Final Internship Review On ZED 2i AI CAMERA & Jetson Nano

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INTERNSHIP MENOTR'S

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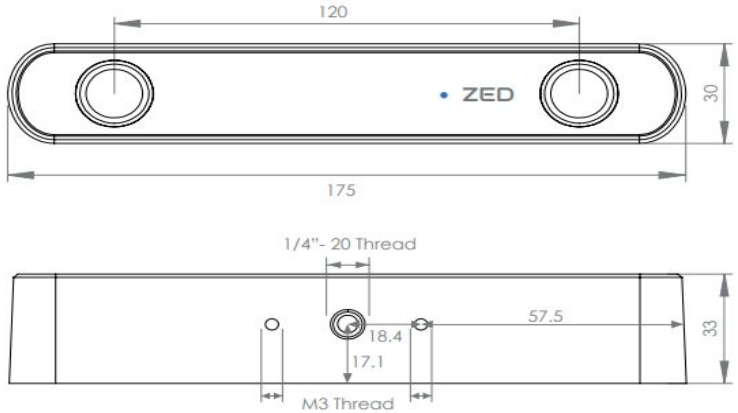
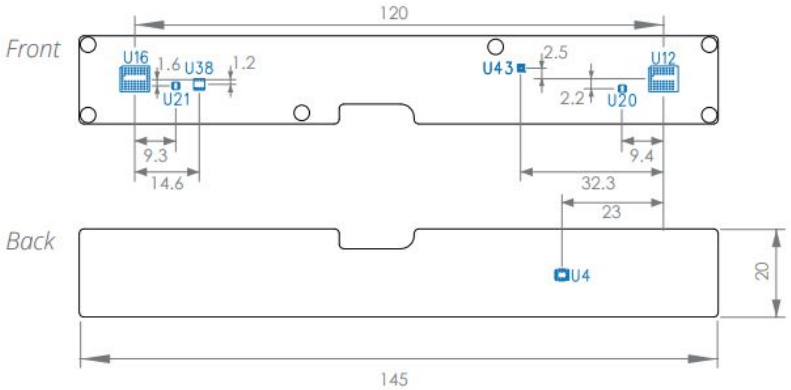
ARCHITECTURE



- Dimensions: 175 mm × 30 mm × 33 mm
- Weight: 229 grams
- Stereo baseline: 120 mm
- Depth range: to 35 meter with 4 mm lens
- < 1% of depth error
- Sensor resolution: 2 × 4MP (2688 × 1520 each)
- Field of view is up to 120 degrees—2.1mm lens
- Lens option: 2.1mm wide/4mm zoom
- Built-in polarizer filter

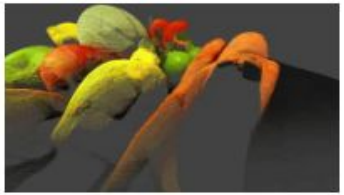
- Environmental rating 1p66
- All-aluminum, sealed enclosure
- Mounting thread: ¼” 20 UNC + dual m3
- Integrated 9 dof imu
- Additional sensors include temperature sensors & barometers.
- Connectivity through USB Type-C
- Power Consumption: 5V @ 380mA (~1.9W)

Sensors Diagram



ADVANCED TASK IT CAN PERFORM

DEPTH SENSING



OBJECT DETECTION

BODY TRACKING

PLANE DETECTION

POSITIONAL TRACKING

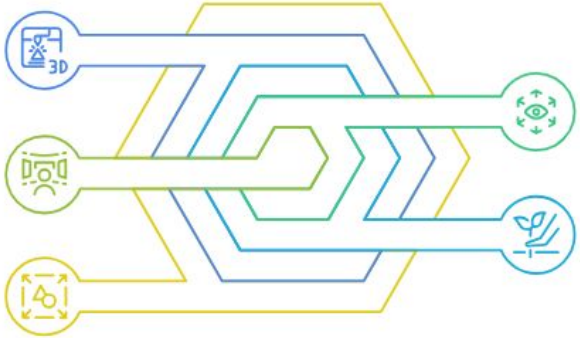
GEO TRACKING

SPATIAL MAPPING

MULTI CAMERA FUSION

DEPTH SENSING

Depth Camera Capabilities



Depth Representation

Depth Representation in the form of 3D Point Cloud

Depth Capture

Depth can be captured at longer ranges, up to 35m.

