Emotion Detection Project - Detailed Report

1. Imports and Library Setup

This section imports essential libraries for building, training, and deploying a Convolutional Neural Network (CNN) for Emotion Detection.

- tensorflow.keras.models, layers: For constructing the neural network.

- tensorflow.keras.optimizers: Adam optimizer for model compilation.

- tensorflow.keras.callbacks: Custom learning rate scheduler.

- tensorflow.keras.preprocessing.image: Preprocesses image data with scaling.

- numpy: Handles numerical operations.

2. Data Generators

The ImageDataGenerator is set up to preprocess training and validation data.

- rescale=1./255: Scales pixel values to [0,1] range.

Code:

```
train_data_gen = ImageDataGenerator(rescale=1./255)

validation_data_gen = ImageDataGenerator(rescale=1./255)
```

3. Model Architecture

Sequential model setup for the CNN with convolutional, pooling, dropout, and dense layers for emotion classification.

Layers Explained:

- Conv2D: 2D convolution layer with ReLU activation for feature extraction.

- MaxPooling2D: Reduces spatial dimensions.

- Dropout: Regularization to prevent overfitting.

- Flatten: Converts 2D matrix to 1D vector.

- Dense: Fully connected layers for classification.

4. Model Compilation and Training

The model is compiled with a categorical crossentropy loss and the Adam optimizer with an exponential decay learning rate.

- Categorical Crossentropy: Measures classification error for multi-class.

- Adam: Optimizer with exponential decay to lower learning rate gradually.

5. Model Saving

The trained model is saved to disk for later reuse.

- Saves both model architecture (JSON) and weights (H5 file) for deployment.

Code:

```
model_json = emotion_model.to_json()

emotion_model.save_weights('./model/emotion_model.weights.h5')
```

6. Real-Time Emotion Detection

OpenCV-based real-time emotion detection from webcam/video input. The model predicts emotions based on a live feed.

Process Explained:

- Loads saved model and weights.

- Detects faces using Haar Cascade, processes each face for emotion prediction.

- Displays prediction on video frame.

- Exit condition on pressing 'q'.