Architecture & Design Document

1. Architectural Overview

The system follows a **Cognitive Agent Architecture** inspired by perception–reasoning–memory–action loops.

```
[ Sensors / Inputs ]
        ↓
[ Perception Layer ]
        ↓
[ Reasoning & Planning Layer ]
        ↓
[ Memory Layer ] ↔ [ Knowledge Stores ]
        ↓
[ Execution Layer ]
        ↓
[ AR/VR / Tools / Actuators ]
```

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2. Perception Architecture

2.1 Components

- Vision Encoders: CLIP, SAM, Rex-Omni
- OCR: Tesseract, PyMuPDF
- ASR: Whisper, Vosk, Wav2Vec2

2.2 Design Considerations

- Latency vs accuracy trade-offs
- Edge vs cloud inference

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3. Reasoning & Planning Architecture

3.1 Planning Frameworks

Framework	Description	Use Case
Sequential Planning	Step-by-step decomposition	Simple tasks
	Plan + act loops	

Framework	Description	Use Case
Interleaved Planning		Dynamic environments
DPPM	Parallel plan generation	Complex tasks

3.2 Reflection System

- Actor: Executes plan
- Evaluator: Scores outcome
- Reflector: Updates strategy

4. Memory Architecture

4.1 Short-Term Memory

- Context window
- Session buffers

4.2 Long-Term Memory

Type	Technology	Use
Vector DB	FAISS, Qdrant	Semantic recall
Graph DB	Neo4j	Entity relations
SQL DB	PostgreSQL	Logs & states

5. Execution Architecture

5.1 Tool-Based Execution

- Web search APIs
- Code execution sandboxes
- AR rendering engines

5.2 Multimodal Action Space

- GUI clicks

- Voice feedback
- AR overlays

6. Failure Modes & Mitigations

Failure	**Mitigation**
Hallucination	Rerankers + Reflection
GUI Misgrounding	Vision + DOM fusion
Loops	State tracking + penalties

7. Example End-to-End Flow

Component	**Function**	**Example**
Sensor	Input	Camera sees yellow leaves
DB	Memory	Retrieve plant disease info
LLM	Reasoning	Diagnose nitrogen deficiency
Actuator	Action	Trigger fertilizer valve

8. Implementation Complexity Analysis

Subsystem	**Complexity**	**Feasibility**
Perception	High	Medium
Reasoning	Medium	High
Memory	Medium	High

Subsystem	Complexity	Feasibility
Execution	High	Medium

9. Future Extensions

- Autonomous robotics
- Digital twins
- Self-improving agents
- Advanced AR/VR interactions