

Fingers See Things Differently (FIST-D):

A Robotic Explosive Ordnance Disposal (EOD) based on Augmented Tactile Imaging

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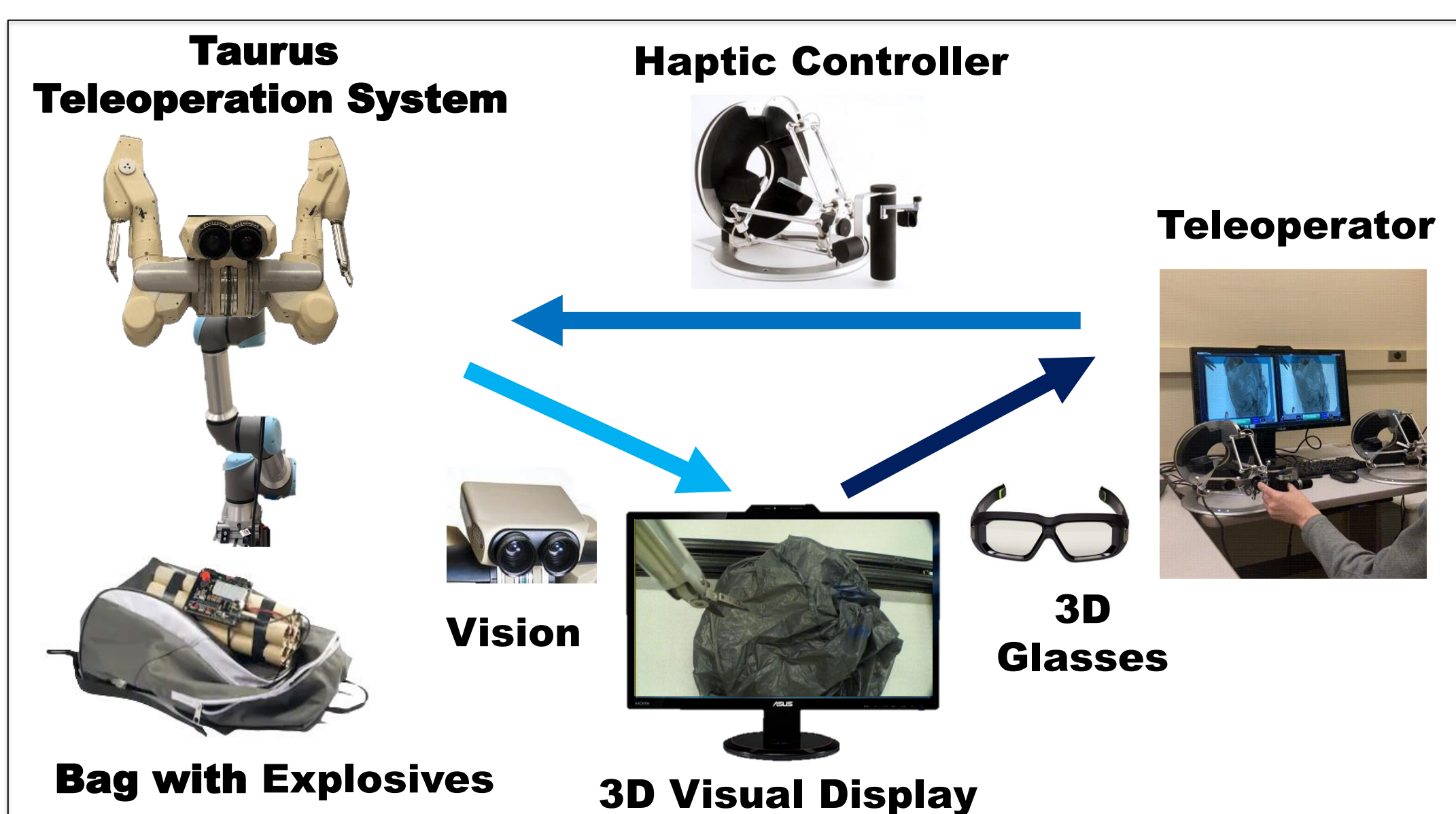
Main Task

Explosive ordnance disposal is among the most hazardous occupations. While various EOD robots have been developed, the task performance is reported to be lower than EOD technicians working on site. One major reason is that the tactile sensing of the EOD robot is not comparable to the human one. We address this problem by developing a robot that can detect and display concealed IEDs based on augmented tactile data using both human perception and tactile sensing.

