

Towards Reading Hidden Emotions: A Comparative Study of Spontaneous Micro-expression Spotting and Recognition Methods

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Abstract—Micro-expressions (MEs) are rapid, involuntary facial expressions which reveal emotions that people do not intend to show. Studying MEs is valuable as recognizing them has many important applications, particularly in forensic science and psychotherapy. However, analyzing spontaneous MEs is very challenging due to their short duration and low intensity. Automatic ME analysis includes two tasks: ME spotting and ME recognition. For ME spotting, previous studies have focused on posed rather than spontaneous videos. For ME recognition, the performance of previous studies is low. To address these challenges, we make the following contributions: (i) We propose the first method for spotting spontaneous MEs in long videos (by exploiting feature difference contrast). This method is training free and works on arbitrary unseen videos. (ii) We present an advanced ME recognition framework, which outperforms previous work by a large margin on two challenging spontaneous ME databases (SMIC and CASMEII). (iii) We propose the first automatic ME analysis system (MESR), which can spot and recognize MEs from spontaneous video data. Finally, we show our method outperforms humans in the ME recognition task by a large margin, and achieves comparable performance to humans at the very challenging task of spotting and then recognizing spontaneous MEs.

Index Terms—Micro-expression, facial expression recognition, affective computing, LBP, HOG.

1 INTRODUCTION

FACIAL expressions (FE) are one of the major ways that humans convey emotions. Aside from ordinary FEs that we see every day, under certain circumstances emotions can also manifest themselves in the special form of micro-expressions (ME). An ME is a very brief, involuntary FE shown on people's face according

to experienced emotions. ME may occur in high-stake situations when people try to conceal or mask their true feelings for either gaining advantage or avoiding loss [1]. In contrast to ordinary FEs, MEs are very short (1/25 to 1/3 second, the precise length definition varies [2], [3]), and the intensities of involved muscle movements are subtle [4].

The phenomenon was first discovered by Haggard and Isaacs [5] in 1966, who called them micromomentary facial expressions. Three years later, Ekman and Friesen also reported finding MEs [6] when they were examining a video of a psychiatric patient, trying to find possible trait of her suicide tendency. Although the patient seemed happy throughout the film, a fleeting look of anguish lasting two frames (1/12s) was found when the tape was examined in slow motion. This feeling of anguish was soon confirmed through a confession from the patient in her another counseling session: she lied to conceal her plan to commit suicide. In the following decades, Ekman and his colleague continued researching MEs [1], [7], [8]. Their work has drawn increasing interests from both academic and commercial communities.

A major reason for the considerable interest in MEs is that it is an important clue for lie detection [1], [9]. Spontaneous MEs occur fast and involuntarily, and they are difficult to control through one's willpower [10]. In high-stake situations [7] for example when suspects are being interrogated, an ME fleeting across the face could give away a criminal pretending to be innocent, as the face is telling a different story than his statements. Furthermore, as has been demonstrated in [9], [11], people who perform better at ME recognition tests are also better lie detectors. Due to this, MEs are used as an important clue by police officers for lie detection in interrogations. Ekman developed a Micro Expression Training Tool (METT) [8] to help improve the ME recognition abilities of law enforcement officers. In addition to law enforcement, ME analysis has potential applications in other fields as well. In psychotherapy, MEs may be used for understanding genuine emotions of the patients when additional reassurance is needed. In the future when this technology becomes more mature, it might also be used to help border control agents to detect abnormal behavior, and thus to screen potentially dangerous individuals during routine interviews.

However, detecting and recognizing MEs are very difficult

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