

Fear and Surprise Facial Recognition Algorithm for Dangerous Situation Recognition

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Abstract

This paper proposes an algorithm for risk situation recognition using facial expression. The proposed method recognizes the surprise and fear expression among human's various emotional expression for recognizing dangerous situation. The proposed method firstly extracts the facial region using Harr-like technique from input, detects eye region and lip region from the extracted face. And then, the method applies Uniform LBP to each region, detects facial expression, and recognizes dangerous situation.

The proposed method is evaluated for MUCT database image and web cam input. The proposed method produces good results of facial expression and discriminates dangerous situation well and the average recognition rate is 91.05%.

Keywords: *Facial expression, Uniform LBP, dangerous Situation*

1. Introduction

Intelligent video surveillance system analyzes the position and pattern of the objects of interest by digitizing the image information input, is to recognize the situation and take the corresponding action [1-3]. There is growing interest in human action recognition of HCI and the studies related to these are expanded to human emotional recognition using image, video, audio, and bio-information. Especially, in the field using video among human emotional recognition technology, real-time facial expression recognition and analysis have been actively studying. Facial expression is a means of nonverbal communication, a important factor to transport information of interpersonal communication. Due to this significance, facial expression research has been actively studied.

In this paper, we define human emotion at dangerous situation as fear and surprise emotion among human emotion such as happy, joy, sad, angry, etc. and detect fear and surprise facial expression. The proposed method converts input to gray image and detects face and detects the face by using the Harr-like technique. For facial expression recognition, the proposed method firstly recognizes facial expressions in the basis lip area. Then secondarily we classify the fear and surprise expressions in the eye region.

2. Proposed detection of lip and eye region and facial expression recognition

Figure 1 is the flowchart of the proposed system, which is divided into pre-processing and facial expression recognition processing. In this paper, we recognize fear and surprise facial expressions that can be shown in the dangerous situation among facial expressions. The proposed method recognizes the fear and surprise expressions using lip area. When recognizing the facial expression using the lips, the characteristic of surprise expression is similar to the characteristic of fear expression. In order to prevent errors due to this, we classify the fear and surprise expression using the eye region.

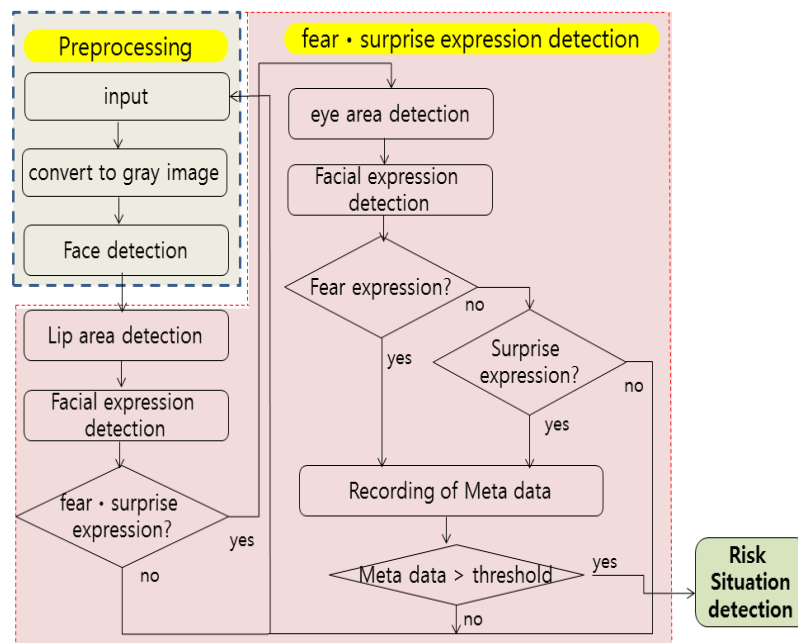
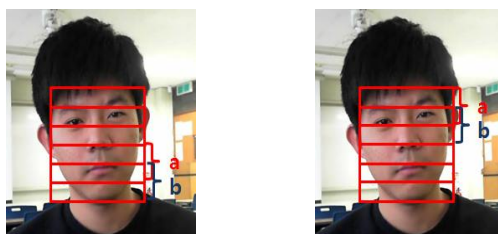


Fig.1 Flowchart of the proposed algorithm

The proposed method converts input color image to gray image and detects the face by using the Harr-like technique. Gray image has only luminance component and is computed $(R+G+B)/3$. Feature for facial expression recognition is used uniform-LBP and lip and eye area are detected using lip and eye position in face.

