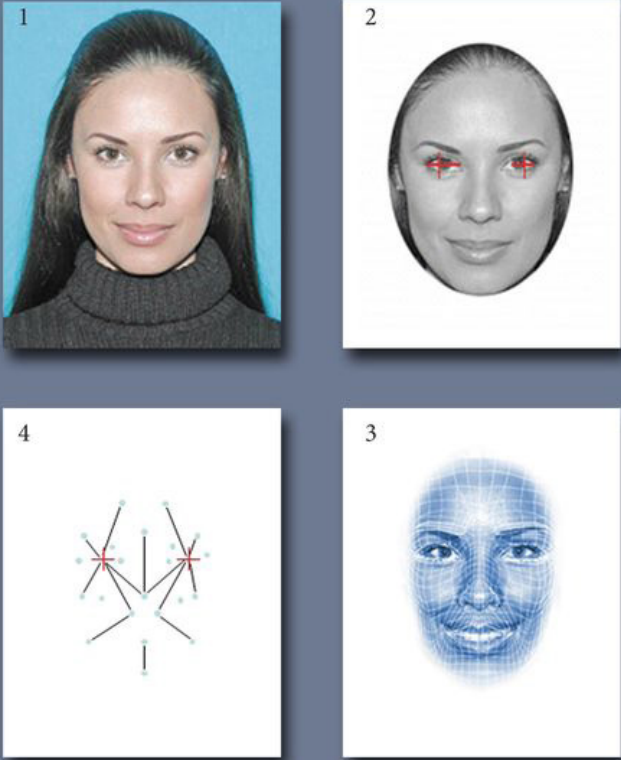


Face recognition:

How facial identification works

1. Image is captured
2. Eye locations are determined
3. Image is converted to grayscale and cropped
4. Image is converted to a template used by the search engine for facial comparison results
5. Image is searched and matched using a sophisticated algorithm to compare the template to other templates on file
6. Duplicate licenses are investigated for fraud



The diagram illustrates the process of facial identification in four steps: 1. A color photograph of a woman's face. 2. The image is converted to grayscale, and red markers are placed on the eyes to determine their locations. 3. The image is converted to a template, shown as a blue wireframe mesh overlaid on the face. 4. The template is converted into a mathematical representation, shown as a network diagram with nodes and lines representing facial features.

Face recognition systems use computer algorithms to pick out specific, distinctive details about a person's face. These details, such as distance between the eyes or shape of the chin, are then converted into a mathematical representation and compared to data on other faces collected in a face recognition database.

Bron: <https://www.eff.org/nl/pages/face-recognition>

Snapchat face recognition:

The technology came from a Ukrainian startup Lookery, which is an application that allowed users to modify their facial features during video chats and for photos. Snapchat acquired this Odesa-based face changing startup in September 2015 for \$150 million dollars.

Their augmented reality filters tap into the large and rapidly growing field of computer vision. Computer vision can be thought of as a direct opposite of computer graphics. While computer graphics try to produce image models from 3D models, computer vision tries to create a 3D space from image data. Computer Vision is starting to be utilized more and more in our society. It is how you scan your checks and the data is extracted from the lines. It is how you can deposit checks with your phone. It is how Facebook knows who's in your photos, how self-driving cars can avoid running over people and how you can give yourself a dodgy nose...

... The specific area of Computer Vision that Snapchat filters use is called Image processing. Image processing is the transformation of an image by performing mathematical operations on each individual pixel on the provided picture.

Bron: <https://medium.com/cracking-the-data-science-interview/snapchats-filters-how-computer-vision-recognizes-your-face-9907d6904b91>

- This large matrix of numbers are codes, and each combination of the number represents a different color.
- The face detection algorithm goes through this code and looks for color patterns that would represent a face.
- Different parts of the face give away different details. For example, the bridge of the nose is lighter than its surroundings. The eye socket is darker than the forehead, and the center of the forehead is lighter than its sides.
- This could take a lot of time, but Snapchat created a statistical model of a face by manually pointing out different borders of the facial features. When you click your face on the screen, these already predefined points just align themselves and look for areas of contrast to know exactly where your lips, jaw line, eyes, eyebrows, etc. are.

