To design a social robot for the **London 2026 Conference on HRI (Human-Robot Interaction)**, we must move beyond simple "detect and react" mechanics. The robot must serve as a **Biological Mediator**—an entity that perceives the environment not just as a set of coordinates, but as a living system of sensory thresholds and metacognitive opportunities.

For this specific "Indoor Forest" context, the robot's perception system should be built on three sophisticated pillars:

1. Olfactory Biosensing (The "Pee" vs. "Cedar" Discriminator)

Traditional electronic noses are often too slow. For 2026, we propose a **Bio-Hybrid Olfactory System**.

- **The Tech:** Integrating locust-inspired biological sensors (antennal biosensors) that convert chemical signals into electrical pulses 10,000x more sensitive than silicon sensors.
- **The Function:** The robot identifies the chemical signature of ammonia (dysregulation trigger) versus cedar/juniper (regulatory anchor). It can then proactively suggest a move to the "Cedar Circle" before a student becomes consciously aware of the olfactory stressor.

2. Semantic SLAM & Waypoint Metacognition

Instead of just navigating a room, the robot uses **Semantic Simultaneous Localization and Mapping (SLAM)** to understand the *meaning* of the forest.

- **The Tech:** 3D LiDAR combined with Object Recognition to build a "Value-Weighted Map."
- **The Function:** The robot remembers where the student took their last photograph of a ladybug. When it perceives the student wandering aimlessly, it can offer a nudge: *"I remember the beetle was by the birch knot at this time yesterday. Shall we check if it's back?"* This supports the **temporal and spatial memory** skills crucial for the Canadian science curriculum.

3. Responsive Joint Attention (The "Digital Hearth" Mode)

To address the "Two-Eyed Seeing" and Piagetian perspective-taking goals, the robot must perceive **Gaze Vectors** rather than just "faces."

- **The Tech:** Multimodal perception using 4K Computer Vision and Depth-Sensing to track **Joint Attention**.
- **The Function:** If a student is looking at a chick in the brooder, the robot doesn't look at the student; it looks at the *chick*. By mirroring the student's focus, the robot validates the student's interest. When a second student joins, the robot facilitates "Visual Perspective Taking" by pointing out the difference in their viewing angles: *"Student A sees the beak; Student B sees the wings."*

Robotic Perception Architecture for Biological Regulation

Sensory Input	Perception Level	Biological/Curricular Outcome
Antennal Biosensor	Olfactory Analysis	Mitigates hygiene triggers; promotes cedar-based regulation.
Gaze Tracking	Joint Attention	Facilitates Theory of Mind; overcomes Piagetian egocentrism.
Semantic SLAM	Environmental Waymarking	Supports longitudinal science observation and spatial memory.
Thermal Imaging	Physiological State	Detects "invisible" dysregulation (flushed skin/rising temp) before a meltdown.

Export to Sheets

The "Participation" in Participatory Design

At the London 2026 conference, the argument would be that the robot is not a "monitor," but a **participant in the ecosystem**. It respects the **Indigenous Wisdom** of the space by acting as a "steward" of the data, ensuring the shared drive reflects a community of perspectives rather than a single "correct" view.

Would you like me to develop the "Robot Response Matrix"—a guide on how the robot should change its lighting and movement based on these environmental perceptions?