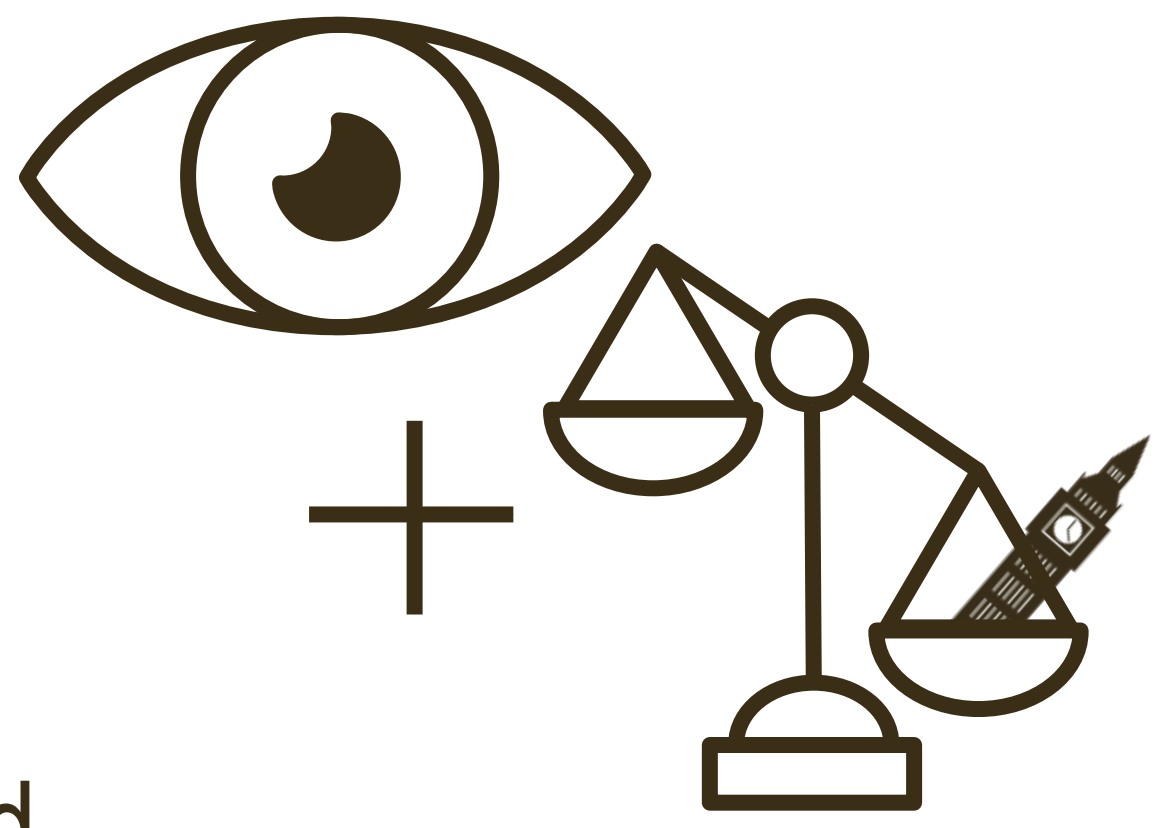


SENSE 3D THROUGH COLOURS

A MECHANOCHROMIC ROBOTIC SKIN

Tight that cap: How many times do we weight things every day?

We unconsciously measure weight **500+** times a day to navigate and interact with the world.



