Project Report

Age Detection Using Deep Learning

Project Members

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1. Abstract

We present a deep learning method for age prediction from facial photos.
With the use of a convolutional neural network architecture, we developed an adapted ResNet-50 model that we utilized to develop a regression system for age prediction from grayscale face images.
The project is facilitated by a facial image database and their corresponding age labels.
After preprocessing, such as resizing and normalization, the model was trained
based on the L1 loss function and assessed using baseline measures. The system produced promising results and is of potential value for use with security systems, targeted advertising, and demographic estimation. This report gives the complete process of the project, from data preparation through model testing and possible avenues for future improvement.

2. Introduction

Background

Facial feature-based age estimation has attracted a lot of attention due to its wide range of applications, such as biometrics, surveillance, and social media personalization. Deep learning has contributed significantly to this area through the availability of strong models for image-based tasks.

Problem Statement

The objective is to create a system that makes an estimate of the age of an individual from a face image using a deep neural network learnt on labelled image data.

Objectives

• Preprocess the facial image data
• Create and train a deep neural network
• Verify the performance of the network at age estimation
• Plot outcomes and examine performance

Motivation

Manual estimation of age by looking an image, may give an error. Automating it has the potential to improve applications such as age-restricted access marketing and retail demographic profiling.

Overview

This is the report summarizing the dataset, model architecture, training process, results, and conclusions
of our project on age prediction using deep learning.

3. Related Work

Some efforts have been made to age estimation from face images.
Classical approaches utilized handcrafted features like texture and shape analysis. With the introduction of deep learning, convolutional neural networks (CNNs) have been shown to have made impressive advancements in prediction performance. Both VGGNet and ResNet models have primarily been applied for the regression tasks such as. Our solution is ResNet-50-based deep learning network which can predict the age by facial data.

Sample Research Paper: Age Estimation from Faces Using Deep Learning: A Comparative Analysis

Paper Summary:

- **Authors:**
  1. Alice Othmani – Université Paris-Est Créteil (UPEC)
  2. Abdul Rahman Taleb – Sorbonne University
  3. Hazem Abdelkawy – Université Paris-Est Créteil (UPEC)
  4. Abdenour Hadid – University of Oulu, Finland

- **Objective:**
  Comparison and assessment of performance of prominent CNN architectures (VGG16, VGG19, ResNet50, InceptionV3, Xception) in real age estimation from face images.

- **Architectures Used:**
  1. VGG16 & VGG19
  2. ResNet50
  3. InceptionV3
  4. Xception

- **Key Findings:**
  1. Xception gave the best MAE:
  2.01 years (pre-trained with CASIA-WebFace)
  2.35 years (pre-trained with ImageNet)
  2. ResNet50 was strong with respect to robustness-against-partial transfer learning.
  3. VGG architectures are stable with fewer unfrozen layers (partial fine-tuning).
  4. Cross-domain tests (e.g. expression, gender, ethnicity) saw deep models demonstrate varying degrees of robustness, with expression producing the largest drop in accuracy.

- **Datasets Used:**
  1. MORPH
  2. FG-NET
  3. FTKFACES
  4. IMDB-WIKI (for pre-training)
  5. CASIA-WebFace (for pre-training)
  6. PubFig

- **Methodology:**
  1. Face Detection & Alignment
  2. CNN-based Feature Extraction
  3. Final 1-layer Regression Head
  4. Mean Squared Error Loss

- **Transfer Learning Insights:**

  1. ImageNet pre-training is beneficial.
  2. Pre-training ImageNet on face datasets (e.g., CASIA) produces even better performance if the dataset is large.
  3. Layer-wise unfreezing has non-linear impacts; ResNet performed best when unfreezing deeper layers.

4. Methodology Used

Data Collection

We have used a dataset with facial images annotated with age, ethnicity and gender. For age estimation only grayscale face images and age annotations were used.

Data Pre-processing

• Transformed RGB images to grayscale
• Resized all the images to 224x224
• Normalized pixel values to zero mean and unit variance

Model Development

• Extended ResNet-50 architecture
• Input layer was changed for grayscale images
• Output layer was substituted with a regression head that provides a single age value
• Trained using L1 loss

Model Training

- Optimizer: Adam
- Learning rate: 0.001
- Epochs: 10
- Batch size: 32
- Early stopping based on validation loss

Diagram

5. Experimental Results

Performance Metrics

- Loss Function: Mean Absolute Error (L1 Loss)
- Best Validation Loss: 7.32 years (at Epoch 10)

Visualizations

• Validation and training loss across epochs graphed
• Predictions of a sample image on versus real ages

Analysis

Decent performance with not many epochs trained. Additional epochs to train and even data augmentation could have better performance. There were some mistakes that were noticed for individuals who were very young or very old, due perhaps to class imbalance.

6. Conclusion

This work can show how deep learning can be applied to face image age prediction. By applying ResNet-50 adaptation and proper preprocessing, we ended up with a working model that performed well. The method is possible and can be improved even more with more data, fine-tuning, and model ensemble.
Future extension can involve multi-task learning of gender and ethnicity estimation or researching transformer-based architectures for better performance.