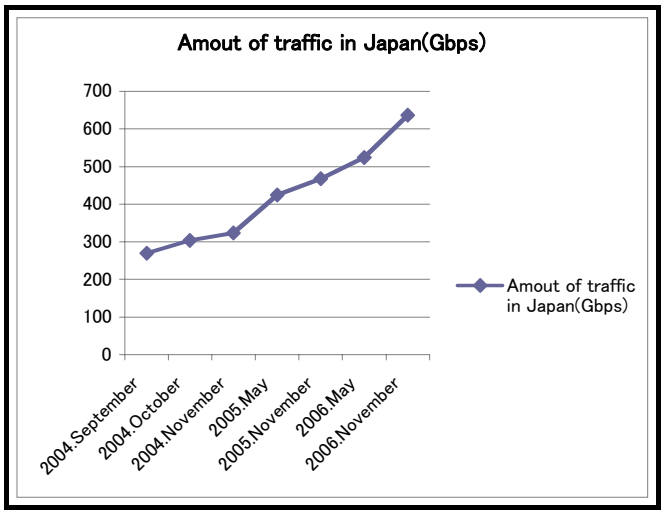


Figure4-4: Transition of the amount of traffic in Japan (Reference: Report data of Ministry of Internal Affairs and Communications)

While the amount of communication increased, super computer and computer cluster which were spotted in many parts to process massive calculation were made available systematically and grid computing system was developed to increase entire throughput.

In consequence the amount of information transmission and the amount of permission processing per unit time increased and it has been realized nowadays that image communication using massive data such as video chat. Then the characteristic of communication is changing from non-facing type to facing type.

5. Hypothesis for testing effectiveness of deformed representation

Communication through image correspondence is utilized for remote technical support in service area. The circumstance in which comparing both there is the big difference about a technological knowledge level or lexical ability like a beginner user and an operator, it is effective to communicate smoothly using image correspondence. Yonemura and others [3] point out privacy of users as a problem concerned here and note that there is a tendency with many users who have resistance in an image communications system. Then they verify effectiveness of deformed image using line for remote support for beginner users describe to achieve a balance between protection of privacy and effectiveness of communication.

However, concerning balancing effectiveness of communication in remote support, it is important that deformed processing level which can protect privacy doesn't prevent the effectiveness of communication for beginner users and it isn't definitely discussed concerning representation of "déformer". It is necessary for daily conversation used exchange of flexible information such as expression of feeling to mention deformed image representation and measure the effectiveness as well as communication and understanding of relatively simple information such as remote support based on manual. In this paper, we extend the range of object for utilization of deformed image from distributing information as remote support to video chatting as daily conversation which is needed more interactive characteristic. We mention the effectiveness of deformed image representation in daily conversation by extending deformed image communication and making multiple comparative analyses.

5.1. Stereoscopic and deformed image representation system

In this paper we propose Pseudo Stereoscopic Effect by "Brightness to Depth Mosaic System"-BDMS, which increases efficiency of daily conversation using video chatting and decreases resistance of face to face communication. BDMC is a system which artificially make stereoscopic images from web camera and outputs them as deformed images. Specifically, illuminating in front of a user can reflect brightly top of nose or cheek and try to make them solidified interchanging information of brightness with information of depth. In development environment, as algorithm adopted Processing which is used to produce easily prototype, we used Jmyron Library, captured image from a web camera, lowered resolution and then brightness information of each picture elements were changed to three-dimensional depth information. By adding information to each picture elements we realized stereoscopic deformed real time image.

