Code Document: Pets Facial Expression Classification

1. Importing Libraries

The necessary libraries for data manipulation, visualization, and deep learning are imported.
Libraries like `cv2` for image processing, `seaborn` and `matplotlib` for plotting, and `tensorflow`
for building deep learning models are included. Additional libraries for missing value analysis, plotting,
and metric evaluation are also imported.

2. Dataset Paths and Data Preprocessing

The paths to the training, validation, and test directories are defined here. These paths contain the images
that will be used for training and evaluation.

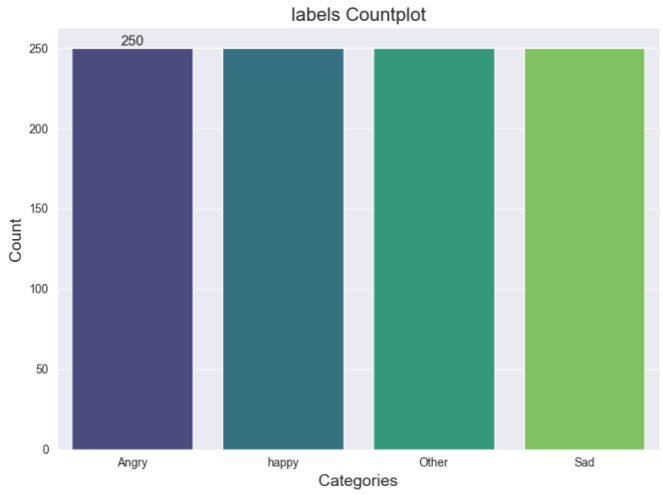
3. Data Path Generation and Dataframe Creation

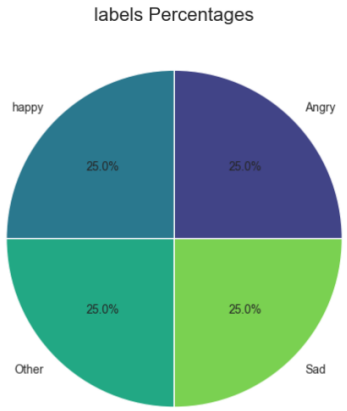
The `generate_data_paths()` function recursively lists the paths of image files and assigns labels to them
based on their respective directories. The `filepaths` and `labels` are then returned to be used in further analysis.

4. Data Exploration: Labels and Class Distribution

Functions like `num_of_examples()`, `num_of_classes()`, and `classes_count()` are used to explore the dataset.
They print the number of examples (images), the number of unique classes, and the count of images in each class.
The function `cat_summary_with_graph_alt()` visualizes the distribution of classes using a

count plot (bar plot)
and a pie chart.



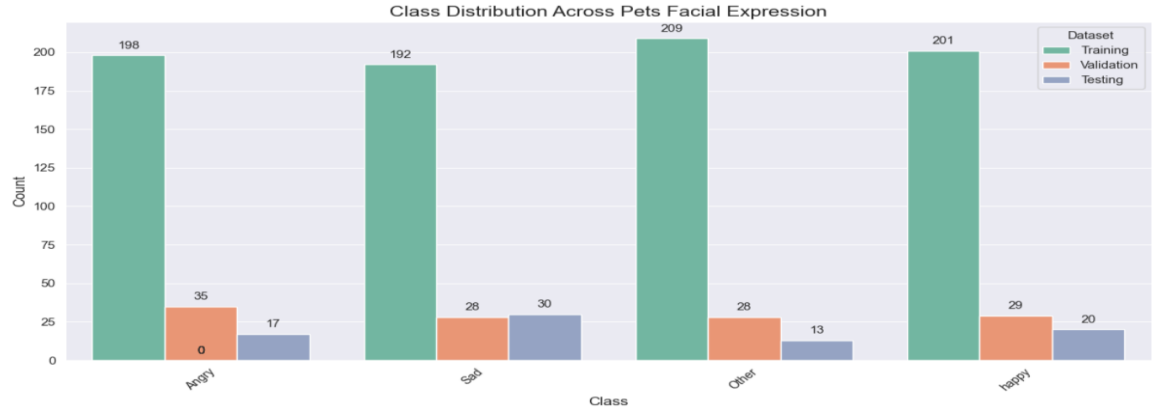


5. Splitting the Data

The dataset is split into training, validation, and testing sets. The `train_df` will hold 80% of the data,
and the remaining data is divided into `valid_df` (60% of the remainder) and `test_df` (40%).

6. Class Distribution Visualization

The `plot_class_distribution()` function plots the distribution of classes across the training, validation,
and test datasets using a bar plot and annotations.



7. Image Preprocessing and Data Augmentation

The `ImageDataGenerator` is used for data augmentation, such as rotation, shifting, and flipping, during
training and testing. The `scalar` function is applied to each image before it is fed to the model.

8. Model Creation

An EfficientNetB5 model is loaded as the base model, without the top layer, for feature extraction. The model
weights are frozen (`trainable = False`) to prevent updates during training. The model is then built using custom
layers such as `BatchNormalization`, `Dense`, and `Dropout` to prevent overfitting and fine-tune the model for
classification tasks.

9. Compiling the Model

The model is compiled with the Adamax optimizer, categorical cross-entropy loss function (for multi-class
classification), and accuracy metric.

10. Model Training and Early Stopping

The model is trained on the `train_gen` data for a specified number of epochs. Validation is performed on
the `valid_gen` data after each epoch. The `EarlyStopping` callback is used to stop training if validation
accuracy doesn't improve after 5 epochs, and the best weights are restored.

11. Training History Plot

In this section, the training and validation loss and accuracy are plotted for each epoch.
- `tr_acc` and `tr_loss` store the training accuracy and loss values for each epoch.
- `val_acc` and `val_loss` store the validation accuracy and loss values.
- The epochs are plotted against loss and accuracy for both training and validation.

- The epochs with the lowest validation loss and highest validation accuracy are highlighted with scatter points.

12. Model Evaluation

The model is evaluated on the training, validation, and test datasets. The number of steps for evaluation is
calculated based on the test dataset size and batch size.
- The model's performance on each dataset is evaluated using the `evaluate` function.
- The results are printed showing the loss and accuracy for each dataset.

13. Model Prediction

Once the model is trained, it is used to make predictions on the test dataset.
- `preds` stores the predicted values for the test dataset.
- `y_pred` stores the predicted classes, which are extracted by taking the argmax of `preds`.

14. Confusion Matrix

A confusion matrix is generated to show the performance of the classification model.
- The confusion matrix (`cm`) is created using the `confusion_matrix` function.
- The matrix is visualized using a heatmap, with annotations showing the values in each cell.
- The x-axis represents the predicted labels, and the y-axis represents the true labels.

15. Classification Report

The `classification_report` function from `sklearn` generates a detailed report that includes precision, recall,
f1-score, and support for each class in the test dataset.
- The `target_names` are the class labels, which are passed to the function to match with the predicted classes.