Neurocomputing 136 (2014) 82–87

Contents lists available at ScienceDirect

Neurocomputing

journal homepage: www.elsevier.com/locate/neucom

For micro-expression recognition: Database and suggestions

Wen-Jing Yan [a,b], Su-Jing Wang [a], Yong-Jin Liu [c], Qi Wu [d], Xiaolan Fu [a,*]

[a] State Key Laboratory of Brain and Cognitive Science, Institute of Psychology, Chinese Academy of Sciences, Beijing 100101, China
[b] University of Chinese Academy of Sciences, Beijing 100049, China
[c] TNList, Department of Computer Science and Technology, Tsinghua University, Beijing 100084, China
[d] Department of Psychology, Hunan Normal University, Changsha 410000, China

ARTICLE INFO

Article history:
Received 8 April 2013
Received in revised form
8 November 2013
Accepted 18 January 2014
Communicated by Qingshan Liu
Available online 15 February 2014

Keywords:
Micro-expression
Database
Recognition
Suggestion

ABSTRACT

Micro-expression is gaining more attention in both the scientific field and the mass media. It represents genuine emotions that people try to conceal, thus making it a promising cue for lie detection. Since micro-expressions are considered almost imperceptible to naked eyes, researchers have sought to automatically detect and recognize these fleeting facial expressions to help people make use of such deception cues. However, the lack of well-established micro-expression databases might be the biggest obstacle. Although several databases have been developed, there may exist some problems either in the approach of eliciting micro-expression or the labeling. We built a spontaneous micro-expression database with rigorous frame spotting, AU coding and micro-expression labeling. This paper introduces how the micro-expressions were elicited in a laboratory situation and how the database was built with the guide of psychology. In addition, this paper proposes issues that may help researchers effectively use micro-expression databases and improve micro-expression recognition.

1. Introduction

Micro-expression is a brief facial movement which reveals an emotion that a person tries to conceal [1,2]. Most notably, TV series *Lie to Me* brought the idea of micro-expression to the public. The reputation of micro-expression is derived from its potential practical applications in various areas, such as clinical diagnosis, national security and interrogations [3–5] because micro-expression may reveal genuine feelings and help detect lies. Lie detection based on micro-expression is not just a fiction, but stems from scientific researches. Haggard and Isaacs first discovered micro-expression (micro-momentary expression) and considered it as repressed emotions [6,7]. In 1969, Ekman analyzed an interviewing video of a patient stricken with depression who tried to commit suicide and found micro-expressions. From then on, several researches have been conducted in the field of micro-expression but few results were published. Ekman [2] even claimed that micro-expressions might be the most promising approach to detect deception.

Micro-expression is featured by its short duration. Though there is a debate on the duration, the generally accepted upper limit duration is 0.5 s [8,9]. Besides, micro-expression usually occurs with low intensity [8]. Because of the short duration and low intensity, it is usually imperceptible to the naked eyes [1]. To make better use of micro-expression in lie detection, one solution is to resort to computers to automatically detect and recognize micro-expressions. An automatic micro-expression recognition system would have far-reaching influence in the fields such as national safety, transportation safety and even clinical diagnosis.

Expression recognition has been intensively studied in the past [10], while little attention was paid to micro-expression recognition until several years ago. Micro-expression recognition raises a great challenge to computer vision because of its short duration and low intensity. The even bigger obstacle is the lack of well-established databases. Recently, several groups have developed micro-expression databases. However, we realize that the existing micro-expression databases have some problems. In the following, we will review the existing micro-expression databases and then introduce CASME database.

This paper is an extended version of our conference paper[1] [11]. Differently, a further review of the previous databases was given, some new findings of micro-expressions were presented, some challenges were pointed out and some suggestions in automatic micro-expression detection and recognition were provided.

2. The existing micro-expression databases

In the following, existing micro-expression databases were reviewed. Table 1 gives a brief description for each database. In USD-HD [12] and Polikovsky's database [13], the drawback is that

* Corresponding author.
E-mail address: fuxl@psych.ac.cn (X. Fu).

[1] Part of this work was presented at FG2013.

http://dx.doi.org/10.1016/j.neucom.2014.01.029
0925-2312

Table 1
The existing micro-expression databases.

Database	Profile	Problem(s)
USF-HD	It contains 100 micro-expressions. Participants were asked to perform both macro- and micro-expressions	Posed micro-expressions rather than spontaneous ones
Polikovsky's database	It contains 10 models, who were instructed to simulate the micro-expression motion	Posed micro-expressions rather than spontaneous ones
YorkDDT	It contains 18 micro-expressions which were collected from the recordings in Warren's study [15]	Spontaneous but with other irrelevant facial movements; small sample
SMIC database	It contains 77 spontaneous micro-expressions which were recorded by a 100 fps camera	Spontaneous micro-expressions; classified as positive, negative

Table 2
Criteria for labeling the emotions and the frequency in the database.[a]

Micro-expression	Criteria	Number of samples
Happiness	Either AU6 or AU12 must be present	9
Sadness	AU1 must be present	6
Disgust	At least one of AU9, AU10 must be present	44
Surprise	AU1+2, AU25 or AU2 must be present	20
Fear	Either AU1+2+4 or AU20 must be present	2
Repression	AU14, AU15 or AU17 is presented alone or in combination	38
Tense	AU4 or other emotion-related facial movements	69