Following excerpt of BDMS.pde is actual code. (Fig.5-1-2)Changing values of max_depth variable determine maximum value of the depth. Figure 6 shows artificial stereoscopic situation in the case in which the value of max_depth is changed from 0 to 30. (2),(3),(4) remarkably show stereoscopic situation, especially on a hand, compared with (1). Since (4) shows outline of fingers and top of nose are broken, we research the situation of (3). (Fig.5-1-3)

In this paper, from 3 perspective- color, shape and texture which are discernment elements of human visual perception, we set 5 solid patterns in which resolution, color, dot and texture are changed, and then build environment in which we can switch by inputting keyboards. (Fig5-1-1)

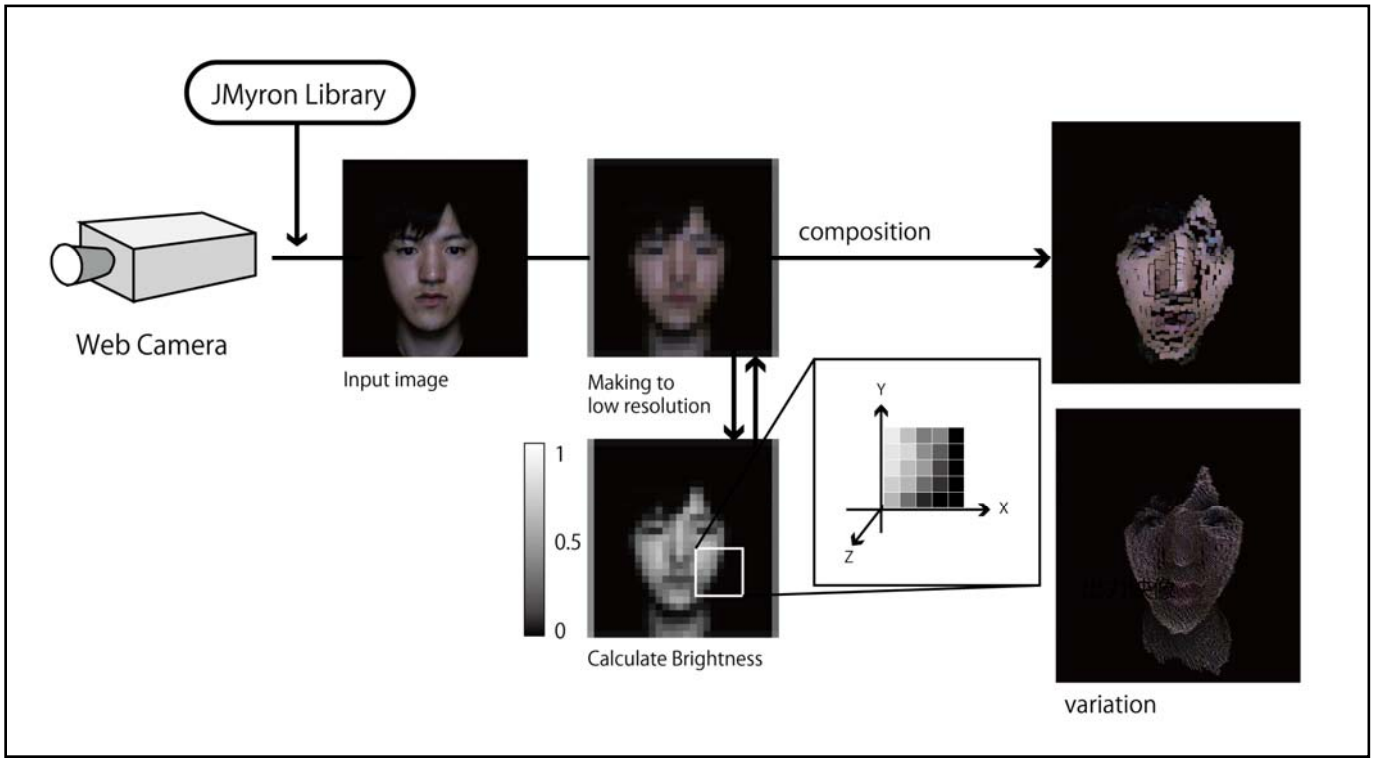


Fig.5-1-1: Work flow of BDMS

```
//---BDMS.pde
JMyron m;
float max_depth;
m.update();
int[] img = m.image();
color c = img[loc];
```
float dot_depth = brightness(c)/256 * max_depth;

