

Generating and Rendering Expressive Caricatures

Mohammad Obaid*

Ramakrishnan Mukundan†

Mark Billinghurst‡

Computer Science and Software Engineering Department, University of Canterbury, Christchurch, New Zealand
HITLab New Zealand, University of Canterbury, Christchurch, New Zealand

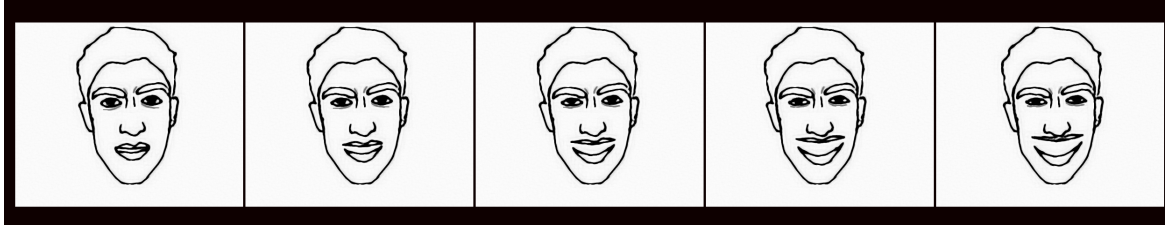


Figure 1: A caricature animation sequence for the smile facial expression

1 Introduction

Facial caricature drawing exaggerates physical face features for a comical effect, and can create an entertaining, humorous, and cartoon-like description of a person's face. Recently, example-based approaches have been introduced to generate facial sketches. Most of these approaches exaggerate the caricature appearance by altering the overall facial shape based on capturing artists' exaggeration-prototypes. Rare attempts have been made to alter and control the facial expressions of the generated caricatures. Moreover, example-based approaches learn how to generate artistic sketch styles through a training phase with prototypes from artist sketches. One of the limitations to these systems is that they require a lot of manual work with a large number of training prototypes drawn by artists. In addition, the final appearance of the caricature can only be limited to the prototypes used in the training phase.

In this paper we propose an approach to generate and render facial caricatures from an input face image. Our approach allows the user to control the exaggeration level of the facial expression imposed on the caricature drawing. It is also capable of producing an expressive facial animation of the caricature drawing (as in Figure 1).

The main contributions of our approach are: (1) A quadratic deformation model for the transformation of facial feature lines, which can effectively map any of the six expressions to a face image, (2) an interpolation method for manipulating the facial appearance and expressivity of the caricature, and (3) an automatic moment-based stroke rendering algorithm to render extracted facial features. Our approach produces very expressive artistically rendered caricatures, and could lead to future research directions in the field of non-photorealistic rendering. Our method could be applied in entertaining standalone applications or caricature animations, or other domains such as augmented reality, animated talking agents etc.

2 Our Approach

We now briefly describe the main components of our caricature generation algorithm. The approach combines three main elements to generate the facial caricature: (1) facial feature extraction algorithms, (2) facial expression representations using quadratic defor-

mation models, and (3) a stroke based caricature rendering algorithm.

The first step is to extract features from the image that will undergo the deformations. Active Appearance model (AAM) and digital matting are used for identifying facial features of interest, such as eyebrows, eyes, nose, lips, ears and hair. We call this part, Rendering Path Extraction, as the extracted path will serve as the painting line for the caricature rendering algorithm.

Once the features have been extracted, they are transformed using facial expression representation described in [Obaid et al. 2009]. In their work, they represent facial expressions by capturing the non-linear nature of muscle deformations for each expression to form quadratic deformation models of the main six expressions (smile, fear, surprise, sad, disgust, and anger). The quadratic deformation models can be applied on any feature line of the caricature by first identifying the region to which the line belongs, and then applying the corresponding transformation parameters to every point on that line.

Finally, the appearance of the generated caricature is enhanced by employing a stroke based non-photorealistic rendering algorithm. The algorithm starts with a blank image (canvas), and then builds a composition of the caricature appearance, by progressively applying strokes along the rendering path. In our approach, strokes are represented as rectangular shapes that have the attribute features colour, position, orientation, and size. We apply the geometric moment shape descriptors, along the rendering path, to determine the stroke attributes. This produces a caricature rendered with a stylized appearance and expression of the original image.

Currently, we are in the process of conducting subjective evaluations of the generated caricatures to study their appearance, exaggeration, and the resembling of the facial expressions. Future work will also focus on integrating our approach into entertainment applications, such as online caricature generations, caricature animations, and standalone applications.

References

OBAID, M., MUKUNDAN, R., BILLINGHURST, M., AND SAGAR, M. 2009. Facial expression representation using a quadratic deformation model. In *International Conference on Computer Graphics, Imaging and Visualization*, IEEE Computer Society.

*e-mail: mohammad.obaid@hitlabnz.org

†e-mail:mukund@cosc.canterbury.ac.nz

‡e-mail:mark.billinghurst@hitlabnz.org