Challenges

- ❖ Visualize concealed objects and plan manipulation policies.
- ❖ Develop tactile device with high resolution and contact sensitivity.
- ❖ Develop selective polymers to detect explosive residues with high sensitivity.
- ❖ Develop a haptic display system to convey the multi-modal information.

System Architecture



Scientific Impact

- ❖ Technology for detecting trace energetics in surface residues can be applied to the detection of hazardous chemicals.
- ❖ Intelligence based tactile exploration can be extended to scenarios where optical information is not available.
- ❖ The enhanced tactile feedback in teleoperation can improve the task performance of telesurgery.
- ❖ The developed haptic display system can help users with hearing/visual impairments in exploring physical objects.

Broader Impact

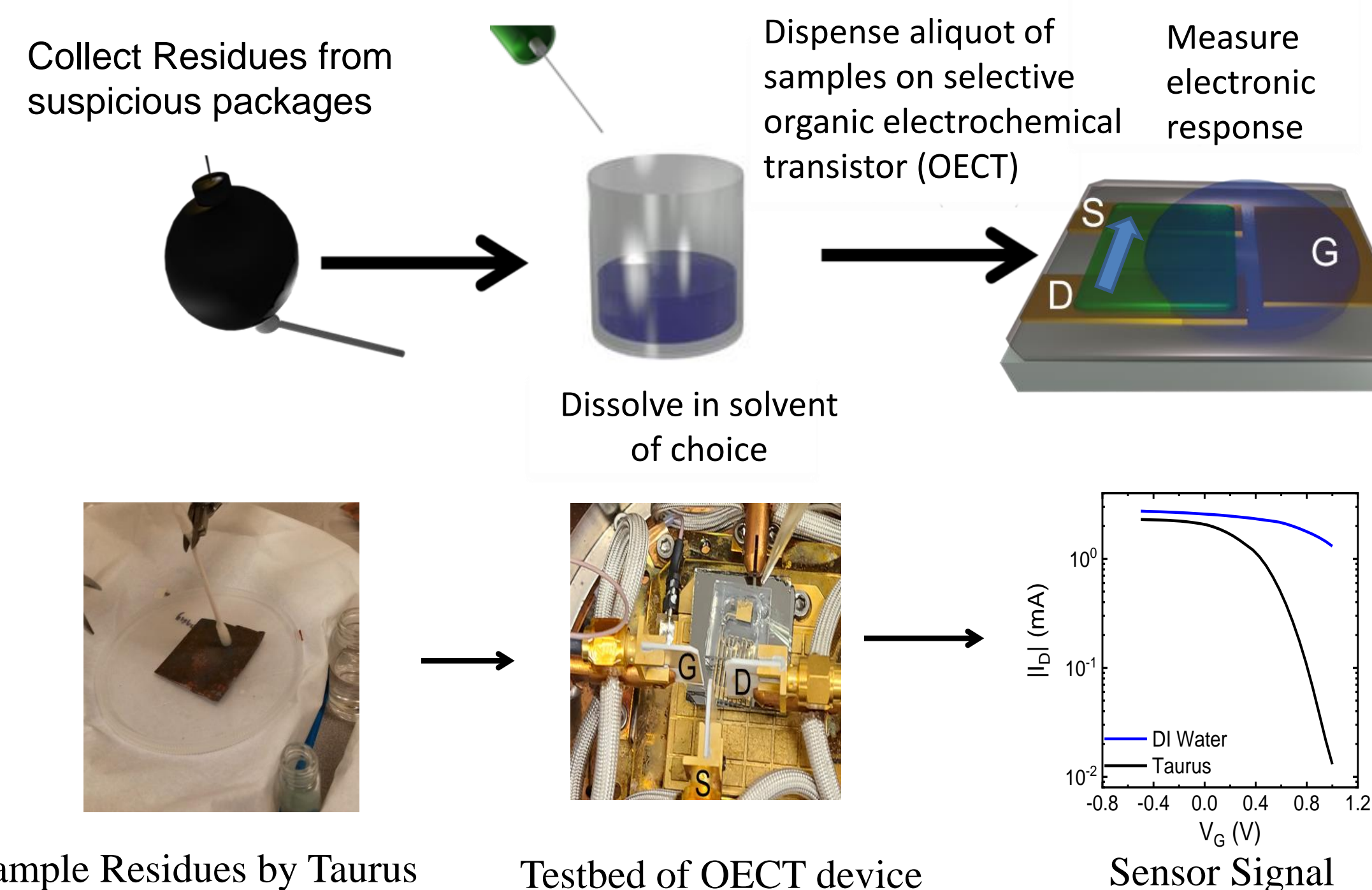
- ❖ Reduce the risk of EOD teleoperators using enriched perception.
- ❖ Incorporate the research outcomes into the coursework.
- ❖ Increase the participation of minorities.

