Celebrity Facial Recognition Model Achieves 85% Accuracy Rate

DS 4002
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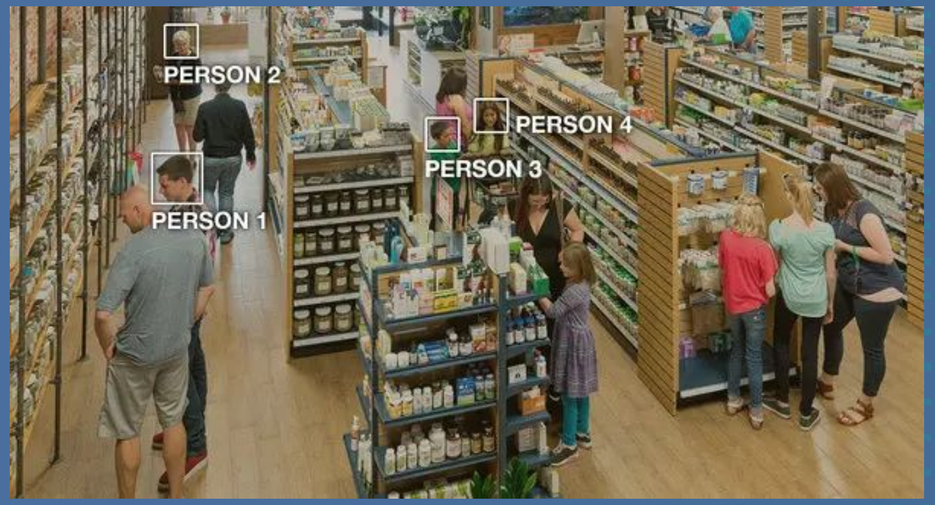
Intro & Hypothesis → Data Acquisition → Analysis Plan → Testing & Analysis → Results → Next Steps

Motivation

- Facial recognition technology has become increasingly prevalent in public spaces.
- Amazon launched the first public Amazon Go Store in 2018, utilizing facial identification to allow for checkout-less payment.
- Facial recognition tech poses benefits to efficiency and crime detection. However, its use also raises concerns in the areas of privacy and racial bias.



Research Question

Is it possible to use a facial recognition model to identify celebrities solely based on an image?

Modeling Approach

Create a facial recognition model using Keras and evaluate the model's accuracy after 100 training epochs.

Data Acquisition and Explanation

Column	Description	Potential Response
celebrity_name	Name of celebrity	Angelina-Jolie
picture_number	Image number of a specific celebrity	1
file_path	String of characters that indicates the location of the image in the repository	celebrities/Angelina-Jolie/1.jpg
brightness	Brightness of an image, measured as a number above 0	145.55162569389373
resolution	The resolution, or quality, of an image listed in the following format: “width x height”	194x260
colorfulness	The level of color contained within an image, quantified as a number above 0	31.304175672462286
gender	Gender of the celebrity	female
race	Race of the celebrity	White

/DATA/celebrities/Ayo-Edebiri//28.jpg

/DATA/celebrities/Pedro-Pascal/49.jpg

/DATA/celebrities/John-Lennon/15.jpg

- Downloaded 100 images for 25 different celebrities. Labelled the photos 01-100 in respective folders.
  - Ex: /DATA/celebrities/Will-Smith/72
- Also added brightness, resolution, colorfulness, gender, and race variables to use when analyzing the accuracy of the model.

Analysis Plan

Data Collection & EDA

After collecting images from Google, we separated them into celeb folders and stored image data in a dataframe.

Added variables: image brightness, colorfulness, resolution, race, and gender.

Image Augmentation

Using the ImageDataGenerator class, we pre-processed the images and added the transformed images to the dataset. This included cropping, flipping, resizing, etc,.

Define Training & Testing Sets

Images in each celeb folder were split into training & testing sets using an 80/20 split.

Test Recognition Accuracy

Goal: Using Keras, train a model to correctly identify images of our 25 celebrities.

To achieve this, we built a CNN model and compiled the model using the Adam optimizer. Subsequently, we trained the model using 100 epochs.

Analyze Results

Using the model.evaluate function, we collected identification accuracy results for the validation set.

Additionally, we collected identification accuracy rates for each individual image.

Subsequently, we evaluated the model's prediction accuracy across celebrities.

Tricky Analysis Decision

- Originally, we planned to have 100 images for each celebrity, with 80 of them being used to train and 20 to test.
- However, later decided to do image augmentation to better test the accuracy of our model.
- We altered images by cropping, resizing, flipping, etc., resulting in a total of **400** images for each celebrity.

Bias and Uncertainty Validation

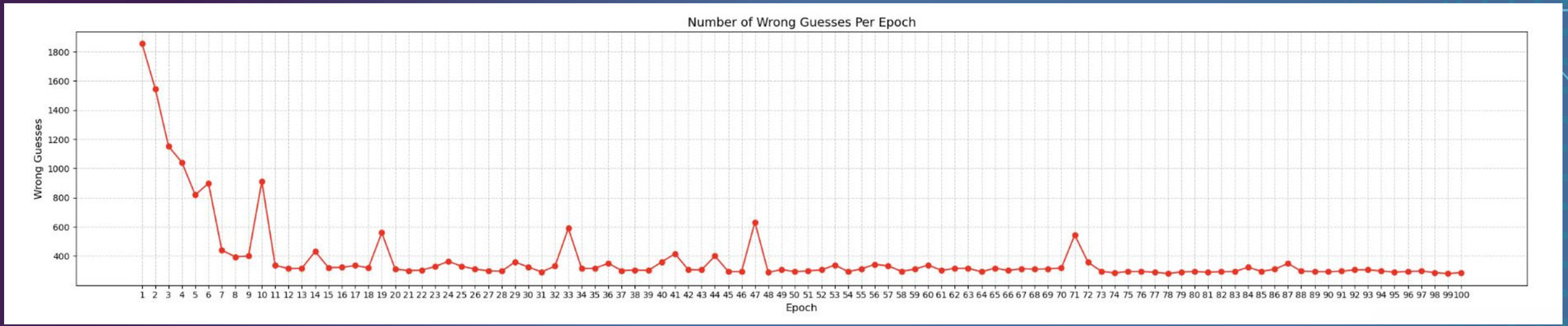
- Our collection methodology involved selecting the first 100 Google images for each celebrity. This strategy was somewhat efficient, but it could have introduced bias.
  - Since the images chosen were at the top of the google search, they were generally high quality. This means that our model had few low resolution, dim, or non-uniform facial images on which to train.
  - Additionally, we avoided selecting images which featured multiple people. As a result, our model was not trained on or asked to identify images with this characteristic.