Fig.5-1-2: Level of depth information in BDMS

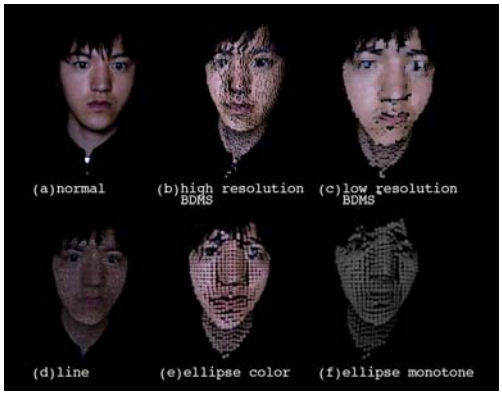


Fig.5-1-3: Stereoscopic patterns of BDMS

6. Experiment description

The examinees experienced face to face communication, in which they can see real image each other, and 5 BDMS deformed representation patterns based on discernment elements of human visual perception. We conducted comparative analyses based on the result. They were partnered each other and had a conversation through image correspondence for definite period time. They evaluated based on the impression. We set up evaluated items as below. Concerning 9 evaluated items(Table6-1), we measured in 5 levels range.(Fig-6). We then set up experiment's turn randomly not to lead evaluation intentionally depended on the order of objects for comparison.

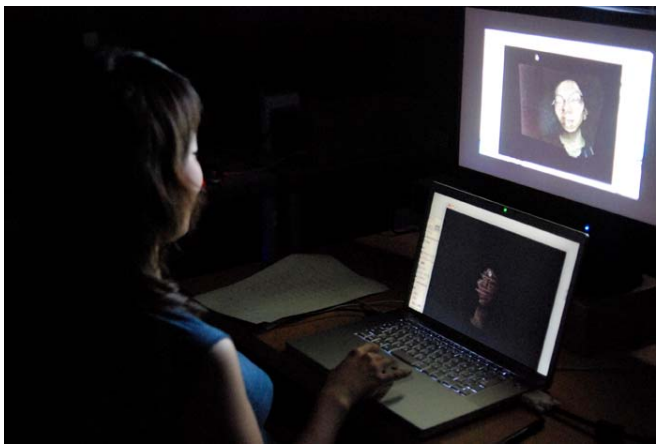


Figure6-1: Appearance of experiment

Table6-1:Contents of item for experiment

Item	Content of item
1	Easy to talk
2	Easy to understand
3	Interesting
4	Incompatibility
5	Sense of intimacy
6	Shamefulness
7	Easy to communicate
8	Privacy to be defended
9	Easy to express feelings

7. Discussion

7.1. Comparison between real image and deformed image

After experiment, we conducted a questionnaire survey. When deformed image, which was brought by synthesizing Rating scale value of 5 deformed representations, and real image are compared, there is a difference in average rating scale value concerning Q3"It was pleasant." Q6"It was thought that it was shameful." Q8"It was thought that privacy was protected." Regarding Q6 and Q8, deformed image can reduce shame and protect privacy, and then it is effective for resistance against real face to face communication of real image. And besides it shows that there is a difference between deformed image and real image concerning Q1 and Q3, and it is remarkable points as a communication in daily conversation with expression of feeling.(Fig.7-1-1)

