A study on age, gender, and race classification from facial images using deep convolutional neural networks (CNNs) with transfer learning

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Introduction: Task and Application

Task

To extract demographic information from facial images.

Applications

- Businesses can promote advertising for an identified target group of potential customers online.
- Law and enforcement can track down a suspect quickly given the surveillance footage of people and some prior demographic information.

Research Question and Objectives

Research Question:

- How accurately can deep CNNs with transfer learning classify age, gender and race from facial images?

Research Objectives:

- To classify facial images into age groups, gender, and race using deep CNNs with transfer learning.
- To investigate if gender could be used as a prior in age classification for improved performance.

Overview of the Dataset

Field	Description
Dataset	UTKFace
Authors	Zhifei Zhang, Yan Song, and Hairong Qi
Location	University of Tennessee Knoxville
Data	20k images of faces in jpg format (1.3 GB)
Labels	Age, gender, and ethnicity
Image Details	Size varies with different poses and illumination

Table: Details of the UTKFace Dataset

Age group distribution in UTKFace

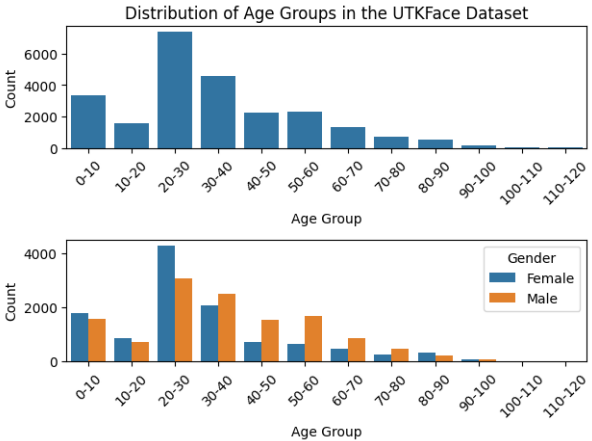


Figure: Age group distributions

Donut chart for gender and race

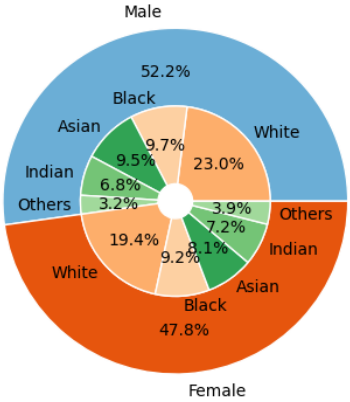


Figure: Gender and race percentages

Race distributions in UTKFace

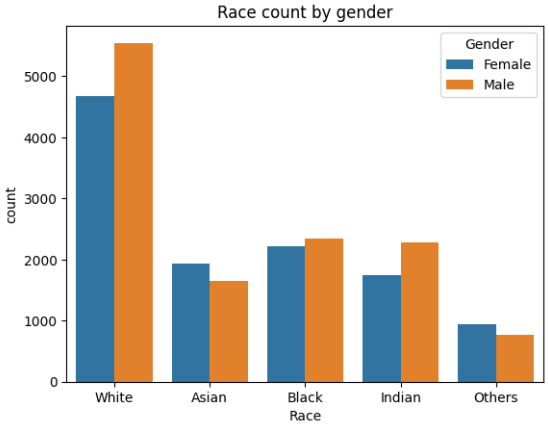
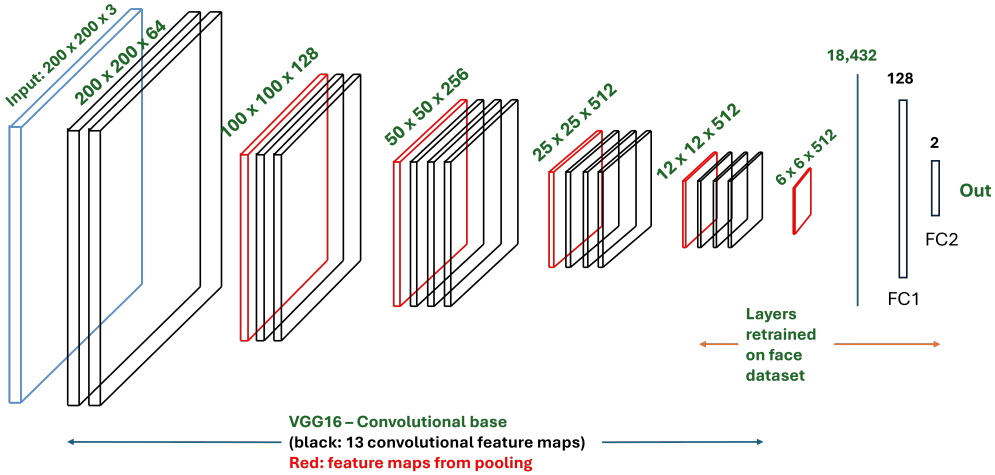


Figure: Race count by gender

Methodology

- Detect and extract faces from the original dataset using Viola & Jones technique (2001) or RetinaFace (Deng et al., 2020) - A deep learning approach.
- Use at least 3 base models - VGG16 (Simonyan and Zisserman, 2015), Resnet50 (He et al., 2016), and EfficientNet (Tan and Le, 2020) trained on ImageNet.
- Attach a classifier head to the base network and retrain the classifier head and some of the latter layers in the base network on the face data to build classifiers.

