

# A Cartoon-Character Costume with Facial Expression

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## 1 Introduction

At a theme park or entertainment show, an actor wearing a cartoon-character costume entertains guests. Unfortunately, existing cartoon-character costumes have a fixed facial expression. The actor must convey an emotional expression by body actions, which usually forces the actor to have special skill and a great deal of training.

We propose a cartoon-character costume of which face can vary according to the emotion.

## 2 Building a head of costume

To represent varying facial expression, we build a head of the cartoon-character costume. The actor wears this head. The head is made of a big plastic box whose front panel is attached with 15.6 inch LED display to represent a cartoon face image. A web camera is equipped inside the box to capture a facial image of the actor. The internal camera and the LED display are connected with computer through USB cables. The computer system (Intel core i7 870, RAM 4GB, Microsoft OS XP) calculates facial expression from the facial image based on a face recognition method, and represents the corresponding cartoon face image to the facial expression. The costume head equips additional set of external web camera and 5 inch small LED display. The actor can see the environment through the small internal display. The costume head has 4 kg weight. The actor has a carrier for climbing mountain on his back. The carrier partially supports and balances the head of the costume.



**Figure 1:** The head of costume

## 3 Recognition and representation

First, the active shape model [D.H.Cooper et al. 1995] stably detects feature points on the face parts such as eyes, eyebrows, mouth and wrinkles. We obtain a deformation of face parts from movements of the feature points. Based on the facial deformation, the facial action coding system [P.Ekman 1978] classifies the facial expression into one of 5 categories of emotion, i.e. anger, joy, sadness, surprise and neutral face. Furthermore, an open or close of the wink of eyes, and lip sync are determined based on the aspect ratios of the pupil and mouth, respectively. Consequently, the facial expression is classified into  $5 \times 2$  (left eye)  $\times 2$  (right eye)  $\times 2$  (mouth) = 40 classes. We prepare a cartoon face image for each of the 40 classes. According to the selected class, our system chooses the corresponding cartoon face image and represents it on the frontal display smoothly. Using the proposed system, the guests can enjoy the interaction with the actor.



**Figure 2:** Facial expressions

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