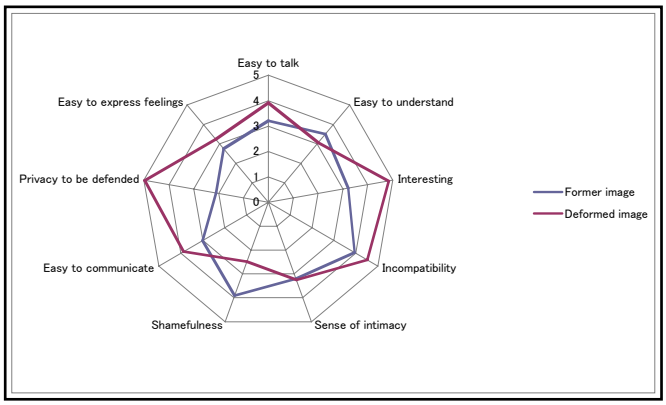


Figure7-1-1: Data about comparison with deformed image and real image

7.2. Comparison of representation of deformed image

It was pointed out saving privacy and reducing shame as the influence of deformed image upon image correspondence system while it shows that there was a marked difference between 2 points of average rating scale value thought to be related with emotional expression in daily conversation. When we carried out an experiment, we prepared some representing patterns of deformed images and validated the evidence of its effectiveness. We conducted comparative analyses of 3 points based on human visual recognition.

7.2.1 Importance of color in deformed representation

In the research which compared color with gray scale in deformed image, there was a difference in evaluated values concerning Q5"I felt an affinity". Since the evaluated value of gray scale fell below the evaluated value of color, information of color can influence on affinity in daily conversation using image correspondence. Also considering That a difference of embarrassment and protection of privacy in both sides was hardly seen, information of color doesn't influence directly upon keeping privacy.

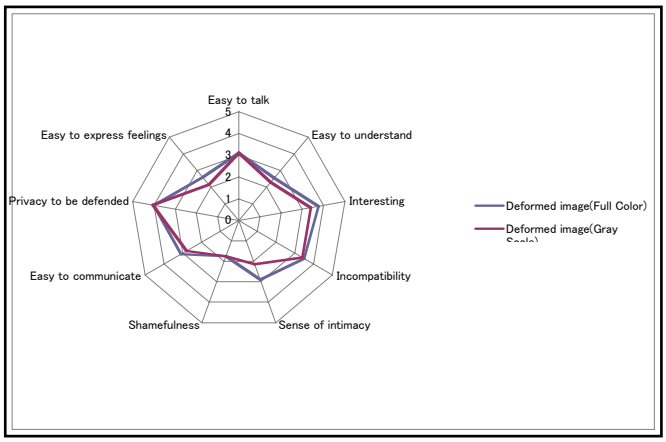
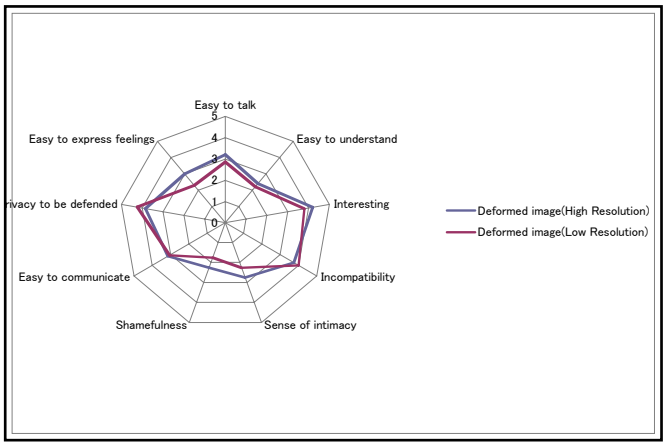


Figure7-2-1-1: Data about comparison with deformed image and real image

7.2.2 Importance of texture in deformed representation

To determine the effectiveness of texture, we conducted an experiment concerning high resolution and low resolution, and then we compared both side by evaluating impression. As a result, concerning Q8"It was thought that privacy was protected." evaluated value of low resolution deformed image exceeds the other while concerning Q2 "Intelligible" the value is below the other. In brief, excessive protection of privacy can lead to unintelligibility and it would appear that higher resolution promote intelligibility.(Fig.7-2-2-1)

