



EMOTION RECOGNITION BY REAL TIME FACIAL EXPRESSION USING PYTHON

Ayush Kumar, Harsh Kumar Mall, Kirti Kasaudhan, Kirti Pandey

Student, Computer Science and Engineering

Institute of Technology and Management, Gorakhpur

ABSTRACTION

The realm of emotion recognition through real-time facial expressions using Python and employing a deep learning model CNN (Convolutional Neural Networks), constitutes a compelling area of research. This technology has wide applications in diverse domains such as human-computer interfaces, human-robot interactions, market research & advertising, and the diagnosis of psychological and mental disorders diseases in Healthcare. Researchers in this domain are actively engaged in developing techniques aimed at interpreting and encoding facial expressions, as well as extracting pertinent features to enhance computational prediction. Leveraging the remarkable success of CNN, various architectural configurations within this paradigm are explored to attain superior performance.

This paper seeks to conduct a comprehensive examination of recent advancements and real-world challenges such as variations in lighting conditions, pose, ethnicity, and gender, to improve the reliability and inclusiveness of CNN-based emotion recognition through real-time facial expression analysis using Python system. The main goal is to carefully examine the contributions, explain the methods used, and describe the databases used. Furthermore, the paper aims to assess progress by comparing the different datasets and the results they yield. The underlying objective of this study is to offer a valuable resource for researchers by reviewing recent developments and providing insights that can facilitate advancements in this evolving field.

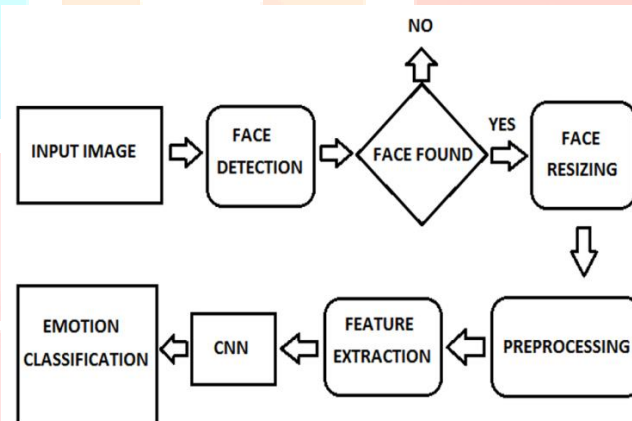
INTRODUCTION

In our daily lives, non-verbal communication plays a significant role. Some studies estimated that approximately 55% to 93% of communications are non-verbal [1]. Predicting emotions through nonverbal communication allows us to understand an individual's emotional state. Emotion recognition through real-time facial expressions is a technology that automates the process of determining emotions by analyzing various facial features. These features include facial landmarks, activations from Convolutional Neural

Networks (CNNs), Facial Action Units (AUs), and other relevant characteristics. The system maps these features to a predefined set of emotions, such as anger, fear, surprise, sadness, and happiness. Facial emotion recognition has diverse applications in areas including marketing, human–robot interaction, healthcare, mental health monitoring, and security. Facial expressions serve as a form of non-verbal communication, offering cues for understanding human emotions. The field of emotion recognition technology is experiencing rapid growth, with the projected size of the global Emotion Detection and Recognition Market reaching \$42.9 billion by the end of 2027, reflecting a Compound Annual Growth Rate (CAGR) of 12.8% during the forecast period.

LITERATURE REVIEW

A Real-time FER system capable of handling varying lighting conditions, diverse facial poses, and occlusions still faces challenges. Researcher studies focus on recognizing facial expressions in real-world situations, especially when dealing with single-in-the-wild (ITW) images with challenges like different poses, directions, and changing resolution. They suggest a new Pyramid with Super-Resolution (PSR) network design and introduce a unique Prior Distribution Label Smoothing (PDLs) loss function. Their approach performs better than the best existing methods on commonly used ITW Facial Expression Recognition datasets[1].



Figure– Block diagram of Facial emotion recognition system

Instead of relying on ensemble models associated with increased complexity, they propose a single standalone-based CNN model. Applied to a real-time Intelligent System for Sentiment Recognition, the model achieves an impressive 76.62% accuracy on the challenging FER2013 dataset without using auxiliary datasets. This approach, focusing on a real-world scenario with mixed emotions, showcases the potential of a single-model solution[2].

