Capstone Proposal

Aparajit Chatterjee

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Title: Facial Keypoint Detection

Domain Background

Face detection is a computer technology being used in a variety of applications that identifies human faces in digital images. Face detection also refers to the psychological process by which humans locate and attend to faces in a visual scene.

Face detection is used in biometrics, often as a part of (or together with) a facial recognition system. It is also used in video surveillance, human computer interface and image database management.

The dataset is obtained from Kaggle.

Problem Statement

The objective of this task is to predict keypoint positions on face images. This can be used as a building block in several applications, such as:

1. Tracking faces in images and video
2. Analysing facial expressions
3. Detecting dysmorphic facial signs for medical diagnosis
4. Biometrics / face recognition

Detecting facial key-points is a very challenging problem. Facial features vary greatly from one individual to another, and even for a single individual, there is a large amount of variation due to 3D pose, size, position, viewing angle, and illumination conditions. Computer vision research has come a long way in addressing these difficulties, but there remain many opportunities for improvement.

Dataset and Input

Each predicted keypoint is specified by an (x,y) real-valued pair in the space of pixel indices. There are 15 keypoints, which represent the following elements of the face:

left_eye_center, right_eye_center, left_eye_inner_corner, left_eye_outer_corner, right_eye_inner_corner, right_eye_outer_corner, left_eyebrow_inner_end, left_eyebrow_outer_end, right_eyebrow_inner_end, right_eyebrow_outer_end, nose_tip, mouth_left_corner, mouth_right_corner, mouth_center_top_lip, mouth_center_bottom_lip

Left and right here refers to the point of view of the subject.

In some examples, some of the target keypoint positions are misssing (encoded as missing entries in the csv, i.e., with nothing between two commas).

The input image is given in the last field of the data files, and consists of a list of pixels (ordered by row), as integers in (0,255). The images are 96x96 pixels.

Data files

training.csv: list of training 7049 images. Each row contains the (x,y) coordinates for 15 keypoints, and image data as row-ordered list of pixels.

test.csv: list of 1783 test images. Each row contains ImageId and image data as row-ordered list of pixels

submissionFileFormat.csv: list of 27124 keypoints to predict. Each row contains a RowId, ImageId, FeatureName, Location. FeatureName are "left_eye_center_x," "right_eyebrow_outer_end_y," etc. Location is what you need to predict.

Solution Statement

In this project, I will implement a Convolutional Neural Network using Keras and feed the data to the Neural Network.

Benchmark model

For a benchmark model I will use a Sequential model and add 3-4 layers of Con2D layers each having a MaxPooling layer and dropouts with a relu activation function. In the end i will add a Dense Layer to get the 15 keypoints as described in the problem. I am thinking to use different types of optimizers and tune in with different no of epochs to calculate when my model performs better. I will use 60% of my data for training, 20% for validation and 20% for testing.

Evaluation metrics

RMSE (Root Mean Square Error)

RMSE is a quadratic scoring rule that also measures the average magnitude of the error. It’s the square root of the average of squared differences between prediction and actual observation.

$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{j=1}^{n}(y_j - \hat{y}_j)^2}$$

Project Design

Display the data files in the notebook using pandas.

Check for missing values and subsequently imputing them.

Implement a CNN as described in the benchmark model section.

Try using different optimizers and different epochs to determine the better performance.

Check the model performance using RMSE.

Links and References:

https://en.wikipedia.org/wiki/Face_detection

https://blog.statsbot.co/data-scientist-resume-projects-806a74388ae6

https://www.kaggle.com/c/facial-keypoints-detection#description