- Augmenting the images helped to correct some of this bias, as we were able to incorporate images which were less “standard” (i.e., with distortions). This seemed to enhance predictive strength.

Results and Conclusion

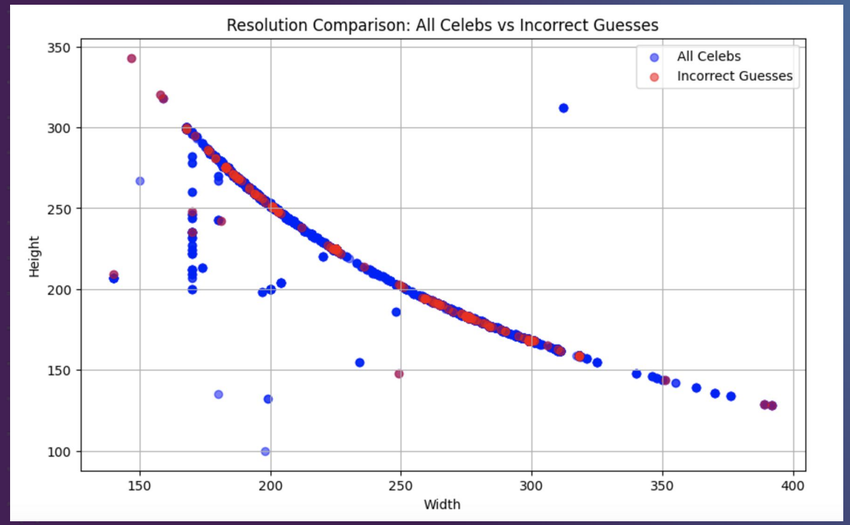
Identification testing was performed in Keras using 100 epochs.

Each celebrity was assigned a class (ex: America Ferrera was class 0). In each epoch, the model was asked to predict which celebrity class images belonged to.



Identification accuracy improved dramatically as epochs progressed. The model achieved 85% accuracy by the 100th (final) epoch. This matches the accuracy rate goal as outlined in MI2 (which was exactly 85%).

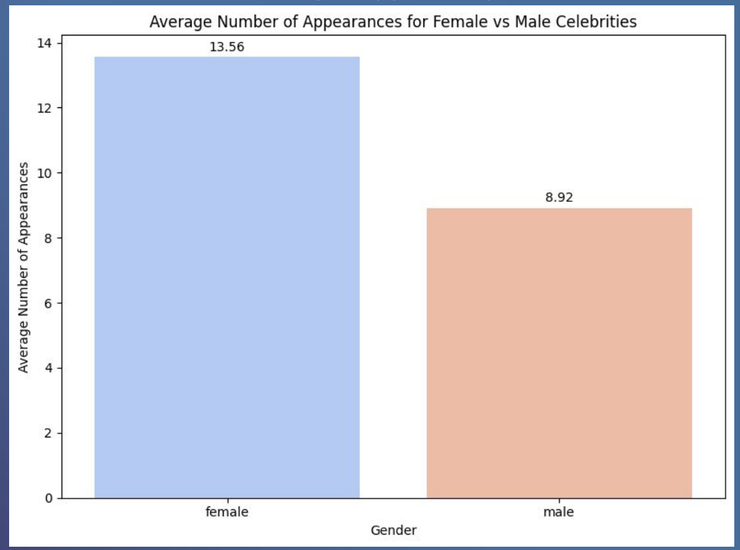
Scatterplot of resolutions for entire dataset (blue) vs. dataset for images incorrectly identified in last epoch (red).




```
Average Width (All Celebs): 247.72
Average Height (All Celebs): 210.47
Average Width (Incorrect Guesses): 241.87
Average Height (Incorrect Guesses): 216.16
T-statistic for width: 2.0859
P-value for width: 0.0370
T-statistic for height: -2.2986
P-value for height: 0.0215
```

Differences for both height and width values were significant at 0.05 level.

Average Number of Appearances for Female vs. Male Celebrities in Final Epoch (Epoch 100)




```
T-statistic: -2.1781
P-value: 0.0415
```

Difference ws significant at 0.05 level

However, our dataset was quite small (with only 25 celebrities featured). Thus, further testing would be required in order to corroborate these results.

Next Steps

New Lines of Exploration

- Expand the model to be able to identify celebrities from videos, multi-face photos, or low quality photos.
- Explore methods to identify celebrities from vocal recordings.

Improvements

- Expand the image database used for analysis.
- Incorporate fine-tuning of the model after each run-through to boost accuracy.
- Test accuracy of model after incorporating additional image augmentations.

New Questions

- Is there a difference in accuracy when identifying celebrities from images versus videos?
- What strategies would we implement to identify celebs from vocal recordings?

References and Acknowledgements

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https://github.com/oak50/DS4002Project3

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Thank you!