Table- Python Libraries used in various Facial Emotion Recognition system

OpenCV	: It provides tools for image processing, video analysis, and computer vision tasks.
Keras	: It provides tools for building and training deep neural networks.
PyTorch	: It simplifies the process of building, training, and deploying deep learning models.
Facenet	: It is known for its dynamic computational graph, making it flexible for research.
DeepFace	: It is a framework for facial analysis, encompassing various deep learning models.

This review paper delves into the application of a deep neural network (DNN) for Facial Emotion Recognition (FER). The primary objective is to identify the key facial features that capture the DNN model's attention in the context of FER. The study employs a Convolutional Neural Network (CNN), incorporating both the squeeze-and-excitation network and the residual neural network for FER. Utilizing AffectNet and the Real-World Affective Faces Database (RAF-DB) as learning databases, the study focuses on extracting feature maps from the residual blocks for thorough analysis. Notably, the results underscore the significance of facial landmarks around the nose and mouth for neural networks in FER tasks. Cross-database validations between AffectNet and RAF-DB were conducted, demonstrating that the network model trained on AffectNet achieved a validation accuracy of 77.37% on RAF-DB. Furthermore, when the model was trained on AffectNet and then transfer learned on RAF-DB, the validation accuracy rose to 83.37%. These findings contribute valuable insights to the understanding of neural networks, offering potential enhancements to the accuracy of computer vision systems in facial emotion recognition[3].

In the current era, numerous ongoing research initiatives are concentrated on exploring and refining deep learning architectures for facial emotion recognition. This encompasses the examination of attention mechanisms, recurrent neural networks (RNNs), and transformer-based models. Researchers are diligently working towards enhancing the efficiency, accuracy, and interpretability of these models.

Datasets used for Facial emotion recognition models

1. **Fer2013** contains approximately 30,000 facial RGB images of different expressions with size restricted to 48×48 , and the main labels of it can be divided into 7 types: 0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral. The Disgust expression has the minimal number of images – 600, while other labels have nearly 5,000 samples each.



Figure- Sample images of FER2013

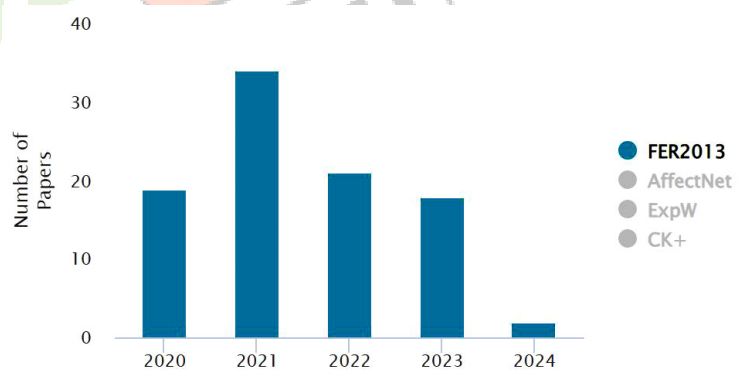


Figure- No. of papers vs year bar graph

2. **AffectNet** is a large facial expression dataset with around 0.4 million images manually labeled for the presence of eight (neutral, happy, angry, sad, fear, surprise, disgust, contempt) facial expressions along with the intensity of valence and arousal.



