mimicat : Face input interface supporting animatronics costume performer`s facial expression

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1. Introduction

Today a character costume can be seen in many places, such as amusement facilities, sport stadium and so on. They perform comical and funny body action for us. In general, the performers can't control their costume's facial expression. We developed "mimicat" that can synchronizing performer`s facial action and costume`s one. A character costume performer can do more comical action by using mimicat. At first our motivation is combining animatronics and face and expression recognition.
Facial Action Coding System (FACS) by Ekman [1] is well known in the field. His process requires a complex three-dimensional measurement of the facial muscles to measure behavior. We tried to detect user's facial action in a dark place like the inside of the costume. At the same time we intended contactless sensing. In this research, we compared and inspected two methods to detect facial actions. First method is multi pointed photo-interrupters on mask. Second method is using an infrared camera.

2. Recognition of Facial action

Firstly, we tried to use multi pointed photo-interrupters to capture user's facial action. nine photo-interrupters (RPR-220) on the mask made of ABS resin (Acrylonitrile-Butadiene-Styrene resin) (Fig1) detect each facial part action on eyes, eyebrows, a cheek and a mouth without skin contact. The value is obtained by serial communication from photo-interrupter via I/O board (Arduino) and was set the threshold to detect facial action by calibrating. Further, we measured the distance between mask and face to adjust sensitivity and consider placement of photo-interrupter. Six voluntary subjects (3 female, 3 male) who were students of graduate school of System Design, Tokyo Metropolitan University participated in this measuring. We determined that it is desirable to detect by 20mm or less from result that the minimum 5.12mm to the maximum of 22.15mm. Thus, we designed the electronic circuit so that the highest sensitivity of photo-interrupter when the distance between them and detected object was 0mm~20mm. In this method responses are quick and system cost is low. On the other hand wearing our mask seemed to be burden for users.

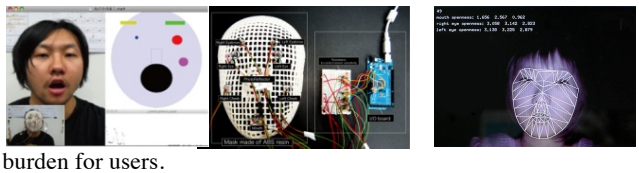

Figure 1. *Left :* Multi pointed photo-interrupters *on the mask*. *Right : Image from an infrared camera in mimicat*.

Secondly, we tried to use an infrared camera to capture user's facial action. We used fitting deformable model [2] (Fig1) developed by J. Saragin et al. for face tracking. The infrared camera enabled this system to detect facial expression even in a dark place. In this system users do not have to put on the mask for sensing. Comparatively speaking, this system is easier to use than older one and able to detect comprehensive facial expression.

3. Animatronics costume

We made original electro magnetic actuators and installed to in the device. These actuators moves the costume's eyes and a mouse. When a user opens or closes his eyes or mouth, the costume's facial parts move similarly(Fig2). These actuators can move quietly and quickly using two opposite directions' electromagnetic force. Furthermore, short-range radio modules (XBee-S1) is mounted in this device. Using this actuators can be controlled wirelessly.

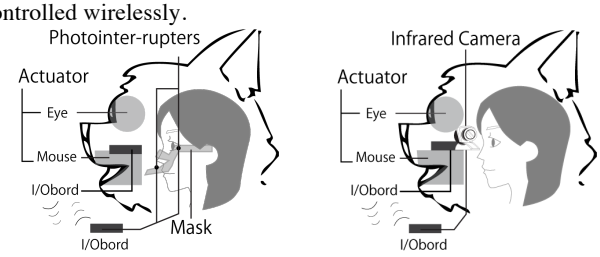

Figure 2. *System of mimicat*

Figure 3. The playing of *mimicat*

4. Future Works

In this paper we developed a system that support character costume performers by combining animatronics and face and expression recognition. Using an infrared camera and image processing we could detect user's facial expression in a costume. On the other hand our actuators are relatively too few and simple. So for the future work we will install other actuators and try to express more minute facial expression, such as an air actuator to express the puff of user's cheek.

References

[1]Paul Ekman, E.L 1987. What Face Reveaks : Basic and Applied Studies of Spontaneous Expression Using the Facial Action Coding System (FACS), pp. 413-425

[2] J. Saragin, S. Lucey and J. Cohn, "Deformable Model Fitting by Regularized Landmark Mean-Shifts", International Journal of Computer Vision (IJCV), 2010

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