VGG-model used in an experiment on gender classification



The above figure is author-generated.

Training and Validation Results on Gender Classification

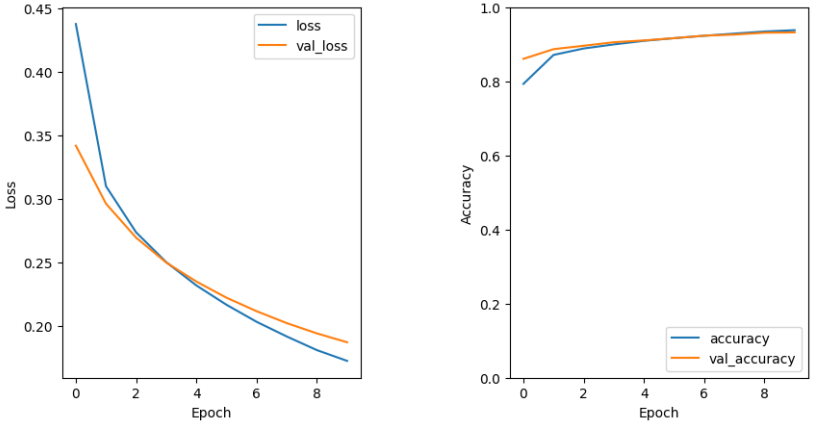


Figure: Left: Training and validation losses. Right: Training and validation accuracies. Following observations were made in the 10th epoch: training loss= 0.1718, validation loss= 0.1871, training accuracy= 0.9374, validation accuracy= 0.9319

Ethical Requirement and Document Storage

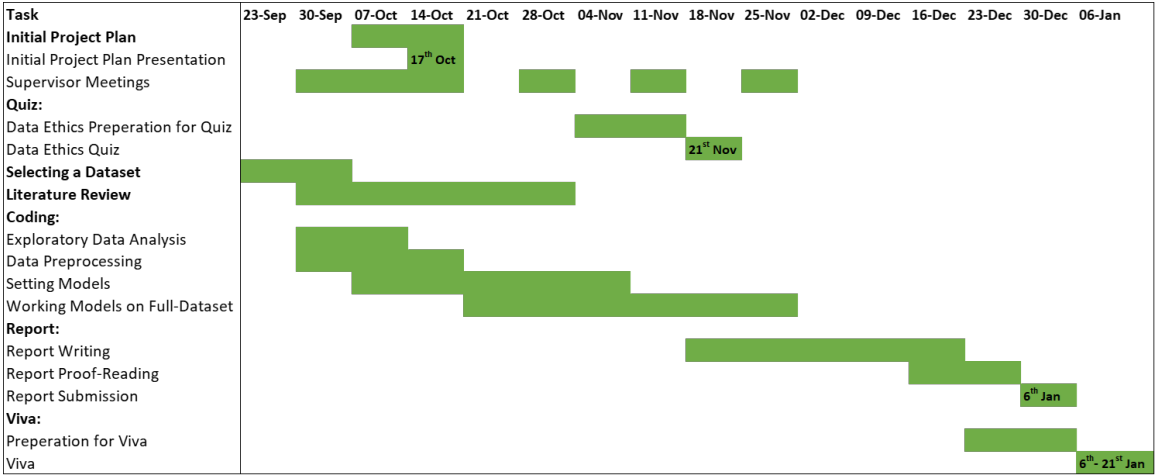
Ethical Considerations

- According to the author's website, the UTKFace dataset can be used for non-commercial research work.
- No face is annotated with actual names.
- No exact age of a person will be estimated.

Document Storage

- The Colab files and data will be stored in GitHub, Google Drive, and University One Drive.
- The files will be backed up weekly.

Project Timeline



References

Deng, J., Guo, J., Ververas, E., Kotsia, I. and Zafeiriou, S. (2020). RetinaFace: Single-Shot Multi-Level Face Localisation in the Wild. *2020 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*. Available at: https://doi.org/10.1109/cvpr42600.2020.00525

He, K., Zhang, X., Ren, S. and Sun, J. (2016). Deep Residual Learning for Image Recognition. In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*. IEEE, pp.770–778. Available at: https://doi.org/10.1109/cvpr.2016.90

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Questions and Answers

Q & A