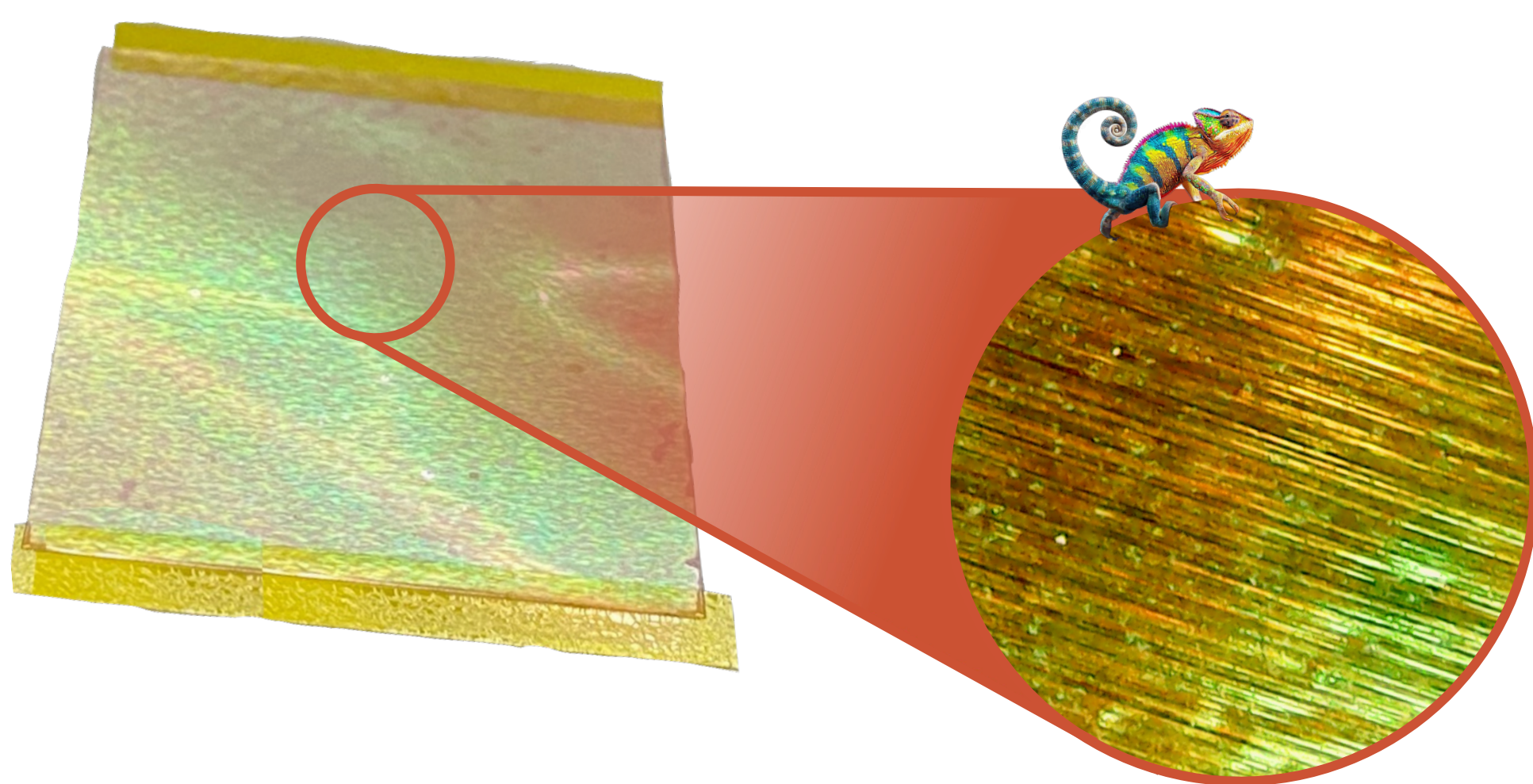
A single human hand has **17,000**^[1] tactile sensors that act like precise scales. But they aren't enough to recognise objects. We also rely on sight.

