Micro-Expressions: More Than Meets the Eye

Using Software to Reveal True Emotions

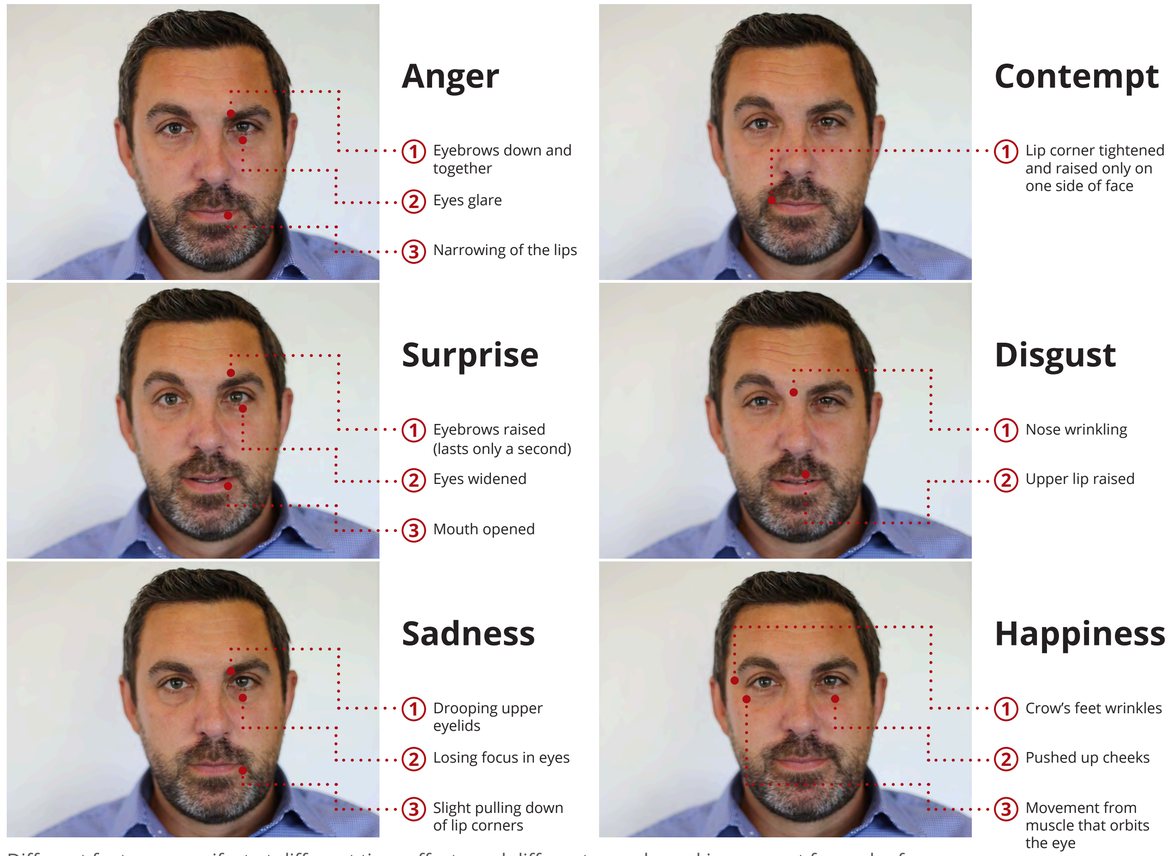
Micro-expressions—involuntary, fleeting facial movements that reveal true emotions—hold valuable information for scenarios ranging from security interviews and interrogations to media analysis. We are developing a prototype software tool to recognize micro-expressions, identifying the emotions they reveal.

Micro-expressions: tiny movements with a lot of information. Micro-expressions can occur on various regions of the face and last only a fraction of a second. These movements have been shown to be universal across cultures, and they are very difficult to suppress.

Defense and intelligence applications. Our work advances capabilities in human-machine teaming and machine emotional intelligence, and can be applied in a wide range of scenarios, including:

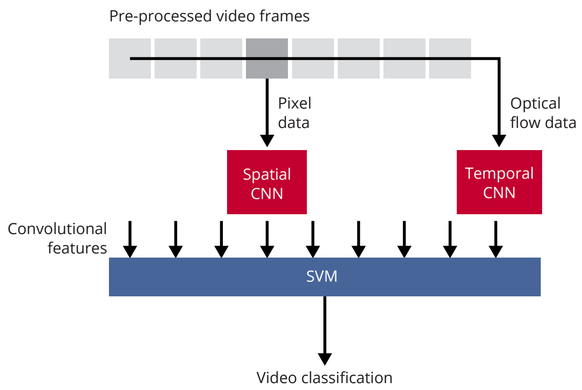
- security checkpoint encounters
- interrogations
- polygraph testing
- media analysis and exploitation
- detection of stress, PTSD

Current state of the art. Current tools for recognizing emotion (for example, Affectiva) can successfully identify emotions based on *macro-expressions* like broad smiles, exaggerated frowns, and obviously narrowed eyes and pursed lips. However, macro-expressions can be easily faked. Current approaches for recognizing *micro-expressions* use hand-crafted features and treat each video frame as a stand-alone image. This approach is brittle, is slow, and has limited accuracy.



Different features manifest at different time offsets and different speeds, making current frame-by-frame approaches to recognizing micro-expressions inaccurate.

An interesting test case for micro-expression recognition is poker tells: can our tool identify emotions highly skilled poker players intend to hide?



Our approach: We use machine learned features and incorporate optical flow to introduce temporal structure.

Results. We designed and built a micro-expression recognition system that improves upon the state of the art:

- We used machine-learned features that treat the whole face as a canvas, in contrast to traditional hand-crafted features and techniques that search pre-defined areas of the face for facial action units. Machine-learned features were generated with a pre-trained convolutional neural network.
- We combined optical flow data with frame-by-frame pixel information to better incorporate temporal structure into the recognition model.
- We used several pre-processing techniques, such as video interpolation via graph embedding, to improve accuracy or maintain accuracy while reducing runtime.

Next steps. A number of opportunities exist to extend our work in micro-expressions. Looking ahead, we are interested in combining micro-expression detection with recognition to increase the practicality of our solution, improving datasets to advance research in micro-expression recognition, and exploring solutions for long-running videos.

Future work includes recognizing emotion from voice.

Related work. Micro-expression recognition is part of a larger portfolio of SEI work in "machine emotional intelligence"—using physiological characteristics to enable machines to better understand humans. In 2016, we developed a tool to extract heart rate from video; our next project in this area is recognizing emotion from voice.

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