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UNIVERSITY OF WOLVERHAMPTON

HERALD COLLEGE KATHMANDU

Artificial Intelligence and Machine Learning

(6CS012)

Task1: An Image Classification with Convolutional Neural Network.

Name: Aayush Bahadur Shahi

Uni-id: 2329565

Group: L6CG9

Module Leader: Mr Siman Giri

1. Title

Facial Expression Recognition Using Convolutional Neural Networks

2. Abstract

This project is about classfiying images using Convolutional Neural Networks (CNNs) a popular deep learning method for recognizing images. It has two parts: Part A in which a basic CNN model is built from scratch. Then, deeper models and regularization techniques are tested to improved results. Part B in which a pre-trained model is used (transfer learning) to get better accuracy with less trainning data. Different optiomizers like SGD and Adam are also compared to see which works better. The results show that deeper models with regularization perform better that simple ones.

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3. Introduction

Image classification is the process of identifying the category of an image, such as differeneces between a cat, dog, or car. This technology is widely used in real-world applications like healthcare, security, and sefl-driving cars. Deep learning, particularly Convolutional Neural Networks (CNNs), has significantly advanced image classification by automatically learning features from images. This project aims to build a CNN model for image classification, compare it with pre-trained model MobileNetV2 through transfer learning, and evaluate their performances. The goal is to understand how CNNs work and improve classification accuracy across different datasets.

4. Dataset

The dataset facial expressions classification was provided by our Module leader Mr siman giri sir. We see the unsupported and corrupt images from both train and test and delete the corrupt images. There are altogether 35 thousand plus images in this datasets. There are 7 classes with the angry, disgust, fear , happy, neutral, sad, surprise, Each class represent a distinct label, such as emotion categories in a facial expression dataset. Images are converted to grayscale to simplofy the process. Some classes had more images than others, which led to an imbalance, we use data agumentation to balance this out.

```
[ ]
    test_dir = '/content/drive/MyDrive/Image/facial expression classification/test'
    train_dir = '/content/drive/MyDrive/Image/facial expression classification/train'
    val_dir ='/content/drive/MyDrive/Image/facial expression classification/validation'
```

