Using Intel's RealSense Camera to Detect Emotion in Facial Expressions: A Validity Study

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Introduction

Most researchers recognize six universal, basic human emotions: surprise, fear, disgust, anger, happiness and sadness (Busso et al., 2004). Researchers typically identify emotions through the coding of facial markers, speech (eg., Busso et al., 2004), and physiological features (e.g., heart rate, skin resistance, blood pressure; e.g., Leon et al., 2007). However, these techniques require a substantial investment of time and effort. The current work examined the utility of Intel's (2015) RealSense USB PC camera and accompanying software as a complement or replacement for these more intensive techniques. If the RealSense camera offers valid, reliable, and efficient ratings of participants' facial expressions, current emotion research may be simplified and new research areas may more easily include emotional data.

Method

Subjects

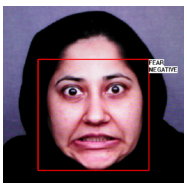
Two databases of emotional faces were used in this study. The FACES database was compiled by Ebner et al. (2010) at the Max Planck Institute for Human Development using 172 individuals that varied in age and race. Each individual conveyed six facial expressions (neutrality, sadness, disgust, fear, anger and happiness), totaling 2052 images**.** The images from this database were narrowed down to 275 faces that included racial diversity and emotion variation. The images were restricted to straight-on shots, thus excluding images taken from the side. The Stirling database (The University of Stirling, 2008) contains 617 strictly straight-on shots. Emotions in this database included happy, angry, disgust, fear, upset and surprised. We selected 145 images from this database at random from this set. The individuals contained in this database are males and females with varied races and genders. Each database provides information on intended expressed emotion, gender, and race within the file name of each image for easy identification.

Materials

The RealSense camera by Intel was used as the emotion recognition hardware, and the Intel RealSense SDK (version 5.0) was used to allow the Windows 10 PC to interface with it properly. The camera detects the face and associated expressions (anger, disgust, fear, joy, sadness, and surprise, according to Intel) at a rate of approximately 30 refreshes per second. The software provided an emotion rating based on the distinct facial markers detected by the camera (using proprietary software).

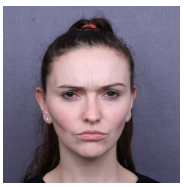
Protocol

A total of 420 images (275 from the FACES Database and 145 from the Stirling database) were analyzed by the RealSense camera. These images were shown one-at-a-time on a single computer screen. The camera was positioned directly in front of the screen to facilitate the analysis of each image. After allowing the camera reading to stabilize for a few seconds, the emotion label it produced was entered into a Microsoft EXCEL spreadsheet that included the individual's characteristics (intended emotion, race, and gender).


Fear


Sadness


Surprise


Anger


Disgust


Joy

Results

We examined the degree of agreement between data-base supplied ratings of emotional expression and those provided by the RealSense camera through the use of Cohen's (1960) Kappa, which corrects for agreement that would be expected through chance alone.

***K* = .365** for the full dataset (N=420), which Cohen labeled "fair"

After removing trials for which the RealSense was unable to acquire a reading (37%), ***K* = .585** (N = 265), which Cohen labeled "moderate."

The RealSense camera appears to be useful… when it gets a reading.

Discussion and Future Directions

Although the results appear to indicate that the RealSense is a potentially useful tool for researchers, there are still several questions that need to be addressed.

First, why did it fail to get a reading on about 1/3 of our sample? Informally, it appears to have difficulty reading individuals with very dark (and light?) skin--perhaps due to a lack of visible contrast in facial lines created when emoting. Also, participants varied in terms of their degree of facial expressiveness, which could also be an issue.

Second, how would the camera fare with humans as opposed to images of humans?

Third, how fast can the camera function accurately? To increase the odds of a reading we gave the camera several seconds to "settle," but human expressions can change very quickly. We will need to assess how quickly an accurate reading can be made in a "real" study with human subjects and if it can keep up with dynamic facial expressions.

Provided we can optimize the function of the RealSense through, e.g., manipulations of the distance between person and camera and the lighting conditions, we may yet be able to prove its usefulness.

Possible applications of this technology include:

Examining the possible link between emotion expression capability and neurodegenerative diseases such as Parkinson's and Huntington's. Such diseases impede emotion expression by damaging the neuromuscular junction responsible for the facial features exuding emotion. By comparing individuals' intended expressions and the ones shown on the camera, researchers can identify which facial areas are not properly showing the emotion.

Augmented reality applications might allow individuals with impaired emotion recognition to interact more "normally" with others.

References

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