Acknowledgement

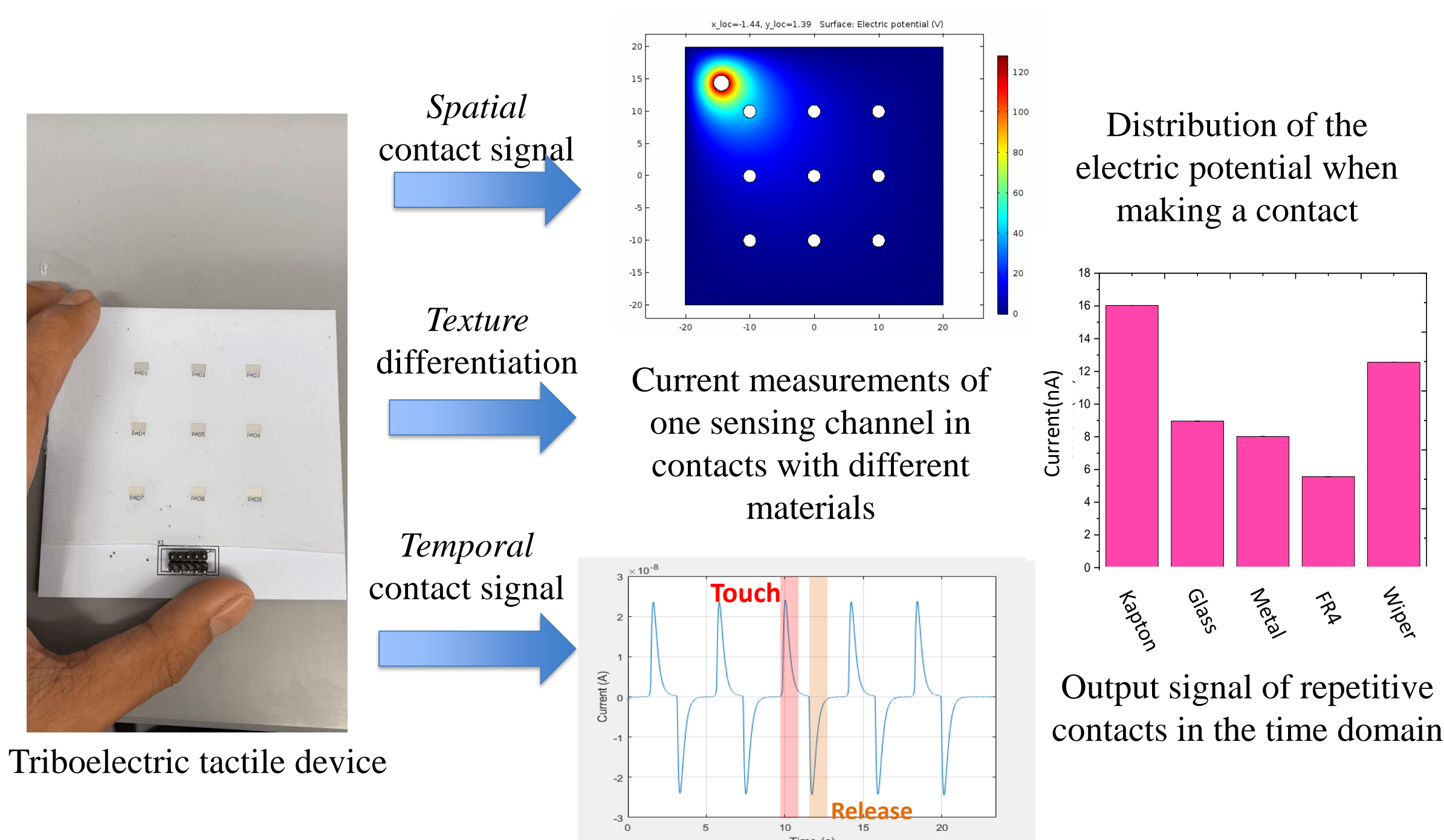
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Technical Approach

