Internship Task

Intern Infotech Virtual Learning Internship Program

Intern Infotech

Project Name: Facial Feature Mapping (CNN)

Problem Statement:

Detecting facial keypoints is a challenging problem in computer vision due to the wide variability in facial features between individuals and even within a single individual caused by factors like 3D pose, size, position, viewing angle, and illumination conditions. Although significant progress has been made in addressing these challenges, there is room for improvement. The goal of this project is to develop an accurate facial keypoint detection model capable of precisely localizing 15 key facial landmarks.

Tasks:

1. **Data Preprocessing:**
   a. Load the dataset consisting of images and CSV files.
   b. Preprocess the images, including resizing and normalizing them.
   c. Extract and preprocess the (x, y) coordinates of the 15 facial keypoints from the CSV files.
   d. Split the dataset into training, validation, and test sets.

2. **Model Selection:**
   a. Research and build an appropriate Convolutional Neural Network (CNN) architecture for facial keypoint detection.
   b. Adapt the chosen architecture for the specific task.
   c. Try using transfer learning as well

3. **Model Development:**
   a. Implement the selected CNN architecture in a deep learning framework (e.g., TensorFlow or PyTorch).
   b. Define the loss function and metrics for training the model.
   c. Train the model on the training dataset and monitor its performance on the validation set.

4. **Model Evaluation:**
   a. Evaluate the trained model on the test dataset to assess its generalization performance.
   b. Calculate metrics such as mean squared error (MSE) or mean absolute error (MAE) for keypoint localization accuracy.
   c. Visualize the model's predictions on sample images to ensure it is correctly detecting facial keypoints.

5. **Hyperparameter Tuning:**
   a. Experiment with different hyperparameters to optimize the model's performance.
   b. Implement techniques like data augmentation to improve model robustness.

6. **Future Work:**
   a. Identify potential areas for future improvement, such as exploring more advanced architectures, incorporating additional datasets, or extending the model to handle 3D pose estimation.

Dataset Overview:

The dataset contains following features:

1) Left Eye Center
2) Right Eye Center
3) Left Eye Inner Corner
4) Left Eye Outer Corner
5) Right Eye Inner Corner
6) Right Eye Outer Corner
7) Left Eyebrow Inner End
8) Left Eyebrow Outer End
9) Right Eyebrow Inner End
10) Right Eyebrow Outer End
11) Nose Tip
12) Mouth Left Corner
13) Mouth Right Corner
14) Mouth Center Top Lip
15) Mouth Center Bottom Lip

The dataset provides images indexed in a corresponding CSV file. Each keypoint is represented as a pair of (x, y) coordinates in the space of pixel indices. The project aims to improve the accuracy of facial keypoint detection to facilitate applications in facial recognition, expression analysis, and other areas of computer vision.

Conclusion:

The Facial Keypoint Detection project aims to advance the field of computer vision by developing a robust model capable of accurately identifying 15 key facial landmarks in diverse images. Success in this project will have applications in fields such as facial recognition, expression analysis, and humancomputer interaction. The dataset, which links images with corresponding keypoint annotations, provides the foundation for training and evaluating the model's performance. Improving facial keypoint detection can enhance the accuracy and robustness of facial analysis systems, further benefiting a wide range of applications.