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## **FACE RECOGNITION TECHNOLOGY**

A facial recognition system is a technology capable of identifying or verifying a person from a digital image or a video frame from a video source. There are multiple methods in which facial recognition systems work, but in general, they work by comparing selected facial features from given images with faces within a database. It is also described as a Biometric Artificial Intelligence based application that can uniquely identify a person by analyzing patterns based on the person's facial textures and shape.

Apple introduced Face ID on the flagship iPhone X as a biometric authentication successor to the Touch ID, a fingerprint based system. Face ID has a facial recognition sensor that consists of two parts: a "Romeo" module that projects more than 30,000 infrared dots onto the user's face, and a "Juliet" module that reads the pattern. The pattern is sent to a local "Secure Enclave" in the device's central processing unit (CPU) to confirm a match with the phone owner's face. It also works in the dark.

The U.S. Department of State operates one of the largest face recognition systems in the world with a database of 117 million American adults, with photos typically drawn from driver's license photos. Although it is still far from completion, it is being put to use in certain cities to give clues as to who was in the photo. The FBI uses the photos as an investigative tool, not for positive identification.

Some face recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject's face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features.

Recognition algorithms can be divided into two main approaches: geometric, which looks at distinguishing features, or photometric, which is a statistical approach that distills an image into values and compares the values with templates to eliminate variances. Some classify these algorithms into two broad categories: holistic and feature-based models.

Three-dimensional face recognition technique uses 3D sensors to capture information about the shape of a face. This information is then used to identify distinctive features on the surface of a face, such as the contour of the eye sockets, nose, and chin.

One advantage of 3D face recognition is that it is not affected by changes in lighting like other techniques. It can also identify a face from a range of viewing angles, including a profile view. 3D research is enhanced by the development of sophisticated sensors that do a better job of capturing 3D face imagery. The sensors work by projecting structured light onto the face. Up to a dozen or more of these image sensors can be placed on the same CMOS chip – each sensor captures a different part of the spectrum.

Even a perfect 3D matching technique could be sensitive to expressions. For that goal a group at the Technion applied tools from metric geometry to treat expressions as isometries. A new method is to introduce a way to capture a 3D picture by using three tracking cameras that point at different angles; one camera will be pointing at the front of the subject, the second one to the side, and third one at an angle. All these cameras will work together so it can track a subject's face in real time and be able to face detect and recognize.

Another emerging trend uses the visual details of the skin, as captured in standard digital or scanned images. This technique, called Skin Texture Analysis, turns the unique lines, patterns, and spots apparent in a person's skin into a mathematical space. Surface Texture Analysis works much the same way facial recognition does. A picture is taken of a patch of skin, called a skin print. That patch is then broken up into smaller blocks. Using algorithms to turn the patch into mathematical, measurable space, the system will then distinguish any lines, pores

and the actual skin texture. It can identify the contrast between identical pairs, which are not yet possible using facial recognition software alone.

As every method has its advantages and disadvantages, technology companies have amalgamated the traditional, 3D recognition and Skin Textual Analysis, to create recognition systems that have higher rates of success. Combined techniques have an advantage over other systems. It is relatively insensitive to changes in expression, including blinking, frowning or smiling and has the ability to compensate for mustache or beard growth and the appearance of glasses. The system is also uniform with respect to race and gender.