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Reading Faces

Smile, you're on camera. Or don't; either way, it matters little to the face recognition system to which it may be attached. But you **are** being watched – a lot. In Albuquerque, there are **4,154** public CCTV cameras, **7.41** for every 1,000 people, making our fair city the **12th most surveilled** in the entire nation.

If you live in New Mexico, you're also in a vast **virtual lineup**. Relax, in 2016 the state was praised by the FBI, particularly APD, for **safeguards** put in place to let the feds access the state's drivers license database of **2.9 million** with their facial recognition software.

In return, the cops may freely search the FBI's database of **24.9 million** mugshots. APD also has access to Amazon's **Ring doorbell surveillance** and that of many businesses ranging from Balloon Fiesta Park to Blake's Lotaburger which can be scanned for faces. Though Amazon put a year-long **moratorium** on police for use of their **Rekognition** system after the riots following the George Foreman murder, that should be over by now.

The simple fact is **face recognition technology** (FRT) is everywhere today, used to unlock phones, verify travelers' identities at airports, and scan your photos posted on social media. Yet, as critical as **identifying** faces may be, beyond that lies **reading** faces, which could turn out to be even more important.

From mugshot to digital template

As might be expected, the primary interest in identifying people came from law enforcement to fight crime in the burgeoning metropolises of the 19th Century. In 1888, a French police officer, **Alphonse Bertillon**, invented the **mugshot** with its standardized

lighting, portrait and side views. He also devised a standard system of measuring the various parts of the human body, which was the most scientific means of identification before fingerprints and DNA, and is the basis of all **computer biometrics**, including FRT.

This inspired the little-known father of face recognition, a former Sandia Labs scientist named **Woodrow Wilson "Woody" Bledsoe**. With several other Sandians, he set up one of the first Silicon Valley companies, **Panoramic Research**. Funded first by the **CIA** and later ARPA, it worked on the former's mind control projects but also on early AI.

Fascinated by the idea of making machines read, Woody and company came up with a statistical means of **pattern recognition**, which chopped an image into small pixel-like units which were then compared. This remains the foundation of **machine vision** and **optical character reading** today.

In 1963, he turned from looking at letters to faces. Based on pattern recognition, his method essentially did what artists do: divide the face into features and then compare distances between them. These would then create a template unique for that face.

As essential data abstracted from an image, templates are small and easier to compare in real time than pictures. This makes it sound simple, but making it work is tricky.

Unlike DNA and fingerprint patterns, faces change easily and often. Facial expressions, hair growth and styling, makeup, glasses, hats, masks, age, and health must all be taken into account. Using mugshots is hard enough but to extract templates from snapshots with heads in any attitude and lighting conditions poses massive challenges for machines.

Yet humans do it instinctively. Recognizing faces is so hardwired into our brains that we look for them everywhere. It makes finding faces on tortillas or planets much easier. In the famous "**hollow-face**" trick, for instance, the inside of a rotating mask looks as convex as the outside because our instincts insist that faces always push out and never in.

The earliest FRT systems were all labor intensive, as people were required to map all the critical feature placement points by hand. Long before digital photography, Woody adapted a primitive stylus and tablet to speed the process. Human oversight was also required for placing points in rotated views.

Human face templates – which have by now become complex and 3D – and photos are still individually checked by techs on most higher-end systems such as that of **Interpol** for its database covering **179 countries**.

But false positives and negatives are still a threat. As most systems were trained only on a few headshots of white men, FRT has historically had a persistent problem in identifying people of color and particularly women.

Because of these built-in **biases**, a lot of thought has gone into the **ethics** of FRT. Significant questions have been raised recently concerned with the circumstances in which FRT data is gathered, by whom, and for exactly what purposes it is kept and used.

These are not trivial issues. China, for example, uses CCTV cameras with FRT software to **watch** the Uyghur minority it is subjecting to cultural **genocide** in Xinjiang. And US academic journals had published their research.

FRT can make mistakes, too. It is often incapable of telling **identical twins** apart. Studies show that **deepfakes** are also close enough to fool commercial FRT systems. Frustrating detection has been done with as little as a medical mask and sunglasses, wearing a shirt with a portrait, or even face painting, but such easy **hacks** may be already outdated.

Twins might point to an underlying reality that may have big implications for all of us. Recently, in a study of **doppelgangers** – people who look alike yet are unrelated – found by photographers and AI, the doubles' DNA was checked. It was found to be very similar, though of course, from other origins.

If doppelgangers show up whenever DNA combinations repeat themselves, it implies that the maximum number of faces humans can wear is actually limited. Perhaps doubles can be predicted, but can they be told apart?

And do faces go with other traits, such as health, longevity, and even success?

Looking for the person within

You have **43 muscles** in your face that pull on your skin and features to make all your expressions. How many different looks can be made is unknown; many artists have created reference lists, often detailed and extensive.

Charles Darwin thought that facial expressions were universally-recognized **signals** of specific emotional states which had evolved from instinctive reactions. A psychologist named **Paul Ekman** with an interest in non-verbal communication sought to prove it. He claimed faces could generate **10,000 expressions**, only **3,000** of which were emotional.

Yet, he showed that even primitive peoples knew and displayed the same **16 basic** human emotions behind most expressions. Since then, other researchers have offered conflicting ideas, but general human experience agrees. Our survival for thousands of years has often depended upon our ability to read the facial signs of what is going on within others – including deception and lies.

The same markers that determine identity move with emotion, and therefore should be useful for detecting emotional states as well. Not only that, but there are fleeting **microexpressions** that may express deep conflicts.

In order to make the **metaverse** work, AI systems will have to detect and react to every minute twitch of the user – which they will constantly track. Could that data be used to manipulate our deepest fears and desires? How might it be employed to sell us stuff?

AI can already generate faces that appear more **trustworthy** than real people. What will happen once they are massaged in ways to make them seem even **more** believable?

In Orwell's **1984**, **facecrime** – incorrect expressions – was also punished. So maybe it's not a bad idea to smile at the camera after all.

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