A sleeker facial recognition technology tested on Michelangelo's David

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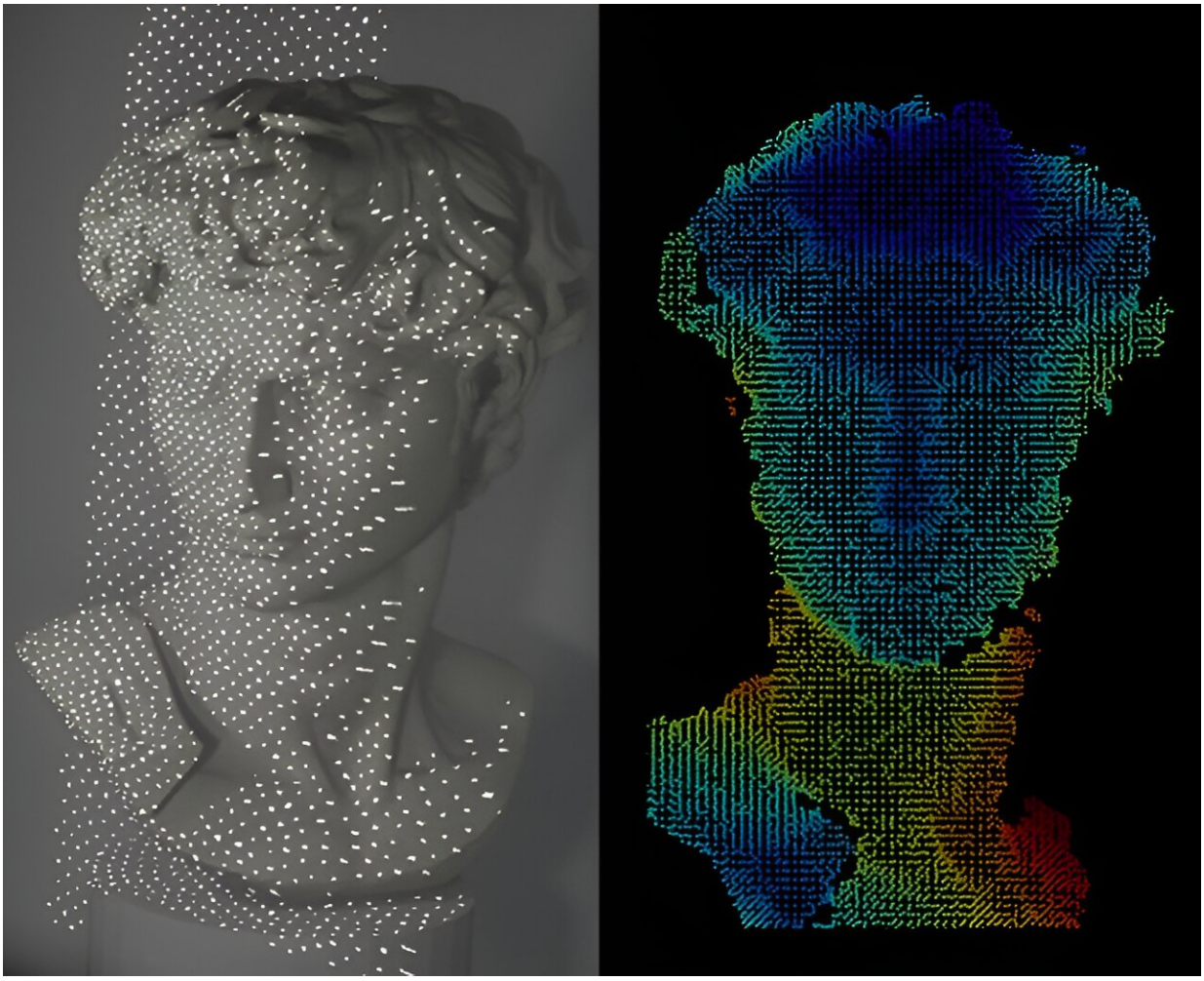

A new lens-free and compact system for facial recognition scans a bust of Michelangelo's David and reconstructs the image using less power than existing 3D surface imaging systems. Credit: *Nano Letters* (2024). DOI: 10.1021/acs.nanolett.3c05002

Many people are familiar with facial recognition systems that unlock smartphones and game systems or allow access to our bank accounts online. But the current technology can require boxy projectors and lenses. Now, researchers report in *Nano Letters* a sleeker 3D surface imaging system with flatter, simplified optics. In proof-of-concept demonstrations, the new system recognized the face of Michelangelo's David just as well as an existing smartphone system.

3D surface imaging is a common tool used in smartphone facial recognition, as well as in computer vision and autonomous driving. These systems typically consist of a dot projector that contains multiple components: a laser, lenses, a light guide and a diffractive optical element (DOE).

The DOE is a special kind of lens that breaks the laser beam into an array of about 32,000 infrared dots. So, when a person looks at a locked screen, the facial recognition system projects an array of dots onto most of their face, and the device's camera reads the pattern created to confirm the identity. However, dot projector systems are relatively large for small devices such as smartphones. So, Yu-Heng Hong, Hao-Chung Kuo, Yao-Wei Huang and colleagues set out to develop a more compact facial recognition system that would be nearly flat and require less energy to operate.

To do this, the researchers replaced a traditional dot projector with a low-power laser and a flat gallium arsenide surface, significantly reducing the imaging device's size and power consumption. They etched the top of this thin metallic surface with a nanopillar pattern, which creates a metasurface that scatters light as it passes through the material.

In this prototype, the low-powered laser light scatters into 45,700

infrared dots that are projected onto an object or face positioned in front of the light source. Like the dot projector system, the new system incorporates a camera to read the patterns that the infrared dots created.

In tests of the prototype, the system accurately identified a 3D replica of Michelangelo's David by comparing the infrared dot patterns to online photos of the famous statue. Notably, it accomplished this using five to 10 times less power and on a platform with a surface area about 230 times smaller than a common dot-projector system. The researchers say their prototype demonstrates the usefulness of metasurfaces for effective small-scale low-power imaging solutions for facial recognition, robotics and extended reality.

More information: Wen-Cheng Hsu et al, Metasurface- and PCSEL-Based Structured Light for Monocular Depth Perception and Facial Recognition, *Nano Letters* (2024). DOI: 10.1021/acs.nanolett.3c05002

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