A scale works like a **3D Pin Board**, where the weight pressing each pin is translated into a precise height. **Pin Height = Pressure**

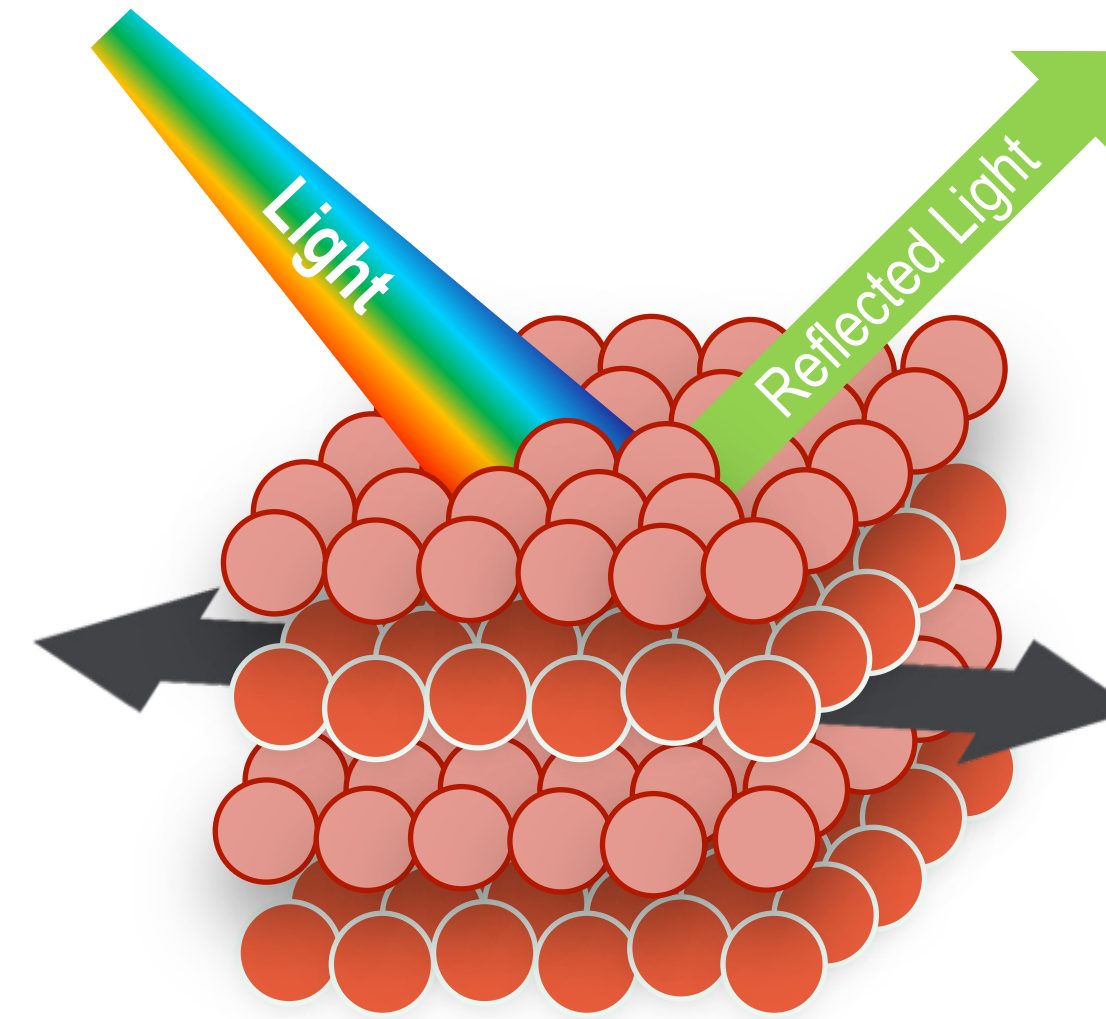
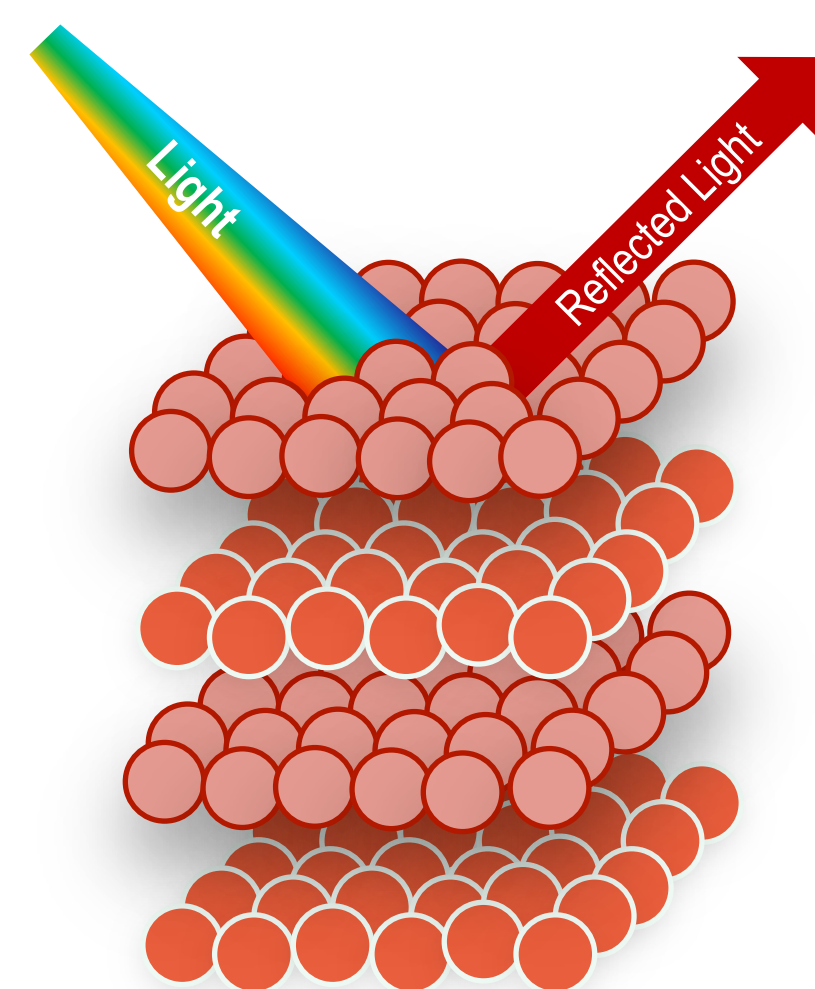


