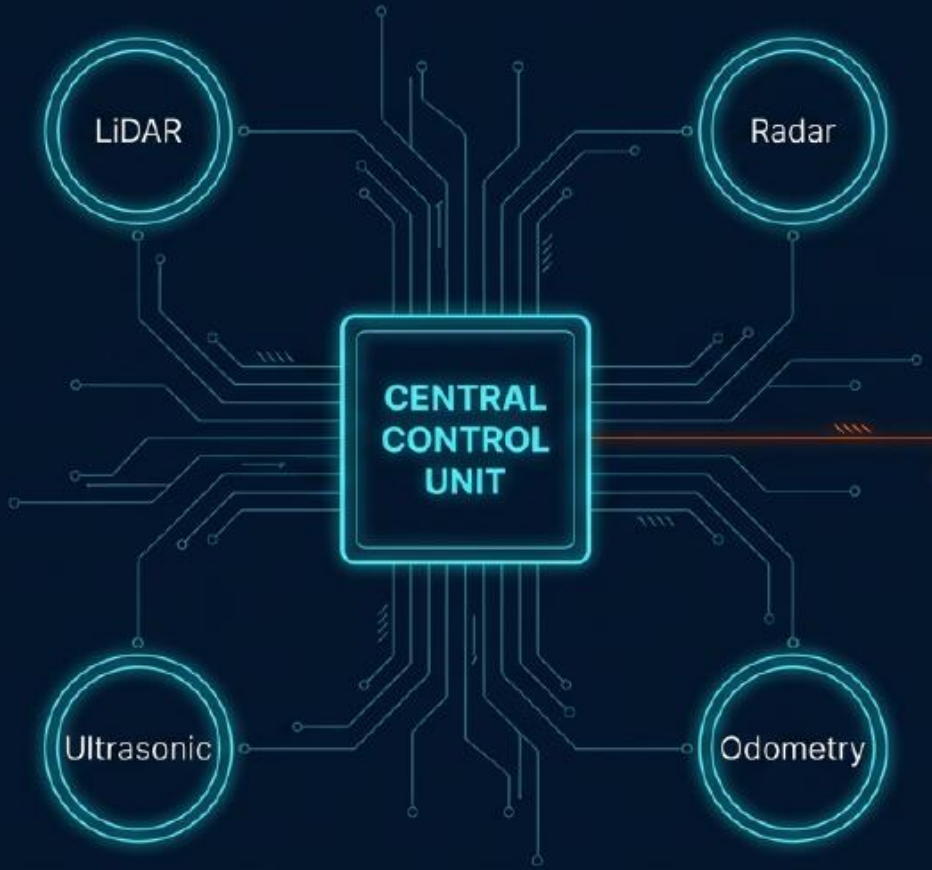
Present and future of AGVs:

How do **visual and language understanding** fit in the landscape?

Scope, risks and promises

Team 3

CURRENT ARCHITECTURE: THE SENSOR FUSION BASELINE



- **Multi-Modal Dependency:** Rigid fusion of LiDAR, Radar, and Camera.
- **Control Logic:** Centralized master governance.
- **Critical Constraint:** Millisecond-level processing required for safety.

LATENCY SENSITIVITY

(Lynch et al., 2018; VDA 5050, 2025)

The Energy Price of Being Smart

The Cycle Never Ends

Cycles of work are increasing. AGVs are now expected to work 24 hours a day to meet delivery speeds.

(IndustryARC, 2024)

Eyes Cost Power

Sensors like cameras and Lidar act as “eyes.” Keeping these eyes open constantly to avoid crashes uses a lot of electricity.

(Zhang, Chen, & Guo, 2022)

Thinking Burns Energy

The onboard AI models used for navigation and decision-making need heavy computing power. This “thinking” process reduces the driving range.

(Lin et al., 2018)

AGV current and future challenges

1. Immediate: Energy & Thermal Limits

2. Immediate: Sensor fusion and Real-Time Latency

3. Future: Flexibility & Human-Robot Interaction

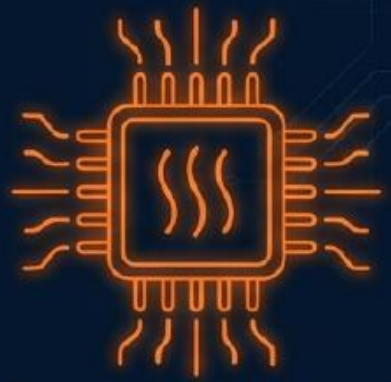
CRITICAL RISKS & COMPLEXITY

Latency & Reaction

VLM reasoning is computationally heavy. Processing lag (**>100ms**) risks collision in dynamic environments. **Target >10 FPS** is difficult.