Figure7-2-2-1: Data about comparison with high resolution image



and low resolution image

7.2.3 Importance of shape in deformed representation

To determine the effectiveness of shape, we conducted an experiment concerning circle, line and square, and then we compared both side by evaluating impression. As a result, concerning Q8"It was thought that privacy was protected." evaluated value of square deformed image exceeds the others while concerning Q2"Intelligible" the value is below the others. Also concerning Q3"It was pleasant." evaluated value of linear deformed image exceeds the others, however, at the same time concerning Q6"It was thought that it was shameful." the value rises. Therefore if the evaluated value related to privacy rises excessively, it would exert harmful influence upon intelligibility of face to face communication

Through image correspondence and it requires attention. In addition, concerning linear deformed image, the evaluated value related to pleasantness is remarkably high, however, the evaluated value related to embarrassment also rises. Then concerning deformed representation, excessive exaggeration doesn't grow in efficiency of communication in daily conversation and it requires attention.

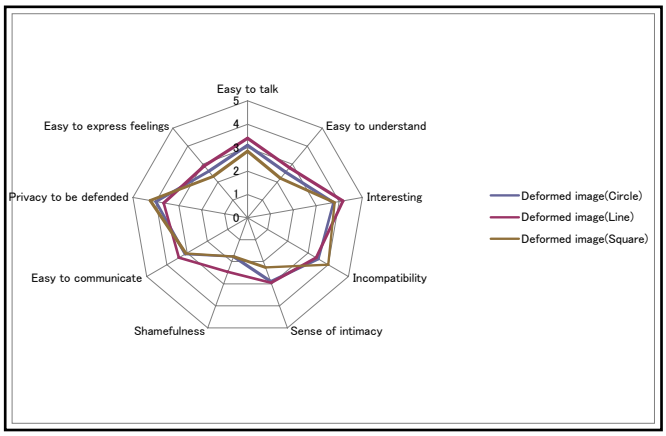


Figure7-2-3-1: Data about comparison among ellipse and line and square

7.3. Questionnaire survey of test subjects

In many evaluation items used in the experiment, the difference of the evaluated values were small between deformed image and real image, yet among the items, there were some evaluated values of real image which rather exceeded the value of deformed image. Then concerning the items used in discussion, we conducted F examination using FTEST function and tested effectiveness. The results were as follows.

Table.1 Research concerning comparison between real image and deformed image representation

Answer	F examination
Q3: It was pleasant.	0.1653>0.05
Q6: It was thought that it was shameful.	0.9118>0.05
Q8: It was thought that privacy was protected.	0.8162>0.05

Table2 Research concerning color of deformed image

Answer	F examination
Q5: I felt an affinity	0.4925>0.05

Table.3Research concerning shape of deformed image

Answer	F examination
Q1: It was easy to talk.	0.834>0.05
Q2: It was intelligible.	0.8403>0.05
Q3: It was pleasant.	0.8277>0.05
Q4: It was uncomfortable.	0.8475>0.05
Q5: I felt an affinity.	0.7711>0.05
Q6: It was thought that it was shameful.	0.5047>0.05
Q7: It was easy to communicate.	0.3182>0.05
Q8: It was thought that privacy was protected	0.6122>0.05
Q9: It was easy to express one's feeling.	0.5185>0.05

Table.4 Research concerning texture of deformed image

Answer	F examination
Q1: It was easy to talk.	0.6011>0.05
Q2: It was intelligible.	0.9778>0.05
Q3: It was pleasant.	0.6011>0.05
Q4: It was uncomfortable.	0.8803>0.05
Q5: I felt an affinity.	0.7439>0.05
Q6: It was thought that it was shameful.	1.4708>0.05
Q7: It was easy to communicate.	0.6835>0.05
Q8: It was thought that privacy was protected	0.7589>0.05
Q9: It was easy to express one's feeling.	0.7651>0.05

As a result, it showed that above each value was not significant difference and statically there was no difference.

