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# Development of Real-Time Emotion Recognition System using only Facial Expressions Based on Machine Learning and Deep Neural Network Methods to Assist Physically Disabled People

## Project Code: PR18- 18EE- 01


**Abstract (English):**

Identifying different types of emotional expressions from the subject's face is a simple approach compared to other modalities and it is essential for developing intelligent systems for a variety of applications. Several research works are reported in the literature utilized different methodologies to recognize facial emotional expressions. Some of the major issues in the literature works are, the researchers performed their experiment in a constrained environment, mostly used manual marker placement method for facial expression detection with many markers, and systems are developed for offline applications than real-time with higher computational complexity (computation time and memory). To circumvent the above issues, the main objective of this project is to develop an automated virtual marker placement approach for facial emotional expression detection with lesser computational complexity and to achieve a higher emotion recognition rate using machine learning and deep learning algorithms. Initially, the subject face is captured through the web camera and Haar-Like features and ADA Boost classification method is used for face detection. Later, ten virtual markers are automatically placed on specific locations in the subject face using the Lucas-Kanade optical flow algorithm (OFA). The position of the markers is sent to OFA for tracking the marker during different emotional expressions and saved it in a computing system for further processing. Eighty-five undergraduate students voluntarily participated in the experiment to develop a facial emotional expression database of six emotions (happiness, surprise, anger, fear, disgust, and sadness) over six trials. Two different types of features are extracted from the marker positions namely, distance feature and triangle feature. Here, distance features are used to measure the distance between the center of the face and each maker. Triangle features are newly proposed in this work and it uses ten virtual markers to form six triangles and six statistical features are extracted from these triangles such as triangle area, triangle perimeter, inscribed circle area, inscribed circle circumference, circumcircle area, and circumcircle circumference. These features are tested using a one-way analysis of variance (ANOVA) method with a significance level of $p<0.01$ to test its significance in distinguishing emotional expressions. Finally, these features were cross-validated using fivefold cross-validation method and fed into the machine learning algorithms (K Nearest Neighbor (KNN), Extreme Learning Machine (ELM), Support Vector Machine (SVM), Regression Tree (RT), Decision Tree (DT), and Probabilistic

Neural Network (PNN)) and deep learning method (Convolutional Neural Network (CNN)). Experimental confirms that the proposed methodology achieved a maximum mean emotional expression recognition rate of 98.32% using CNN and 98.20% using RF classifiers on distance features. In the case of the triangular feature, the inscribed circle area gives the maximum mean classification rate of 96.25% in CNN and 98.20% in the RF classifier. Among the different types of machine learning algorithms, ELM offers the lowest mean accuracy (<96%). The experimental results indicate that happiness, surprise, fear and anger emotions achieved a maximum recognition rate compare to the other two emotions (sadness and disgust). It might be due to the reasons that the subject did not perceive and naturally express these emotions.