Utilization or Elimination of Mona Lisa Effect for Eye Contact with Characters

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ABSTRACT

Interactive characters as digital signage are becoming popular. Eye contact from the character in appropriate situation may cause sense of awareness from the character, and attract people attention. Also, widely used planar display cause Mona Lisa effect. We focused on positive and negative aspect of the effect, and created novel way to enable eye contact from characters to viewers, which is utilizing or eliminating the Mona Lisa effect.

1 INTRODUCTION

Interactive characters as digital signages are expected to be virtual receptionists, salespersons, advertisements or even a new entertainment media in daily life. In addition to use appearance of popular characters, human-like interactions are keys of familiality and to provide enjoyable experience. Furthermore, image quality and affordable cost are both important factors as for digital signages.

Eye contact is one of the basics of human communication. Implementing eye contact function in interactive characters may be effective to realize human-like interactions. Eye contact from the character in appropriate situation and timing may cause sense of awareness from the character, and attract people attention.

Showing the character eye gaze to bystanders or passserby is also informative to attract and involve people into the interactive session naturally. They will understand content of ongoing interaction from social behaviours including eye contact, and will perhaps be interested in the intaraction. Those expressions of eye gaze are important to gain social presence of the interactive character.

Unfortunately, planar display has a great limitation to convey gaze direction, which is known as the Mona Lisa effect: frontal face image shown in planar display cause eye contact feeling to everyone regardless of viewing position, and nobody feel eye contact by non-frontal face image.

As for interactive characters, even in the situation that the character should stare at only one person, every other persons also feel eye contact by the Mona Lisa effect unintentionally. As for them, such gaze behaviour of the character looks unreasonable and may cause distrust sociality of the character. This will disrupt social presence of the character and also decrease power of eye contact to attract people.

Display without Mona Lisa effect are developed in past telecommunication or display researches. However, those methods at least have one of following problems: high cost, small screen size, limited image quality, limited view angle or limitation of face position.

In this paper, we focused on both positive and negative aspect of this effect, and created novel way to enable eye contact from characters to viewers.

First objective is to utilize Mona Lisa effect, to make people feeling eye contact from the character independent of people's position, which is effective for attracting many persons' attention at once.

Second objective is to eliminate Mona Lisa effect, to make only one selected person can feel eye contact from the character, which is crucial to realize eye contact for addressing or turn taking in multiparty conversation. We propose simple but powerful method to construct face display with the expression of correct eye gaze direction dependent on each observer's position without Mona Lisa effect. The display has wide view angle without collapse image, and high resolution large screen display for digital signage can be achieved in affordable cost.

2 GAZE DISPLAY USING MONA LISA EFFECT

Considering existence of Mona Lisa effect, displaying face image which is looking just forward to the display is the way that any person in front of monitor can feel as if they are looked by the displayed character. Selective gaze like real human is not possible, but generating eye contact feeling is better than having no eye contact feeling.

Therefore, we propose the method that, if the character try to look nearby person, the system render the face image with frontal gaze direction, wherever the observing person is standing.

The method is quite simple and require no special display hardware, but powerful enough to attract attention of passerby people.

However, when the character continuously look at same person, and if the person is walking through in front of the character, naïve implementation of this method will render still image of face with frontal gaze. We expect

the character will chase us with their gaze while we're walking through.

To solve this, moving character's face in accordance with the viewer's position is effective. Eye gaze should be center to generate eye contact feeling, but face direction may not be limited to center. With the method, viewers can feel that the character is chasing them with character's face direction while they are walking through.

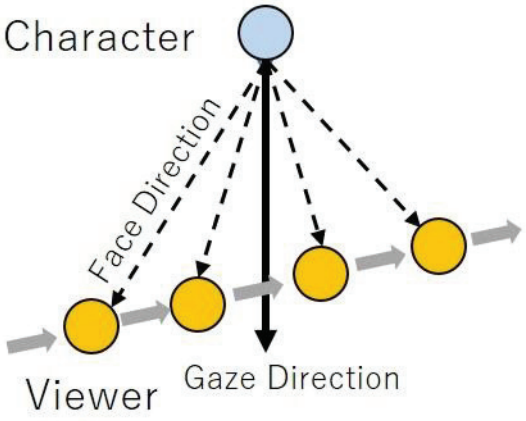

Fig. 1 Gaze Render Using Mona Lisa Effect

Fig. 2 Result of Chasing Moving Person

3 DISPLAY WITHOUT MONA LISA EFFECT

Fig.3 shows principle of the proposed method. Using 2 layered display, back layer shows face image without pupil and surface layer shows pupil image. In accordance with viewer's position, pupil image appears to change its position relative to white of the eye. Thus, pupil image locates in center of the eye only from particular viewing direction, and only the viewer at this direction can feel eye contact from the displayed face. Eye contact direction can be arbitrarily set by changing relative image position between white of the eye and the pupil.