8. Conclusion

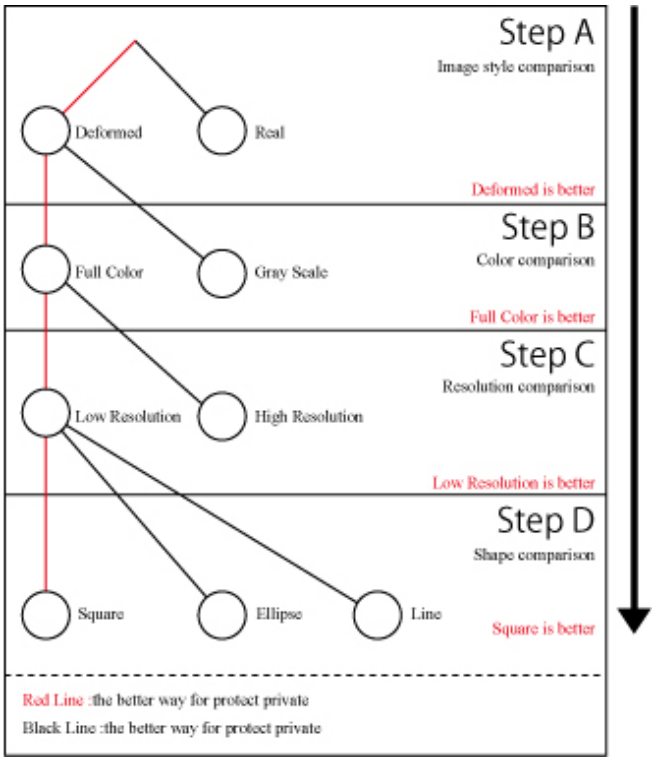


Figure8-1: Work schedule about way to make conclusion

In this paper, we verified reducing stress which users feel toward pseudo face to face communication in daily communication using video chatting and effectiveness of "déformer" method which accelerate information exchange. Concerning influence on daily conversation by visual effect of deformed image, we conducted subjective evaluation by examinee using solidified and deformed image BDMS to analyze from several perspective of "color", "shape" and "texture" which are discernment elements of human visual perception.

Then, it showed deformed image is more effective than real image concerning privacy or shame in daily communication using video chatting.

Furthermore, we verified "déformer" method using several patterns as well as comparison between real image and deformed image and showed effectiveness of deformed image on a step by step basis, Especially from perspective of privacy as the figure explains best method. (Fig-) As figure "Comparing color in A" shows, we compared full color with gray scale. Then since there was no difference concerning the evaluation of privacy and we could see remarkable differences concerning the evaluation of feeling affinity, we found that full color is more suitable. Concerning "Comparison of texture in B" we compared high resolution with low resolution. As a result, the evaluation of protecting privacy was high with low resolution. Therefore as the figure shows, low resolution is more suitable for "déformer" in full color. Moreover concerning "Comparison of shape in C" we compared among linear type, square mosaic type and dot mosaic type. As a result, the evaluation of privacy is highest with square mosaic type and is also highly effective.

The comparison analyses above showed that as a best pattern of deformed image, meeting the condition of color data: full color, texture data: low resolution, and shape data: square mosaic type could increase effectiveness in daily communication using video chatting. (Fig.8-1)

9. Future Direction

In this paper, we found that deformed image was effective in terms of reducing stress of daily information exchange in pseudo face to face communication. Also we verified using BDMS that there were remarkable differences concerning the evaluation for "pleasantness". That meant it should be attention that deformed image to reduce stress gave users pleasantness and the evaluated values were high compared with real image.

Image correspondence communication is considered that the amount of information per hours is overwhelmingly large compared with text chatting, and is considered that it is communication method which can realize smooth pseudo face to face communication. However, if we consider the future when many services based on video chatting are developed, for prevalence of the service the system is needed to solve the problem of personal information, privacy and security. We could illustrated in the research stereoscopic and deformed image method that "déformer" method could abstract face data enough to protect privacy and also keep intelligibility of data, in addition it gave feeling "communication itself is enjoyable. " which wasn't exist before and lead to new representation which could prompt activeness. That showed the guideline of research in the future.

Acknowledge

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