Figure- Sample images of AffectNet

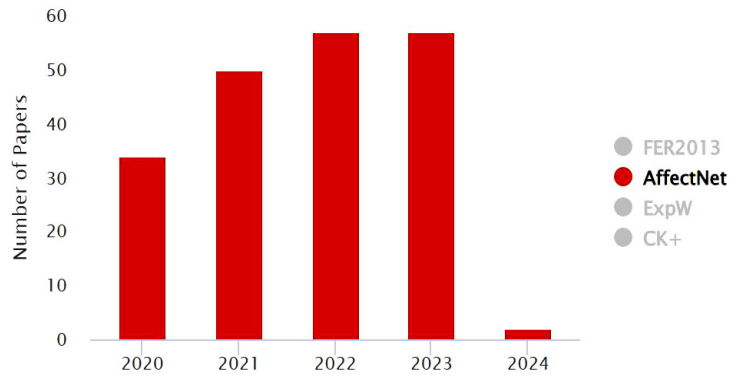


Figure- No. of papers vs year bar graph

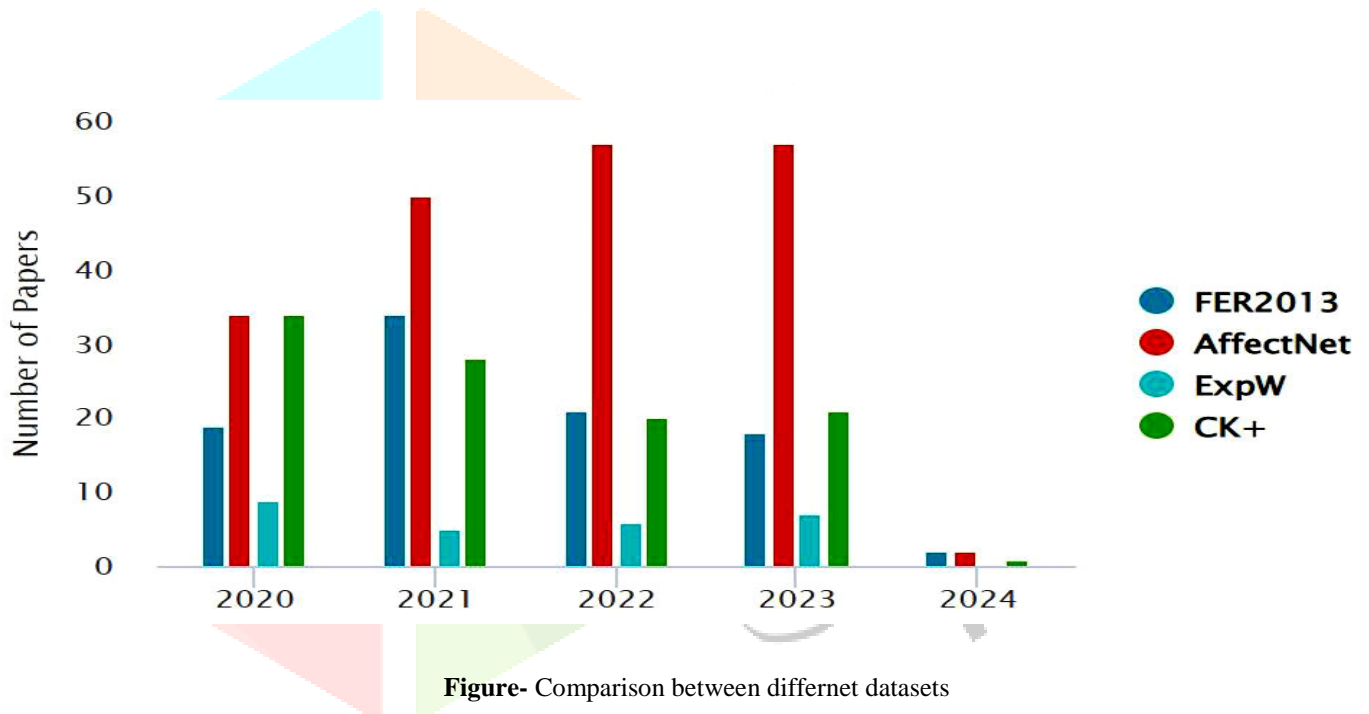


Figure- Comparison between different datasets

CONCLUSION

Advancements in Facial Emotion Recognition (FER) using datasets like FER2013 and AffectNet could lead to improved accuracy and robustness. Further exploration of neural network architectures and feature extraction techniques may enhance the capabilities of FER systems. Cross-database validations, as demonstrated in this study, offer valuable insights for refining models. Continued research in this direction holds the potential to elevate the performance of FER in real-world applications, contributing to a more nuanced understanding of human emotions

LITERATURE CITATION

1. [1]Pyramid With Super Resolution for In-the-Wild Facial Expression Recognition. (2020). IEEE Journals & Magazine | IEEE Xplore. <https://ieeexplore.ieee.org/document/9143068>
2. [2]Facial Emotion Recognition using Deep Learning. (2022, March 10). IEEE Conference Publication | IEEE Xplore. <https://ieeexplore.ieee.org/document/9752189>
3. [3]Emotion recognition based on facial expressions using convolutional neural network (CNN). (2020, December 9). IEEE Conference Publication | IEEE Xplore. <https://ieeexplore.ieee.org/document/9302866>
4. [4]Mehendale, N. (2020). Facial emotion recognition using convolutional neural networks (FERC). *SN Applied Sciences*, 2(3). <https://doi.org/10.1007/s42452-020-2234-1>