Touch requires a fine sensing & vision system to recognise objects.

How can a nature-inspired soft material help us see invisible forces?

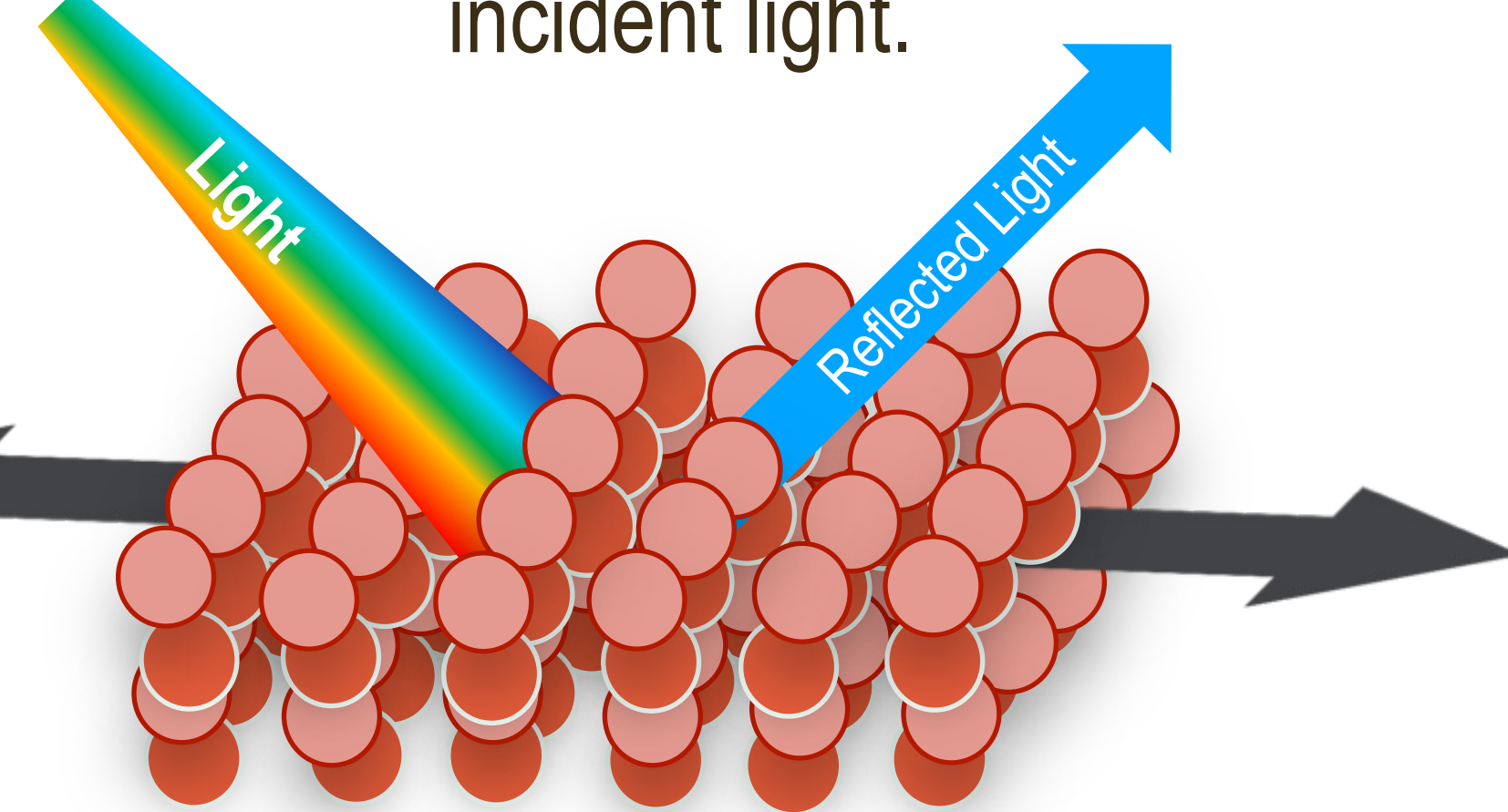


Like **chameleons** change colour to blend in with the surrounding, some active materials react to external input by shifting colour. A **structurally coloured material**, in particular, changes colour under **mechanical stimuli**, making it a powerful tool for optical sensing and visual communication. [2]



The internal structure of the material consists of **alternating layers**, each with a **fixed density**. When deformed, the thickness of these layers changes, shifting the **interference pattern** of incident light.

This soft material is created by a **photographic technique** on a **holographic film**. The imprinted pattern **filters and reflects specific wavelengths**, revealing **pressure as a colour** for each internal structure reached with deformation.



Pressure becomes visible through colour, no electronics required.

Feel objects with a single camera: The future of robotic skin is at your fingertips.

While a human hand has only 17,000 sensors, a **single £10 webcam** has more than **2,000,000 eyes** detecting structural colour changes in the active material, which makes it as a **high-definition pressure-map sensor**.

Thanks to its **soft** nature, this material can be **shaped** around any surface, making human-like **robotic skin** possible. Unlike complex sensor-based technologies, it costs **£2** or less to produce – cheaper than a Tube ride.

- **Recognise** the right coin in your pocket.
- Enhancing authentication with fingerprint **pressure mapping**.
- **Medical touch** in delicate operations (e.g. endoscopy).
- **Cheap** solution for more than 3000 **amputees** per year.

With a mechanochromic robotic skin, robots walk on eggshells.

NEXT STEPS: Future work will integrate AI models for faster association of pressure maps with real-world textures and objects, enhancing robotic manipulation and assistive healthcare applications.

FORCES AND PRESSURES ARE NOW VISIBLE BY TOUCH. SEE IT. SAY IT. SORTED.

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References

- [1] Vallbo (1984) "Properties of cutaneous mechanoreceptors in the human hand related to touch sensation", Human Neurobiology
 [2] Miller (2022) "Scalable optical manufacture of dynamic structural colour in stretchable materials", Nature Materials