1. Loading Dataset

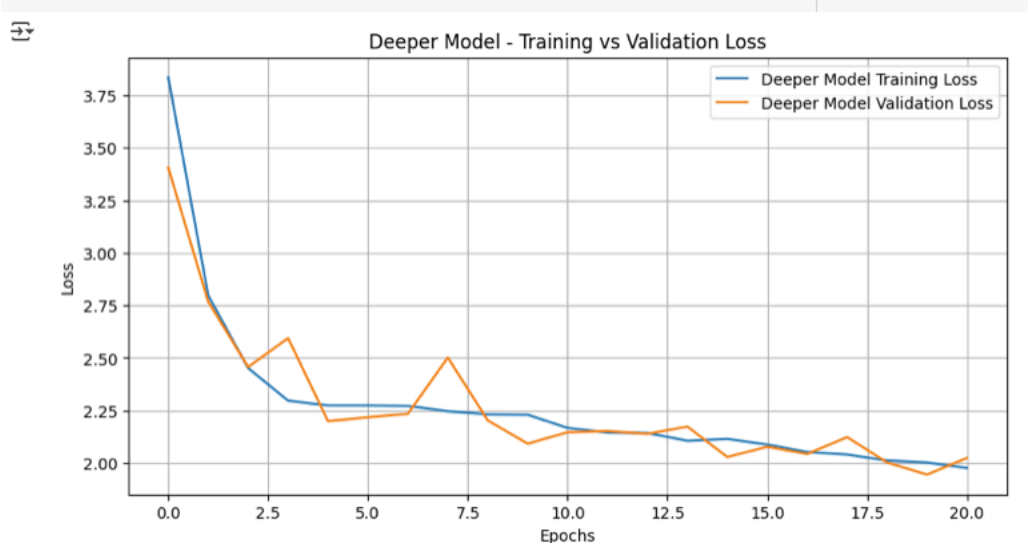
5. Methodology

In this project, two deep learning models were created to recognize facial emotions. The baseline model was a simple CNN with 3 convoultional layers (each followed by pooling) amd 3 fully connected (dense) layers, ending with a softmaz output layer to classifiy emotion. The deeper model added more layers along with Batch normalization, Dropout , and L2 Regularization to improve accuracy and reduce overfitting. Both models uses the Categorical cross-entropy loss function, which is suitable for multi-class classification. For training, two optimizers were used: Adam (faster training) and SGD (more stable). The images were resized to 128 X 128 pixels, and batch size of 32 was used. The models were trained for up to 22 epochs with early stopping to avoid trainning for too long if the model stopped improving.

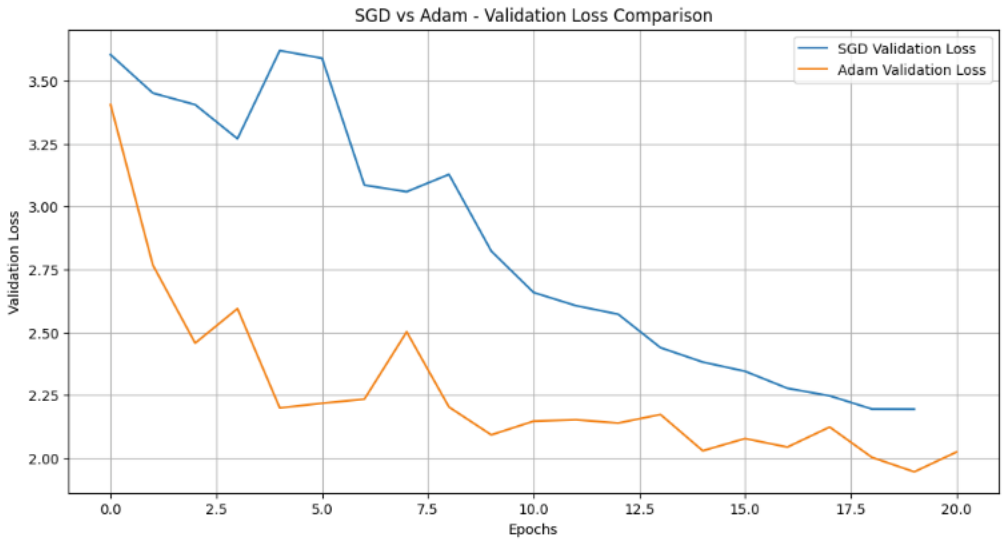
6. Experiments and Results

In this section, the performance of a baseline CNN model is compared with that of a more compelx, deeper CNN. The evaluation includes key aspects such as model accuracy, trainning duration, and the influence of various optimizers on performance.

2. CNN model



3.Deeper CNN model



4. SGD vs Adam

Challenges Encountered:

- Overfitting in the baseline model: The model showed stong performance on the training data but struggled with validation data as trainning progressed.
- Class imbalance: Certain emotions had a higher number of samples, resulting in weaking performance on underrepresented classes.
- Trainning stability: implementing dropout and batch normalization helped reduce overfitting and improved the stability of trainning in the deeper model.

7. Conclusion and Future work

This project used to CNNs to classify facial expressions, comparing a basic model with a deeper one. The deeper CNN, with droput and batch normalization, performed better by reducing overfitting and improved accuracy. The Adam optiimizer outerperformed SGD, providing faster and more accurate results. Overall, deeper models with good regularization worked best for this task.

To improve the model, we can adjust setting like learning rate and dropout. Using pre-trained models like. VGG or ResNet could boost accuracy. Increasing data variety with techniques like image flipping or rotation can help the model learn beeter. We can also address class imbalance by giving more weight to less common emotions or adding more samples.