Locust Vision-Inspired Silver Nanowire-Based Printed Near-Infrared Image Sensor Label for Collision Avoidance

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#### 1. Introduction of Research Engineering Center for R2R Printed Flexible Computer

Final Goal of the R2R Printed Flexible Computer Research Center

To secure core technologies in materials, components, equipment, and device design for next-generation R2R printed electronics foundry, and to demonstrate the world's first fully roll-to-roll printed 4-bit flexible computer (CPU + ROM + RAM + I/O + 13.56 MHz module) and flexible printed sensors.





# 2. Key factor for R2R printing system

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Silver nanoparticle based conductive ink



#### BaTiO<sub>3</sub> based dielectric ink



#### SWCNT based semiconducting ink



## **INK TRANSFER**





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#### Ink Web Ink Drying Tension Drying Layer 1 Web Layer 2 Nip Roll **Overlay Printing Registration Accuracy** Ink Rheology and Transfer Doctoring mechanism Gravure Calculation of registration error, Roll corrective actuation, and servomechanism Ink Reservoii

### **OPRA SYSTEM**







# 3. Motivation



**Printed NIRIS label** 

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- ✓ HIGH PERFORMANCE Locust-inspired Near-Infrared Image Sensor (NIRIS) with embossed Ag-NW arrays enables fast and accurate collision detection through plasmonic enhancement and neuromorphic signal processing.
- ✓ **REASONABLE** Fully roll-to-roll printed NIRIS and neuromorphic controller provide a low-cost alternative to bulky computer vision systems for industrial robots.
- ✓ FLEXIBLE Thin, lightweight, and printable sensor labels can be easily attached to various robotic surfaces, enabling adaptable human-robot interaction across environments.

#### Locust Vision (Compound eye)

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Insect compound

eye mimic sensor





- Perspective-based collision detection signal processing of objects.
- Neuromorphic signal reception & transmission.

# 4. Development of NIRIS

Development of NIRIS Platform through NIR sensor part based on NFC band



Testing of the NIR sensor using a 1 Hz signal from a function generator



Testing of the NIR sensor using printed RO, TFTs and antenna

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System Overview: Printed Tag + Si Rectifier + Printed RO + Printed NIR + Printed TFT

**NIR Sensor Data** 





**Reader with Demodulator** 

# 5. Conclusion

- Omnidirectional detection sensor in the form of insect compound eyes
- NIR wireless sensor label in single chip form
- Ultra-low-cost mass production possible based on R2R gravure printing
- Lightweight compared to silicon-based sensors.

Thank you.