

Chapter 7

Advancements in Facial Expression Recognition Using Machine and Deep Learning Techniques


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ABSTRACT

In the field of computer vision, facial expression recognition is an emerging field that looks at visual face data to try and understand human emotions. Facial expression detection and recognition has been popular recently in the research field. The literature is compiled from several credible studies that have been released in the last 10 years. In the recent years, the artificial intelligence has evolved a lot along with which there has been rise in experimenting with various methodologies for facial expression recognition, which has given promising results in accurately identifying and recognizing facial emotions from input modalities like images, text,

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facial expressions, and physiological signals. However, accurate analysis of basic emotions like anger, happiness, sadness, and fear remains a challenge. This chapter provides valuable insights for researchers interested in advancing facial emotion recognition using machine learning and deep learning techniques.

INTRODUCTION

Facial expression is a natural and most effective way for people to communicate their thoughts and emotional states. Early humans used facial expressions to communicate emotions like fear, anger, happy, disgust etc. rage to survive threats. Therefore, these facial expressions have evolutionary roots also. According to a research study by psychologist Mehrabian (2008), majority of the information is conveyed through facial expression around 55%, followed by 38% tone of voice and merely 7% through verbal cues. Individuals express their emotions mostly through their facial expressions. According to research by Paul Ekman (1978) state evolution of artificial intelligence (AI) has led to expressive developments in the study of sentimental analysis through facial expressions. Facial Expression Recognition has made significant advancements in terms of their effectiveness, precision, transfer learning, multi-modal integration, novel approaches to pattern recognition, ethical considerations, and practical applicability. It is concerned with detecting human emotional states through involuntary facial muscle movements caused by variations in an individual's emotional state. machine and deep learning methods exhibit greater robustness to variations in facial expressions, lighting conditions, and image quality compared to traditional machine learning algorithms. This robustness enhances the reliability of facial expression recognition systems across diverse real-world scenarios, contributing to their practical utility and effectiveness (Rai, M., 2022). Moreover, the automation of feature extraction in deep learning models streamlines the model development process, enabling researchers to focus on refining and optimizing model performance rather than manual feature engineering. However, despite these significant advantages, facial expression recognition using machine and deep learning techniques also presents certain challenges. Foremost among these challenges is the dependency on large, labelled datasets for training. Acquiring and annotating such datasets can be resource-intensive and time-consuming, particularly for rare or culturally specific facial expressions. This data dependency may limit the generalizability of facial expression recognition systems and raise concerns about bias and fairness across diverse populations and contexts There are six basic universal emotions as recognized by Paul Ekman (2003) in the categories of human emotional states like happy, sad, fear, anger, surprise, and disgust. One of the emotional states

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