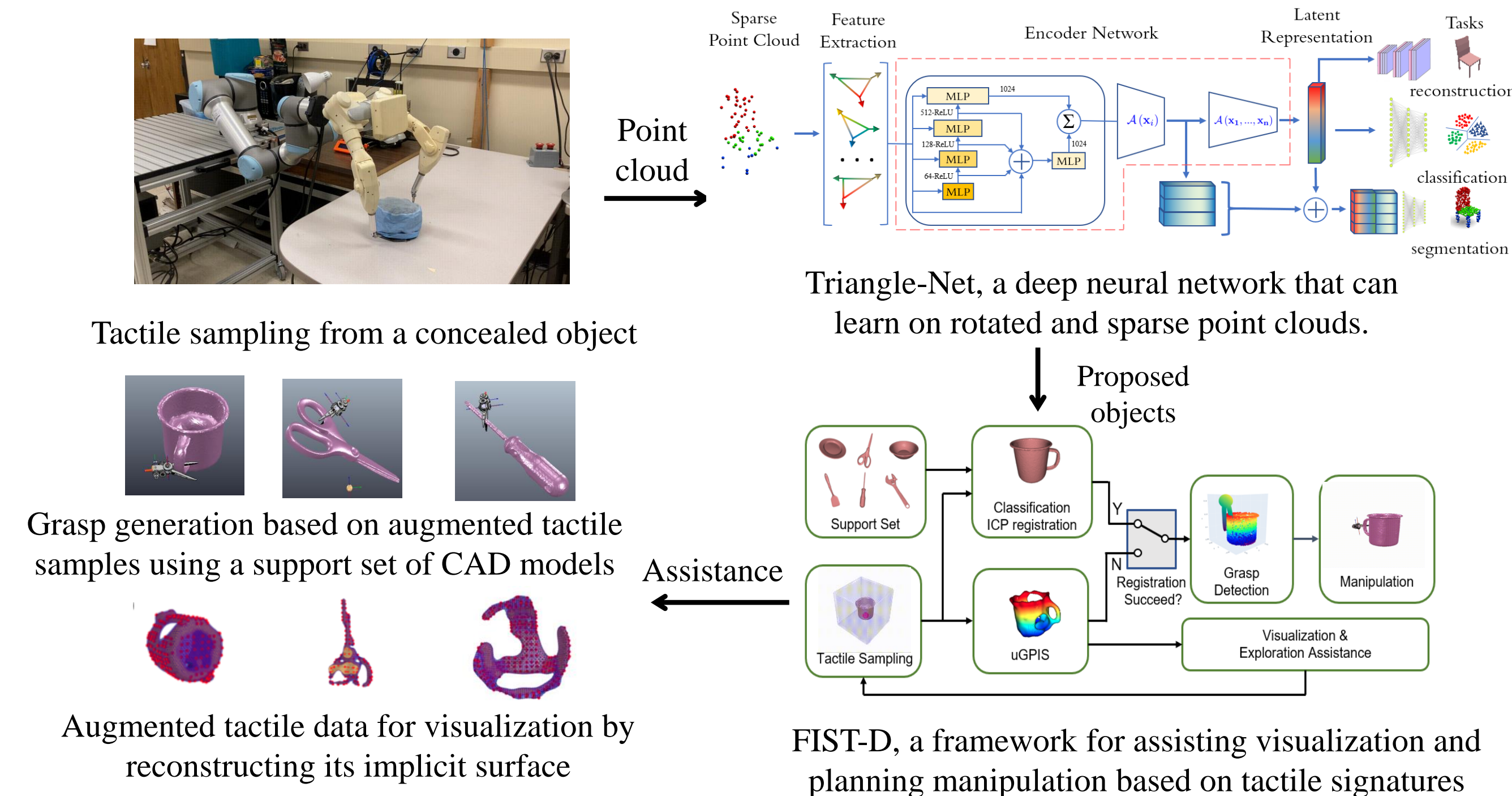
1. Sensing Solution: Explosive Recognition Based on the OECT Device