[a] The emotion labeling is just *partly* based on the AUs because micro-expressions are usually partial and in low intensity. Therefore, we also take account of participants' self-report and the content of the video episodes.

they consist of posed micro-expressions rather than spontaneous ones. However, micro-expression is considered involuntary and difficult to disguise [1]. In addition, the duration limit set for micro-expressions in USD-HD (2/3 s) is longer than the generally defined one (1/2 s). As for YorkDDT [14], the samples are spontaneous micro-expressions with high ecological validity but accompanied with other irrelevant head and face movements when speaking. For the early stages of micro-expression recognition, such complicated facial movement is not ideal, as it greatly increases the complexity of the recognition task. Furthermore, very few micro-expressions were acquired in this dataset because micro-expression is difficult to elicit with the "telling lies" approach. SMIC database [14] contains spontaneous micro-expressions elicited in a laboratory. This is a great improvement compared with the posed micro-expression databases. This database, however, did not provide AUs for the samples and the micro-expression labeling was only based on participants' self-report. This might cause a problem since video episodes convey various emotional stimuli and thus an overall report may not be precise (e.g. chewing a worm in a video episode may be disgusting but sometimes also amusing or surprising). Besides, some facial movements may be emotion-irrelevant, such as moving eyebrows due to the changes in eyesight. These irrelevant facial movements should be removed. Based on previous issues and drawbacks, we try to build an improved micro-expression database to facilitate the development of a robust automatic micro-expression recognition system.

3. CASME database

3.1. Database profile

The Chinese Academy of Sciences Micro-Expression (CASME) database contains 195 spontaneous micro-expressions filmed

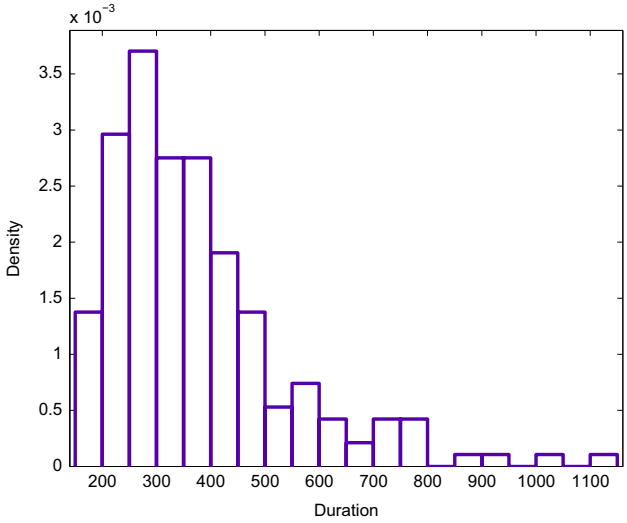

Fig. 1. The distribution of total duration of the micro-expressions.

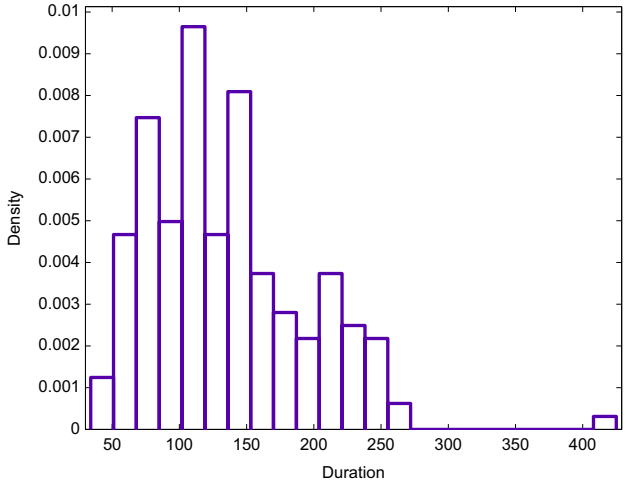

Fig. 2. The distribution of onset duration of the micro-expressions.

under 60 fps. These samples were coded so that the onset, peak and offset frames were tagged. The onset frame was the first frame which changes from the baseline (usually neutral facial expressions). The apex-1 frame is the first frame that reached highest intensity of the facial expression and if it keeps for a certain time, the apex-2 frame is coded. Facial expressions with the duration no more than 500 ms were selected for the database. In addition, facial expressions that lasted more than 500 ms but their onset duration less than 250 ms were also selected because fast-onset facial expressions are also characterized as micro-expression [8] (that is why the duration of some samples exceed 500 ms). The distributions of the samples' duration were provided (see Figs. 1 and 2). Action units (AUs) [16] were marked and emotion labels were given (Fig. 3). To enhance the validity, emotions were labeled based on 3 aspects: AU-combinations, the main emotion of the video episode and participants' report (see Table 3). Compared with other micro-expression databases, the CASME database includes the following advantages:

(1) The samples are spontaneous micro-expressions. The frames before and after each target micro-expression in each video sample show baseline (usually neutral) faces.

(2) Participants were asked to maintain a neutral face (neutralization paradigm) in the study. Therefore, micro-expressions