**DeepFace**

**DeepFace** is a [deep learning](https://en.wikipedia.org/wiki/Deep_learning" \o "Deep learning) [facial recognition system](https://en.wikipedia.org/wiki/Facial_recognition_system" \o "Facial recognition system) created by a research group at [Facebook](https://en.wikipedia.org/wiki/Facebook,_Inc." \o "Facebook, Inc.). It identifies human faces in digital images. The program employs a nine-layer [neural network](https://en.wikipedia.org/wiki/Neural_network" \o "Neural network) with over 120 million connection weights and was [trained](https://en.wikipedia.org/wiki/Machine_learning" \o "Machine learning) on four million images uploaded by Facebook users. The Facebook Research team has stated that the DeepFace method reaches an accuracy of 97.35% ± 0.25% on Labeled Faces in the Wild (LFW) data set where human beings have 97.53%. This means that DeepFace is sometimes more successful than human beings. As a result of growing societal concerns [Meta](https://en.wikipedia.org/wiki/Meta_Platforms" \o "Meta Platforms) announced that it plans to shut down Facebook facial recognition system, deleting the face scan data of more than one billion users. This change will represent one of the largest shifts in facial recognition usage in the technology’s history. Facebook planned to delete by December 2021 more than one billion facial recognition templates, which are digital scans of facial features. However, it did not plan to eliminate DeepFace which is the software that powers the facial recognition system. The company has also not ruled out incorporating facial recognition technology into future products, according to Meta spokesperson.

**Commercial rollout**

Origin

DeepFace was produced by a collection of scientists from Facebook’s artificial intelligence research team. The team includes Yainiv Taigman and a Facebook research scientist Ming Yang. They were also joined by Lior Wolf, a faculty member from Tel Aviv University. Yaniv Taigman, came to Facebook when Facebook acquired Face.com in 2012.

Facebook started rolling out DeepFace to its users in early 2015, and have continuously expanding DeepFace's use and software,. DeepFace, according to the director of Facebook’s artificial intelligence research, is not intended to invade individual privacy. Instead, DeepFace alerts individuals when their face appears in any photo posted on Facebook. When they receive this notification, they have the option of removing their face from the photo.

**European Union**

When the DeepFace technology was initially deployed, users had the option to turn DeepFace off. However, they were not notified that it was on. Because of this, DeepFace was not released in the European Union. A data privacy law in the EU argued that Facebook’s facial recognition did not comply with EU data protection laws. Because users do not consent to all the uses of their biometric data, it does not comply.

**Architecture**

The DeepFace system consists of four modules: 2D alignment, 3D alignment, frontalization, and neural network. An image of a face is passed through them in sequence, resulting in a 4096-dimensional feature vector representing the face. The feature vector can then be further processed for many different tasks. For example, to identify the face, one can compare it against a list of feature vectors of known faces, and identify the face with the most similar feature vector.

DeepFace uses fiducial point detectors based on existing databases to direct the alignment of faces. The facial alignment begins with a 2D alignment, and then continues with 3D alignment and frontalization. That is, DeepFace’s process is two steps. First, it corrects the angles of an image so that the face in the photo is looking forward. To accomplish this, it uses a 3-D model of a face.

**2D alignment**

The 2D alignment module detects 6 fiducial points on the detected face — the center of the eyes, tip of the nose and mouth location. These points are translated onto a warped image to help detect the face. However, 2D transformation fails to compensate for rotations that are out of place.

**3D alignment**

In order to align faces, DeepFace uses a generic 3D model wherein 2D images are cropped as 3D versions. The 3D image has 67 fiducial points. After the image has been warped, there are 67 anchor points manually placed on the image to match the 67 fiducial points. A 3D-to-2D camera is then fitted that minimizes losses. Because 3D detected points on the contour of the face can be inaccurate, this step is important.

**Frontalization**

Because full perspective projections are not modeled, the fitted camera is only an approximation of the individual's actual face. To reduce errors, DeepFace aims to warp the 2D images with smaller distortions. Also, thee camera P is capable of replacing parts of the image and blending them with their symmetrical counterparts.

**Neural network**

The neural network is a sequence of layers, arranged as follows: convolutional layer - max pooling - convolutional layer - 3 locally connected layers - fully connected layer.

The input is an RGB image of the face, scaled to resolution

152×152{\displaystyle 152\times 152}, and the output is a real vector of dimension 4096, being the feature vector of the face image.

In the 2014 paper, an additional fully connected layer is added at the end to classify the face image into one of 4030 possible persons that the network had seen during training time.