Journal of Industrial Information Technology and Application Vol.4 No.4

ISSN(Online) : 2586-0852

Development of an Face Chroma-key Application for Mixed Reality based Interactive Contents

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Abstract. In this paper, to develop mixed reality (MR) based interactive contents, we introduce face chroma-key application using face detection and face landmark detection techniques. For face detection, we propose deep learning based face detection algorithm, For face landmark detection, we use Constrained Local Neural Fields (CLNF) model as patch model of Constrained Local model (CLM). For interactive contents, we send the result of face chroma-key to main server and put them on the virtual character's face. We implement face chroma-key application on android mobile.

Keywords; face detection; face landmark detection; face chroma-key; human computer interaction

1. Introduction

In recent years, augmented reality (AR) and mixed reality (MR) techniques to improve human perception of reality by sensory input created by computers have become an increasingly interesting area. MR is a powerful user-interface paradigm that enhances user awareness by inserting computer generated information into the user's real-world experience [1]. Interaction between content and users means that users participate directly in content to induce self-directed motivation and to appear immersive or self-esteem through rewards related to the role of the character identified with them.

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Received Oct 14, 2019; Revised Dec 22, 2019; Accepted: Jun. 31, 2020

2. Face and landmark detection

For face detection, we propose deep learning based face detection algorithm. Recently, YOLOv3 and Tiny-YOLOv3 have achieved fast and accurate result in the object detection field [2]. Hence, starting from the Tiny-YOLOv3 network, we applied the following strategies to provide more fast and accurate result. In order to shrink the size of the network, we removed the last 2 convolutional layers and 1 max polling layer of the backbone network in Tiny-YOLOv3 network. Moreover, we reduced the number of convolution filters by half at every convolutional layer after the first 4 convolutional layers. There is a tradeoff between speed in the lightweight models and accuracy in the larger models. Hence, we added 1 branch to improve detection accuracy. Moreover, we set the input image size of the proposed network to 224×224 and remove batch normalization on all of the convolutional layers. Fig. 1 shows the proposed face detection network.

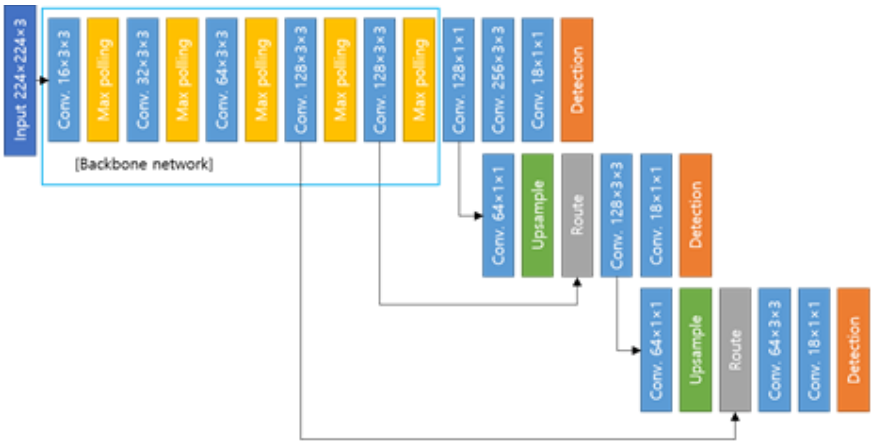

Fig 1. Deep learning based face detection network

For face landmark detection, we use Constrained Local Neural Fields (CLNF) model as patch model of Constrained Local model (CLM) framework [3, 4]. CLM is a framework for complementing the disadvantages of the conventional Active Appearance Model (AAM) and Active Shape Model (ASM), which composed of a shape model that finds the parameters to represent the fittest face shape using Point Distribution Model (PDM) and a patch model that uses the texture around the landmark position. Fig. 2 shows the entire process for face landmark detection based on CLM framework

