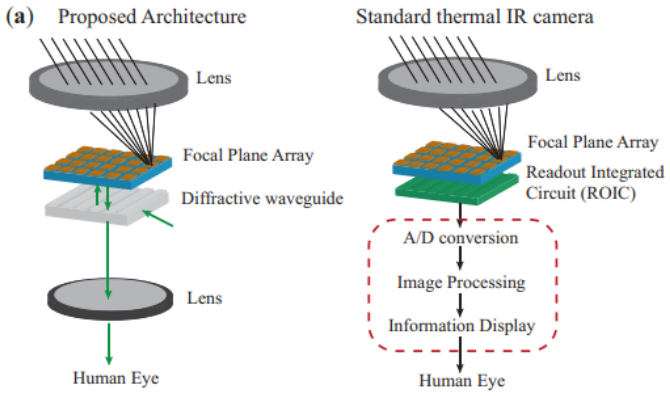
Docket #: S21-293

Direct Thermal Infrared Vision via Nanophotonic Detector Design

Researchers at Stanford have designed a new nanophotonic detector to reduce cost, size and power consumption compared to existing thermal infrared (IR) cameras. Traditional IR cameras contain specifically designed IR detectors whose output is converted to digital signals followed by image processing and a final projection of the IR image on a separate display screen. The new nanophotonic design eliminates the need for analog to digital conversion, image processing and a separate display device, thus considerably simplifying the overall architecture. Potential products based on this functionality include a small-size eye-wearable that can allow direct thermal IR vision to human eyes. Such a technological capability does not currently exist. In this architecture, the array of detector pixels is illuminated by visible laser light. The detectors are designed such that the amount of reflection of the laser light depends on the temperature change in the pixel relative to the substrate induced by IR radiation focused onto it. In other words, the IR image of the far-field scene can be directly seen by looking at the detector array (also called as focal plane array) through a magnifying lens. This new, minimalist approach can considerably simplify an uncooled infrared camera.



The proposed architecture is schematically shown in comparison to the standard thermal IR imaging system. Seen in the red dotted lines are system parts eliminated

in the new minimalist design (*image credit: the inventors*)

Stage of Development
Proof of concept

Applications

- Similar to IR cameras, relevant applications requiring infrared images include:
  - Detection and sensing in industrial (gas/chemical leakage), agricultural (crop qualities), infrastructure (building, bridge inspection), healthcare (thermograms)
  - Night-vision or low-light vision applications for military, fire-fighters, camping-enthusiasts

Advantages

- Existing thermal infrared cameras are typically bulky and costly
- New approach potentially cuts cost, form factor and power consumption by eliminating conventional system components

Publications

- Khandekar, Chinmay, Weiliang Jin, and Shanhui Fan. "Direct thermal infrared vision via nanophotonic detector design." *arXiv preprint arXiv:2108.11583* (2021).

Patents

- Published Application: 20240369821
- Issued: 12,393,013 (USA)

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