Detecting human faces using a deep learning neural network

Face detection in images

Detecting faces in images is a problem with many different solutions that is often developed on using modern artificial intelligence technologies.

In this project we tackle face detection using a simplified deep learning neural network, implemented using the Keras library for Python. The neural network is designed to classify a 32x32 pixel image into two classes, ones that are images of human faces and ones that aren't. Using this approach we can later search through a larger image and find parts of it that have a face on them.

Gathering training data

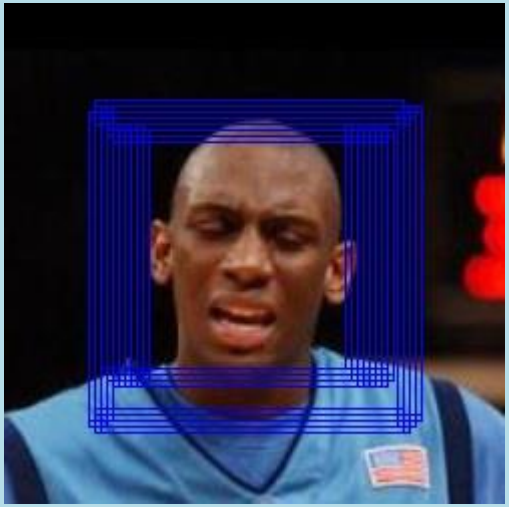
One of the main issues that arise when training a neural network to recognize something as diverse as human faces is gathering enough training data. We will need two sets of data for the two classes our neural network is designed to recognize, for this purpose images were gathered from the following sources:

- 13233 images with human faces from the Labeled Faces in the Wild dataset [1] (vis-www.cs.umass.edu/lfw/)
- 60000 images in total that are divide into 10 classes from the CIFAR-10 dataset [2] (https://www.cs.toronto.edu/%7Ekriz/cifar.html)

While the images from the CIFAR-10 dataset are already of the correct dimensions for our neural network (32x32 pixels) the images with the human faces aren't. All images from the first dataset are 250x250 pixels and are slightly zoomed out from the face, because of this we must crop each image so that it only contains the face and then resize it to 32x32 pixels. You can see an example of this process bellow:

From left to right: the original image, 128x128 image cropped from the middle of the original and the cropped image resized to 32x32 pixels.

Finding faces on a larger image



Finding faces on an image is done simply by going through the image step by step and cropping squares of different dimensions from it, then resizing the cropped images and sending them to the neural network to classify. It has been determined that searching the image doesn't have to be done very thoroughly because the neural network finds faces in the image even if it is slightly zoomed out or shifted.

The image represents the end result of searching an image and outlining the squares that were found to contain a face.

Results and analysis

Before training the neural network 20 images from both classes were removed from the training set to later be used as validation examples. Of the 40 validation images in total only one was predicted incorrectly. Although this shows as promising, when tested on random images the face detection algorithm demonstrated slightly worse results.

- **False negatives** – the neural network is sometimes unable to recognize faces that are tilted sideways or on images that are lower resolution.
- **False positives** – in comparison to false negatives, false positives are much more common. This is mainly because of the limited dataset used to train the neural network to recognize images that are not faces (6000 images but of only 10 different classes).

References

[1] Gary B. Huang, Manu Ramesh, Tamara Berg, and Erik Learned-Miller.
Labeled Faces in the Wild: A Database for Studying Face Recognition in Unconstrained Environments.

[2] Alex Krizhevsky.
Learning Multiple Layers of Features from Tiny Images, 2009.