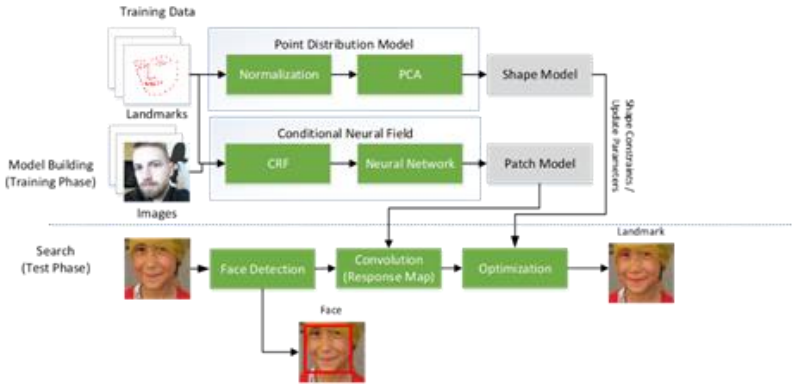

Fig 2. Block diagram of the face landmark detection based on CLM framework

3. Face chroma-key application

To develop face chroma-key application, we find an ellipse, which is fitted around detected face landmarks. And then we set the alpha value of pixels outside the ellipse to zero to separate face and background. Finally, we send the result of face chroma-key to main server and put them on the virtual character's face. The whole process of face chroma-key application was implemented using Android studio and OpenCV library and all tests were carried on Android mobile. Fig. 3 show the result of proposed face chroma-key application.

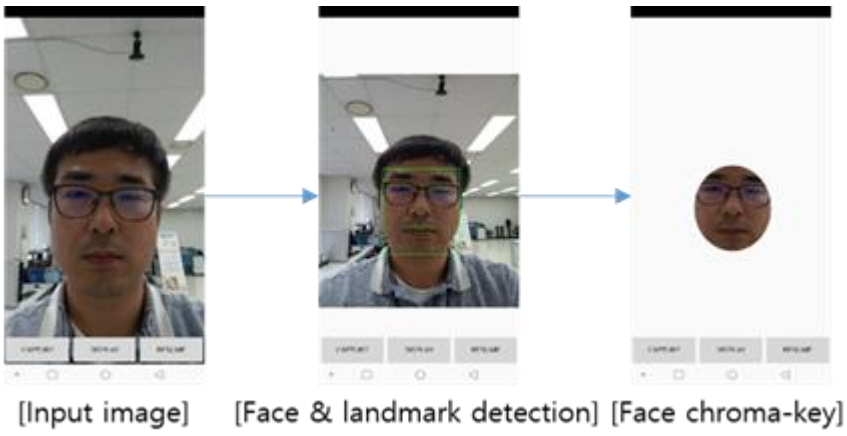

Fig 3. The result of the proposed face chroma-key application

4. Conclusions

In this paper, we proposed face chroma-key application to develop MR based interactive contents. The proposed face chroma-key application consists of three processes. First, to detect face region, we proposed deep learning based face detection algorithm, which is modified Tiny-YOLOv3 networks. To make the network faster and more accurate, we applied some strategies. To detect face landmark, we use face landmark detection algorithm based on Constrained Local Neural Fields. Finally, to develop face chroma-key application, we fitted ellipse to detected face landmark and set the alpha value of pixels outside the ellipse to zero.

Acknowledgment

This work was supported by the DGIST R&D Program of Ministry of Science and ICT (19-IT-01).

References

[1] X. Wang and P. S. Dunston, “User perspectives on mixed reality tabletop visualization for face-to-face collaborative design review,” Automation in construction, vol. 17, no. 4, pp. 399-412, 2008.

[2] J. Redmon and A. Farhadi, “Yolov3: An incremental improvement,”. arXiv preprint arXiv:1804.02767, 2018.

[3] T. Baltrusaitis, P. Robinson, and L. P. Morency. "Constrained Local Neural Fields for robust facial landmark detection in the wild," IEEE Int. Conference on Computer Vision Workshops, 300 Faces in-the-Wild Challenge, pp. 354-361, 2013

[4] D. Cristinacce and T.F.Cootes, "Feature Detection and Tracking with Constrained Local Models," Proc. British Machine Vision Conference, vol. 3, pp.929-938, 2006.