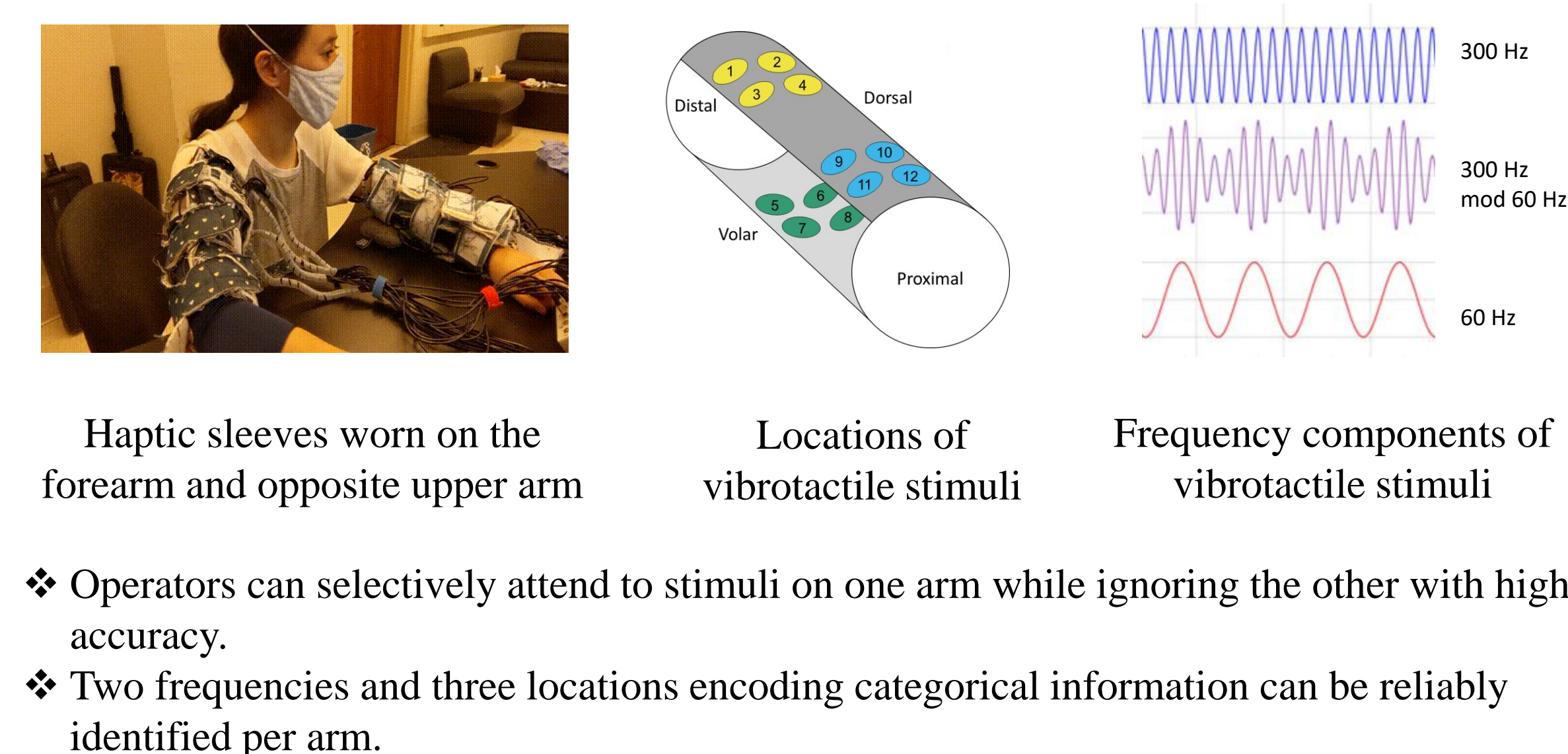
2. Create Tactile Feedback Based on the Triboelectric Material



3. Intelligent Assistive System Based on Tactile Data



4. Tactile Display for Conveying Multi-modal Information to Teleoperator



- ❖ Operators can selectively attend to stimuli on one arm while ignoring the other with high accuracy.
- ❖ Two frequencies and three locations encoding categorical information can be reliably identified per arm.