# Face Expression Recognition Using Convolutional Neural Networks (CNN)

High Impact Skills Development Program for Gilgit Baltistan

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Github link: <https://github.com/Anzal-hussain-Anzal/Face-Expression-Recognition-Using-Convolutional-Neural-Networks-CNN->  
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## Abstract

This project focuses on developing a deep learning model to classify facial expressions using the Expression in-the-Wild dataset. The primary goal is to accurately detect emotions from images, with applications in fields like human-computer interaction, psychology, and security. The model was trained using a Convolutional Neural Network (CNN), and achieved a validation accuracy of approximately [XX%]. The report details the methodology, results, and areas for improvement.

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## Introduction

Background: Facial expression recognition is a crucial aspect of human-computer interaction. It has diverse applications, including psychological analysis, security, and real-time feedback systems. This project aims to design a deep learning model using CNN to classify facial expressions from images.

Objectives: Develop a CNN-based system for recognizing facial expressions. Evaluate the performance of various model architectures. Investigate hyperparameter tuning techniques to optimize model accuracy.

Scope: This project focuses on recognizing seven basic emotions (anger, disgust, fear, happiness, sadness, surprise, neutral) using grayscale facial images.

Problem Statement: Recognizing emotions from facial images is challenging due to variations in pose, lighting, and occlusions. This project addresses these issues by training and fine-tuning CNN models on the ExpW dataset.

## Literature Review

Several works have explored facial expression recognition using machine learning and deep learning methods. Zhang et al. (2018) proposed an approach to predict interpersonal relations from facial expressions, achieving significant results in classification accuracy. Jonathan Oheix's dataset, which we used in this project, contains grayscale images for training deep learning models, providing a balanced data structure for emotion recognition tasks.

## Methodology

Data Preprocessing: The images were resized to 48x48 pixels. Converted to grayscale for uniformity. Normalization of pixel values to a range of 0 to 1 for effective model training.

Model Architecture: A CNN was designed with multiple convolutional layers for feature extraction, followed by pooling layers and dense layers for classification. Early stopping and model checkpoint techniques were employed to prevent overfitting.

Hyperparameters: Batch size: [Insert value] Epochs: [Insert value] Learning rate: [Insert value] The model was fine-tuned using Keras' hyperparameter tuner to achieve optimal performance.

## Implementation

The implementation followed a structured process: Training the CNN: The dataset was split into training, validation, and test sets. A variety of models were trained, and their performances compared based on accuracy and loss metrics. Evaluation: The models were evaluated on unseen test data, and predictions were made using the best-performing model.

## Architecture Results and Analysis

**Training Set:** Used to train the model.

**Validation Set**: Used to validate the model's performance during training.

**Test Set**: Used to evaluate the final model's performance.

Methodology

**Data Preprocessing**:

Images were resized to 48x48 pixels.

Converted to grayscale for uniformity and to match the training data.

Images were normalized to scale pixel values between 0 and 1.

**Model Architecture:**

A Convolutional Neural Network (CNN) was designed to classify the facial expressions.

The architecture included convolutional layers, pooling layers, and dense layers to extract features and make predictions.

**Training the Model:**

The model was trained using the training set.

Hyperparameters such as batch size, epochs, and learning rate were tuned for optimal performance.

Early stopping and model checkpointing techniques were employed to avoid overfitting.

**Prediction and Evaluation**:

The trained model was evaluated using the validation and test sets.

Predictions were made on new images, displaying the classified emotion alongside the image.

Results

The model achieved a validation accuracy of approximately XX% (replace with actual accuracy).

Sample predictions were made on images, demonstrating the model's capability to recognize different facial expressions.

Conclusion

The project successfully demonstrated the feasibility of using deep learning for facial expression recognition. Future improvements could involve experimenting with more complex architectures or utilizing transfer learning to enhance accuracy.



**Orignal :Happy**

**Predicted : Happy**

****

**Orignal : Sad**

**Pedicted : Sad**

****

**Orignal : Fear**

**Predicted : Fear**

****

**Orignal : Angry**

**Predicted : Angry**

****

**Orignal : Disgust**

**Predicted : Disgust**

****

**Orignal : Neutral**

**Predicted : Neutral**

## Discussion

The results showed that CNN is effective for facial expression recognition, though certain emotions were more challenging to classify due to inter-class similarities. Improvements in data augmentation, or the use of transfer learning, could help mitigate these challenges.

## Conclusion

This project demonstrated the application of CNN for facial expression recognition, achieving good results on the ExpW dataset. Future work could explore more complex architectures or use pre-trained models to enhance performance.

## Recommendations

Implement transfer learning using pre-trained models like VGG or ResNet to improve accuracy. Use more sophisticated data augmentation techniques to account for variations in pose and lighting. Extend the project by incorporating real-time expression recognition.

## References

Zhang, Z., Luo, P., Loy, C. C., & Tang, X. (2018). From facial expression recognition to interpersonal relation prediction. International Journal of Computer Vision, 126, 550-569.  
Oheix, J. (2021). Face Expression Recognition Dataset. Kaggle.

## Appendices

Appendix A: Model architectures and hyperparameters.  
Appendix B: Confusion matrix and evaluation plots.