From making you look like a puppy to an old truck driver. But that's not all Snapchat filters do. An updated version of Snapchat had a feature for swapping faces with a friend, whether in real time or by accessing some faces from your gallery (yes, you allowed Snapchat to look in your Camera Roll). Notice how the face shapes are visible, that's the position where the statistical model lies. It helps Snapchat to quickly align you and your friends face and swap the features.

Bron: <https://www.technobyte.org/2016/11/snapchat-filters-work/>

Google face recognition:

Met de Google cloud face recognition kun je gezichten herkennen, maar niet de contouren van de gezichten. Je kunt dus geen filters op of om een gezicht heen plaatsen.

Bron: <https://cloud.google.com/vision/docs/face-tutorial>

Face recognition software:

Augmented Reality SDK ~ Why Did We Build it?

The DeepAR Augmented Reality SDK is made for developers who want to add the highest quality, mobile optimised, Snapchat and Facebook style 3D and realistic face lenses, masks and special FX to iOS, Android, HTML5 and Unity applications. The best part is that the DeepAR SDK can be integrated in a matter of minutes, and supports hundreds of masks, lenses, effects, and filters. Our team is also ready to help you create amazing new content for your platform.

DeepAR Studio allows you to focus on creating incredible assets rather than focusing on building a complex Augmented Reality technology platform. The DeepAR Studio allows you to use existing software like Maya and Blender to create deformable and rigid objects, video filters, video effects, animated and morphing objects, as well as particle effects. It enables super fast asset creation and testing.

Bron: <https://www.deepar.ai/augmented-reality-sdk>

Banuba Studio is the engine where you can create, test and adjust your own camera face filters before uploading them to your camera app via Banuba face filter SDK.

This tool is made for designers and developers who work on their own filter apps and want to create their AR effects. No special coding skills needed to construct effects. Any person can work in Banuba Studio, and your effect quality and beauty will depend solely on your design skills (plus imagination).

Bron: <https://blog.banuba.com/how-to-create-your-own-face-filters-like-snapchat-in-banuba-studio.-part-1>

Conclusie:

De meeste face recognition software werkt met het scannen van een gezicht om het vervolgens om te zetten naar data. Bijvoorbeeld de afstand tussen de ogen, de kleuren en de contouren worden omgezet in getallen om het gezicht te kunnen bepalen. Dit is echter vaak niet real-time.

Snapchat heeft een bedrijf, Looksery, gekocht zodat ze zelf niet meer een programma hoeven te ontwikkelen die bovenstaande kan. De software van Snapchat begint met het scannen van de contouren van het gezicht. Ze scannen stukje voor stukje en met een algoritme wordt dan bepaald of het gescande stuk een gezicht is of niet. Vervolgens worden de kenmerken in het gezicht bepaald, dus de mond, de ogen, wenkbrauwen etc.

Nu het gezicht herkend is gebruikt Snapchat image processing, ze gebruiken 'standaard gezichten' om het filter er overheen te plaatsen. Vervolgens wordt de filter aangepast aan jouw gezicht, omdat de standaard gezichten nooit exact overeenkomen. Naast filters kan Snapchat ook gezichten wisselen, ze maken dan een omlijning van de gezichten en kunnen deze verwisselen met elkaar.

Naast Snapchat en Looksery zijn er nog meerdere softwares die gezichten kunnen scannen/herkennen. Zo is er Google face recognition, dit programma kan gezichten herkennen in een beeld, maar kan het gezicht niet uitsnijden. Er wordt enkel een vak om het gezicht geplaatst.

Daarnaast is er DeepAR, deze software kun je implementeren in bijvoorbeeld je IOS app of HTML code. Met het programma kun je zelf filters maken om deze over gezichten heen te plaatsen. Dit programma gebruikt externe tools om 3D filters te kunnen creëren. Het is een betaald programma en je kunt een 30-day trial aanvragen

Tot slot is er Banuba studio, met dit programma kun je je eigen filters maken en testen om vervolgens te gebruiken in je camera app. Het is een programma waarvoor je geen programmeer vaardigheden nodig hebt, ook hiervan is een trial.

Het is technisch dus vrijwel onmogelijk om zelf een programma te schrijven wat gezichten kan herkennen en filters kan maken. Om een filter te maken kun je dus het beste een trial aanvragen voor een van bovenstaande programma's.