

Abstract

Affective computing and machine vision is increasingly becoming an integral part of our daily lives, with the development of systems that can accurately gauge human emotions or affective states having countless potential implementations in a wide array of human-machine interactions. Key applications include the early diagnosis of multiple medical conditions, real time accurate product evaluation, remote hospital patient monitoring and safety indicators in cars.

In the following report, a novel classification framework is presented to identify a person's emotions from an input depth scan of their face. The framework utilises three-dimensional (3D) data to increase its ability to operate under challenging conditions such as low illumination levels and large head pose variations. The classification task is defined as recognising an emotion as one of Ekman's six fundamental emotions (Happy, Sad, Angry, Fear, Surprise or Disgust) and the input data is restricted to facial data alone. The proposed framework is composed of three fundamental modules: the pre-processing module, the feature extraction module, and finally the classification module. In the pre-processing module, the input data is refined via the application of pose-correction, face crop and surface smoothing algorithms. The feature extraction module defines two novel feature vectors that represent the movement of multiple facial landmarks over time, as well as integrating an Action Unit detection system based on the FACS framework. The classification module presents a novel adaptive classification system, based on the strategic selection of the most applicable classifier for the extracted features. The module utilises multi-class ensemble and support vector machine (SVM) classifiers.

The framework has been validated on the most widely used BU-3DFE and BU4DFE to enable performance evaluations against other SOTA frameworks. The proposed system produces higher recognition accuracies than average within the field, however direct comparison between systems is usually problematic due to lack of accepted standards for producing validation figures.

The project has produced extensive, well documented, and easily interpretable code for the implementation of the entire framework in MATLAB. This has been identified as a key output that previous studies have neglected to present and is a vitally important contribution of this work.