Since human lips, as shown in Figure 1, is in the lower part of the face, the proposed method divides the detected face area into six areas in the vertical direction and sets the most lower two portions among these as lips candidate region. Also, since the eye is in the upper part of the face, and the proposed method divides the detected face area into five areas in the vertical direction and sets the most higher two portions among these as eyes candidate region



(a) lip candidate area (b) eye candidate area

Fig. 2 The candidate region mouth and eye

To detect lip and eye area at the candidate region, the proposed method divides the lip candidate region into 6×8 , and detects blocks with a lot of high frequency component as lip area. Eye area is detected like that. Firstly after dividing eye candidate region into 2 parts, left eye portion of the two eyes is selected. And then the eye is divided into 4×6 , and blocks with a lot of high frequency component are selected as eye area. The proposed method firstly recognizes facial expressions in the basis lip area. Then secondarily we classify the fear and surprise expressions in the eye region.

For extracting the features, the proposed method is applied to uniform-LBP[4][5]. The proposed method computes uniform-LBP histogram of 64×96 blocks for lip area and 64×64 blocks for eye area. For facial expression recognition, the proposed method firstly recognizes facial expressions in the basis lip area. Then secondarily we classify the fear and surprise expressions in the eye region. When recognizing the facial expression to the lips, surprise, fear and happy expression have similar characteristic of facial expression, in order to prevent errors due to this. Also upon expression, the proposed method detects features using a single left-eye. When recognizing facial expression, the proposed algorithm classifies facial expressions into fear and surprise and sets it as dangerous situation in case that the cumulative number is over three times

3. Experiment and analysis

In order to analyze the performance of the proposed method, the proposed method is applied to face recognition database image and the recognition rate of fear and surprise expressions of fear and surprise is gotten. Also we evaluate the fear and surprise expression recognition and the notification service performance. The proposed system is implemented at Intel CPU 2.0GHz, 1G RAM, using Visual Studio 2010 and OpenCV 2.1.

The proposed method was applied to MUCT database which is widely used in facial expression recognition in order to test whether fear and surprise expressions are classified [6]. This database contains a face image of 3755. In this paper, we classify the fear and surprise expressions as dangerous situations among a various expressions and uses 20 images for each facial expression. Figure 3 various facial expression of web cam input.



Fig. 3 The various facial expression of test images

By applying the proposed technique in the database image, the face area, lips and eye region extraction results are shown in Figure 4. Figure 5 show the detection results of fear and surprise facial expression to apply the proposed method web-cam images. The results prove that the proposed method classifies fear and surprise facial expression among various facial expressions.

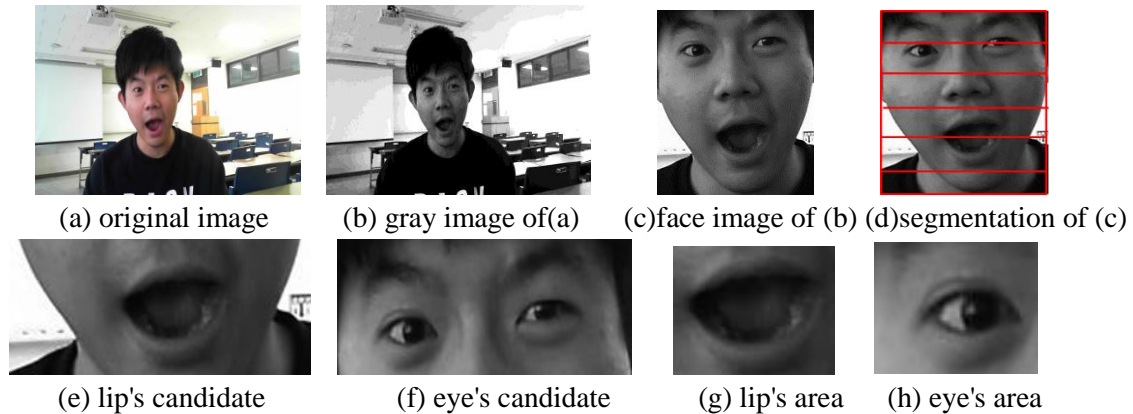


Fig. 4 The detecting result of each region



Fig. 5 The facial expression result using web-cam input

In order to evaluate the performance of the proposed method, the lip, fear and surprise expression recognition rate is won. Table 1 shows the result and in case of lip+eye, for fear facial expression, the recognition rate is 90.3 %, for surprise facial expression, the recognition rate is 91.8%, and the average recognition rate is 91.05%.

Table 1. Facial expression recognition result of fear and surprise

facial expression	feature		
	lip	eye	lip+eye
fear	81.7%	79.7%	90.3%
surprise	86.4%	81.3%	91.8%

4. Conclusion

In this paper, we propose the human facial expression recognition algorithm for danger situation recognition. The proposed method defines fear and surprise facial expression among various facial expressions, detects two expressions and recognizes danger situation using the detected facial expressions. The proposed algorithm is applied to MUCT database and web-cam input and the average recognition rate of 91% is gotten. When the proposed method is applied to the web cam, the proposed method is good at classifying as a dangerous situation.

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