MARCUS PROJECT

Autonomous G1 EDU Robot System

YS Lootah Technology | Technical Architecture Document | April 2026

Project Name	Marcus — Autonomous G1 EDU Robotic System
Organization	YS Lootah Technology
Version	1.2 — Updated April 4, 2026
Author	Kassam — Robotics & AI Developer
Platform	Unitree G1 EDU + Jetson Orin NX 16GB
Status	ACTIVE — LLaVA AI Vision Control Working

1. Executive Summary

Project Marcus is the autonomous navigation and inspection system built on the Unitree G1 EDU humanoid robot for YS Lootah Technology. As of April 4, 2026, the system achieves full AI vision control: LLaVA 7B running offline on the Jetson Orin NX understands natural English commands, sees through the RealSense camera, and controls Holosoma locomotion via ZMQ. The robot executes multi-step natural language commands entirely offline — no cloud, no remote control required.

Core: Text command → LLaVA sees camera → JSON action list → ZMQ → Holosoma 50Hz → G1 EDU moves. Fully offline on Jetson Orin NX.

2. Development Modes — How Marcus Was Built

Marcus was developed through three progressive modes, each building on the previous. This approach allowed safe testing at each layer before adding complexity. All three modes remain available and serve different purposes.

Joystick Minimal AI Manual joystick control via Holosoma. No AI involved. Used for testing raw robot movement, verifying the locomotion policy works on the physical robot, and as emergency fallback.	✅ **WORKING**

Purpose	When to use

Test locomotion policy on real robot	First bring-up of robot
Verify joint control and stability	Hardware debugging
Emergency manual override	Any time AI is not responding
Demonstrate basic walking to clients	Quick demos without AI stack

ZMQ AI Control (Marcus Mode) Python scripts send velocity commands directly via ZMQ to Holosoma. AI is external. Used for testing the ZMQ bridge, precise movement scripts, and wiring new AI models before integration.	✅ **WORKING**

Purpose	When to use
Test ZMQ bridge independently	Debugging communication layer
Send precise movement commands	Scripted movement sequences
Wire new AI models to locomotion	Integrating NaVILA / GR00T
Unit test individual movements	Verifying velocities and timing

LLaVA + Holosoma (Marcus AI Mode) Full autonomous AI stack. LLaVA 7B sees camera + understands English commands + returns multi-step action list → executed via ZMQ → Holosoma. Offline, no cloud. This is the current production mode.	✅ **WORKING — CURRENT SYSTEM**

Confirmed Commands	Robot Action
turn left / turn right	Rotates 2s
walk forward / move back	Walks forward or backward
move forward and then turn right	Executes both steps in sequence
what do you see?	Describes scene from camera
inspect the office	Scans room and reports findings
turn left three steps please	Natural language understood