Merit of proposed display is wide viewing angle, fine resolution and low cost. Use of depth fused display (DFD) is the most similar approach [1]. However, DFD based face image becomes ugly because front part of face protrudes from head in oblique view. Parallax barrier or lens array based light field display [2] [3] are gradually becoming commercial and they also have ability to eliminate Mona Lisa effect, but those displays are still quite expensive and/or low resolution than normal LCD. Projection on 3D face shaped screen [4] is also known method for accurate gaze display, but it requires robotic mechanism to rotate face.

Fig.4 shows the result. From different viewing angle, the display successfully show image with different eye direction. Only from certain direction can perceive eye contact from the character in the display.

Due to overwrapping pupil image on white of the eye image, surface layer display should be attenuation panel (e.g. LCD). In contrast, any type of display can be used for back layer: LCD, OLED, projection screen, etc.

Distance of each displays affects shift amount of pupil in accordance with viewer's position change. Too much distance will cause excessive eye movement, and the eye direction which is perceived by the viewer will overshoot intended gaze target person. Optimal display distance for maximum gaze direction accuracy may depend on scale of the face image, pupil distance of image and perhaps shape of the eyes. Psychological experiment to achieve them is a future task.

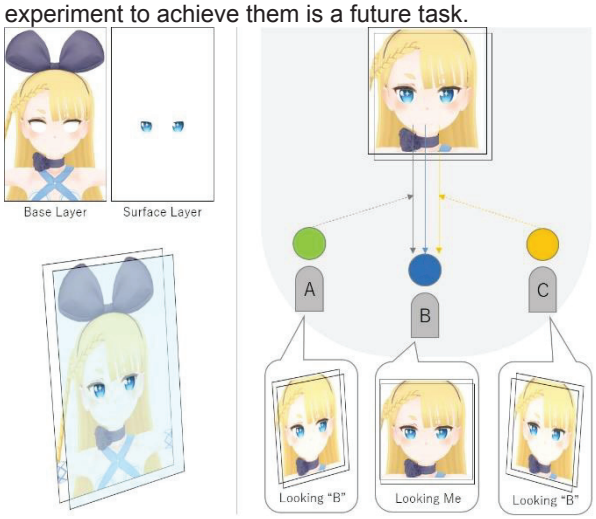

Fig.3 Principle of Layered Gaze Display

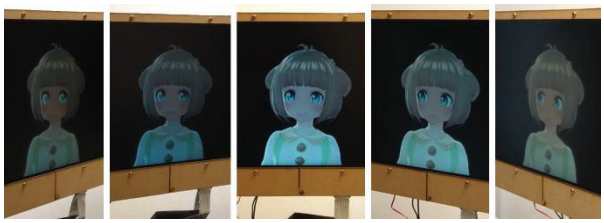

Fig.4 Result of Layered Gaze Display

With straightforward use of layered display, the pupil image may protrudes from the eye area when the display is seen in oblique view (Fig. 5 left). Time-division display is effective to avoid this. Fig.6 shows the principle. While surface layer showing pupil image, face area around the eye is darkened. Thus, pupil image out of eye area becomes invisible. Face area around the eye is displayed in following frame instead. Using high refresh-rate display (e.g. over 120Hz) is necessary to avoid flickering, which is affordable as gaming monitors recently.

With time-division display method, displayed face image is fine and consistent from wide field of view (more than 120 degrees, apparently).

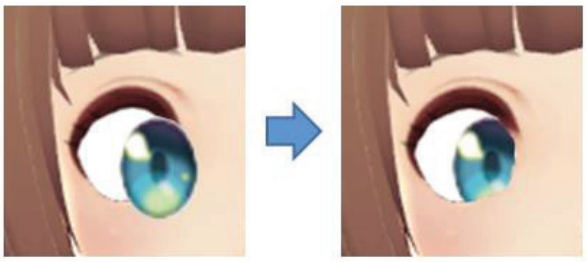

Fig. 5 Necessity of eye protrusion avoidance

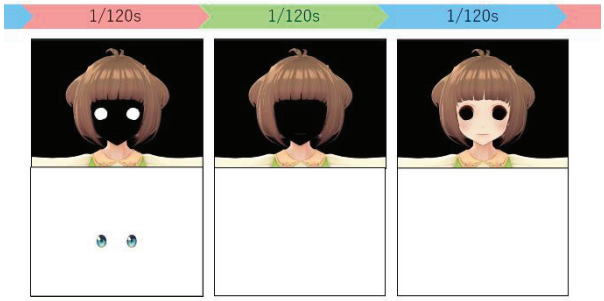

Fig. 6 Time Division Method

4 CONCLUSIONS

Natural eye contact has great impact for people. If characters will become our partner in real world and real society, existence of characters must be expressed by eye gaze. In such circumstances, effectiveness and problem of Mona Lisa effect may have more and more importance. We believe that the proposed display method and hardware are feasible solution in those society in the near future.

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