Hallucinations

AI model misinterpretation. Identifying shadows as obstacles or failing to see transparent surfaces (glass).

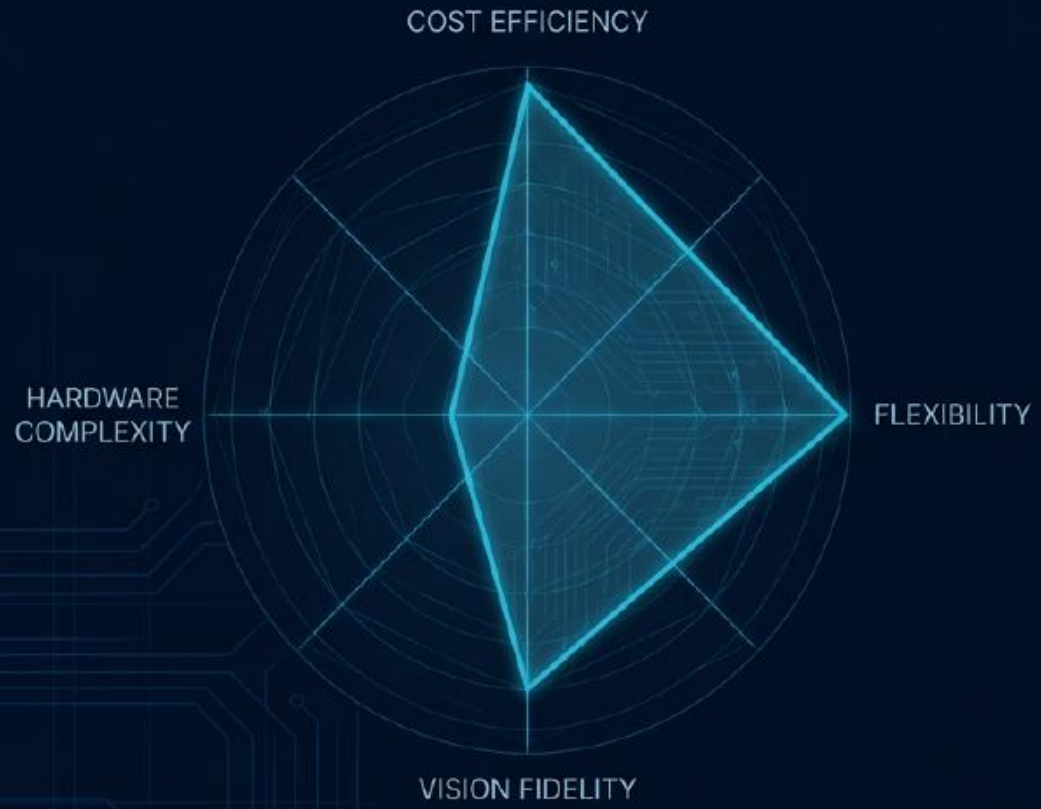


Processing Load

Thermal bottlenecks. Massive compute requirements drain battery and require complex cooling solutions.

(Real-time open-vocabulary perception, 2025; Challenges Facing Warehouse AGV Manufacturers, 2025)

STRATEGIC TARGET: VISION-FIRST ARCHITECTURE



CORE CAPABILITIES

- **Camera-First Design**: Removing expensive LiDAR for high-fidelity image integration.

- Zero-Shot Task Execution: Instruction-based navigation without pre-mapping (e.g., "Find the exit").

- Human-Robot Interaction: Natural language understanding via Vision-Language Models (VLMs).

(Analog Devices, 2025; History-Augmented Vision-Language Models, 2025)

Final remarks

1. **Prototype for the future (seminal stage):**

2. **Sharpen the current challenges and add some news:**

   Battery, Latency, Hallucinations

3. **Simulation environment to address issues out of scope:**

   Battery, Latency, damages, AGV communication.

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