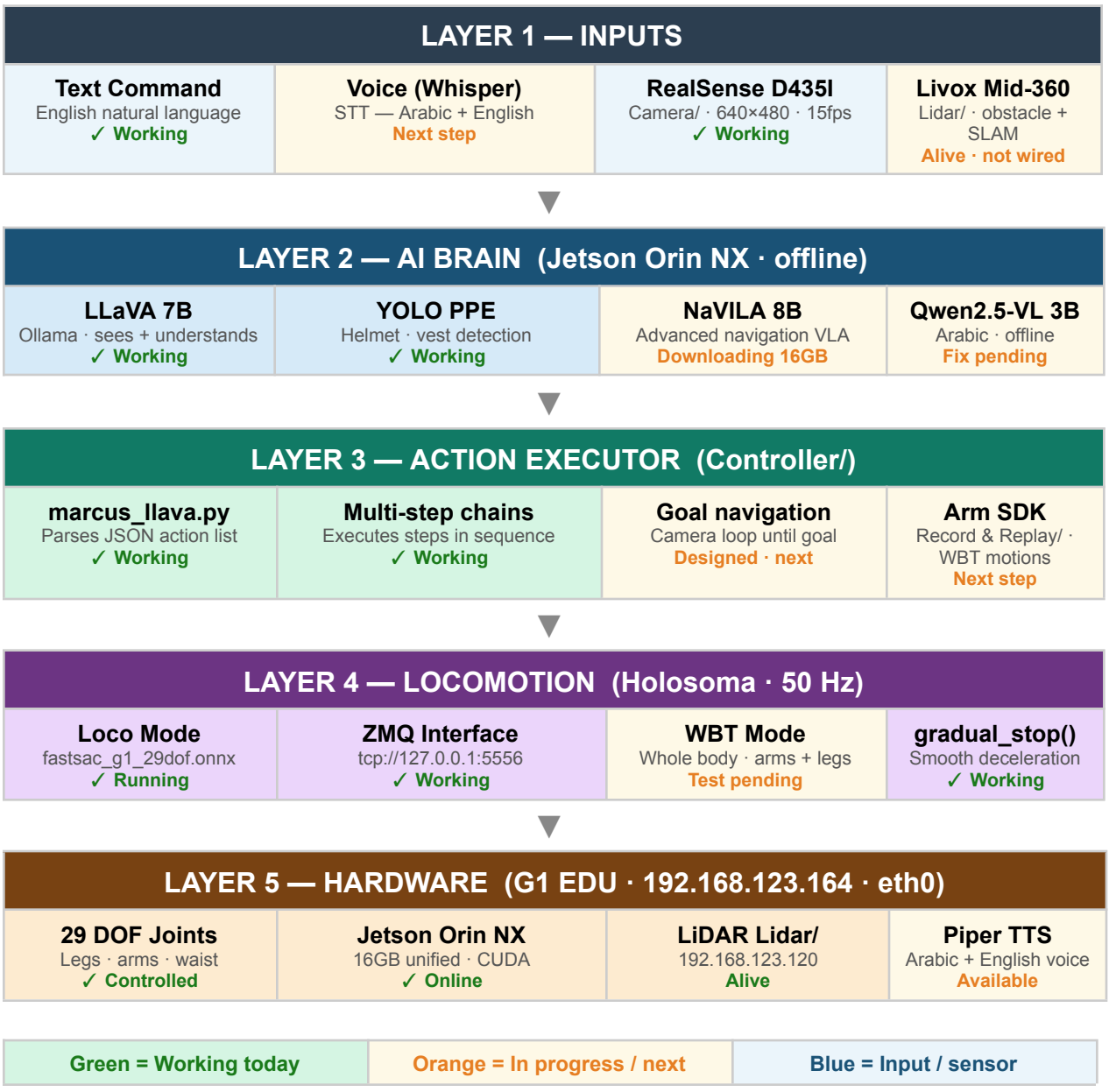
3. Project Folder Structure

The Marcus project is organized into functional folders. Each folder has a specific role in the system and maps directly to a layer of the architecture.

Folder	Role	Description
Controller/	Robot behavior logic	Defines how the robot will work — movement decisions, state machine, command routing, behavior modes. The brain wiring.
Camera/	Vision system	How the robot sees — camera setup, frame capture, image preprocessing for AI models, visual feedback pipelines.
Lidar/	Full autonomy sensing	LiDAR data processing for obstacle avoidance, distance measurement, SLAM mapping. Required for true unsupervised navigation.
Record & Replay/	Dataset collection	Records system interactions — camera frames, commands, robot actions — for replay, debugging, and training data collection for future model fine-tuning.
Models_marcus/	AI brain scripts	Current AI control scripts — marcus_llava.py, Modelfiles, navigation scripts. The active runtime.

4. System Layer Diagram

Five layers from input to hardware. Each layer has one job. Communication flows downward through well-defined interfaces.



5. Current State of Marcus AI (April 4, 2026)

Marcus is currently a command-driven AI robot. You give a natural language command — Marcus sees the camera, decides what to do, and moves. It does not yet set its own goals or patrol autonomously.

5.1 What Marcus Can Do Right Now

- Understand natural English text commands
- See the environment through RealSense camera
- Describe what it sees (people, objects, layout)
- Execute single and multi-step movement chains
- Walk forward, backward, turn left, turn right
- Inspect a room and report findings
- Run fully offline — no cloud, no internet
- Auto-reconnect camera on USB drops

5.2 What Marcus Cannot Do Yet

- Set its own goals or patrol without being told
- Stop when it reaches a specific target (goal navigation loop)
- Control arms (G1 Arm SDK not yet wired)
- Understand Arabic commands (Qwen 3B fix needed)
- Use voice input (Whisper STT not yet installed)
- Avoid obstacles automatically (LiDAR not yet wired)
- Walk a precise distance (odometry /dog_odom not yet wired)

5.3 Autonomy Level

Level	Description	Marcus Status
Level 1	Remote controlled — human controls every move	Done (joystick mode)
Level 2	Command-driven — AI executes natural language	✅ Current state
Level 2.5	Goal-driven — AI navigates until condition met	Designed, next step
Level 3	Fully autonomous — sets own goals, patrols alone	Month 2 target

6. Network Topology

Device	IP Address	Credentials	Interface
Jetson Orin NX	192.168.123.164	unitree / 123	eth0
Workstation RTX 4060	192.168.123.222	zedx	enp3s0
G1 Locomotion Computer	192.168.123.161	proprietary	internal
Livox Mid-360 LiDAR	192.168.123.120	—	eth0

7. Marcus as a Platform — Future Projects

Marcus is not a single-purpose robot. It is a reusable humanoid robot platform. The five-layer architecture is designed so that any new application only changes the top two layers — the AI prompt and the task logic — while the locomotion infrastructure remains unchanged.

Every project below reuses: Holosoma walking · ZMQ interface · Jetson offline stack · RealSense camera · YOLO detection · Record & Replay dataset pipeline. Only the AI task layer changes.

Project	What it adds to Marcus	Target Client
AI Tour Guide	Face recognition + multilingual speech + waypoint map	Hotels, airports, museums
Security Patrol Robot	Anomaly detection + 24/7 patrol loop + alert system	Industrial facilities
Warehouse Assistant	Object pick location + arm SDK + inventory tracking	Logistics companies
Reception Concierge	Visitor management + Arabic/English speech + directions	Corporate offices
Cleaning Robot	WBT arm motions + surface detection + task scheduling	Hospitality
Medical Assistant	Patient detection + medication reminder + safe nav	Clinics, hospitals

7.1 What Never Changes (Shared Infrastructure)

- Holosoma locomotion — 50Hz stable walking on G1 EDU

- ZMQ control interface — velocity commands via PUB/SUB
- Jetson Orin NX offline stack — no cloud dependency
- RealSense D435I camera — vision for all AI models
- YOLO detection — PPE, people, objects
- Record & Replay system — dataset collection for all projects
- Controller folder — behavior state machine

7.2 What Changes Per Project

- LLaVA system prompt — defines persona, language, task rules
- YOLO classes — different detection targets per use case
- Patrol route — different waypoints per facility
- Voice persona — name, language, response style
- Alert conditions — different violation rules per client

Marcus is the foundation. Every future YS Lootah Technology humanoid robot project builds on this platform. YS Lootah Technology | Kassam | April 2026