Depth Accuracy

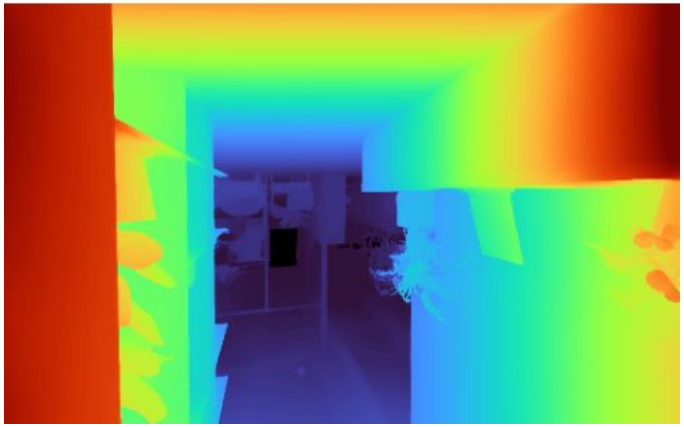
Precision of depth measurements is typically around 1% to 9%

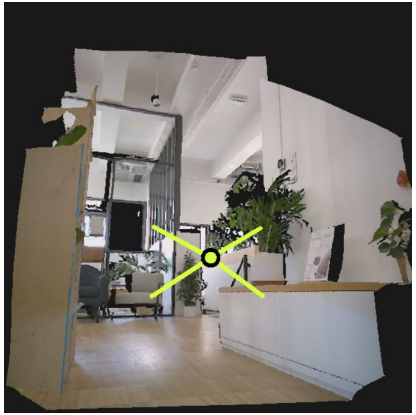
Field of View

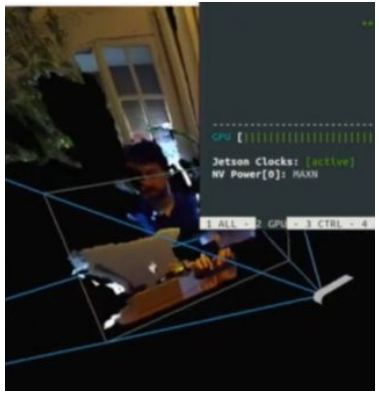
Field of view is much larger, up to 110° (H) x 95° (V).

Environmental Versatility

The camera can works indoors & outdoors







Application of Depth Camera in Child Detection

Height Estimation

Can be used to distinguish children from adults. with the help of Depth Derived Height

Occlusion Detection

Identifies partially hidden children using shape + depth.

3D Localization

Determines the child's precise location in 3D space with the aid of point visulaization.

Crowd Handling

Isolates children from adults in crowded scenes preventing overlaps.

Environment Adaptability

Functions well in various lighting conditions, even solving issues of night vision.

Depth Viewer

StereoLabs*

LIVE HD720 30 ID: ZED 2I - CAM0 SN: 37901724

VIEW LEFT

MEASURE DEPTH

POINT CLOUD

- DEPTH SHADING
- LIDAR VIEW
- IMU ORIENTATION
- CONFIDENCE 95

FPS: CAMERA: 30HZ | DEPTH: 30HZ

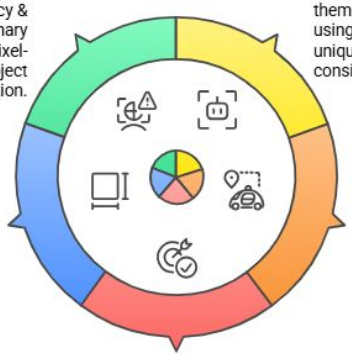
V5.0.7

Object Detection

Object Tracking System Features

Confidence Scoring & Segmentation
Assigns a confidence score (0–100) for detection accuracy & Generates a binary mask for precise pixel-level object segmentation.

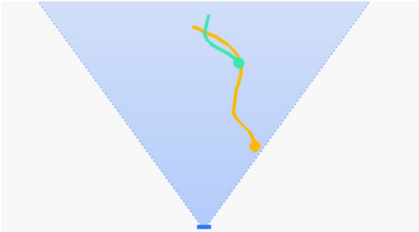
Object Detection & Classification
Detects objects and classifies them as "person" or "vehicle" using onboard AI & assigns a unique ID for each object for consistent tracking over time.



Bounding Box & Size estimation
Outputs 2D bounding boxes in the image and 3D bounding boxes in real space. Calculates object dimensions: width, height, and length in meters.

3D Localization & Movement
Estimates real-world position [x, y, z] and velocity [vx, vy, vz] of each object & Determines action state (Idle or Moving) to understand object behavior

Object Status Tracking
Monitors the object's tracking state: Ok, Searching, Off, or Terminated & Helps assess if the system is actively following or has lost the target.



Child Detection Features

Object Status Tracking
Assigns a unique ID to each person, indicating if the child is being followed or lost.

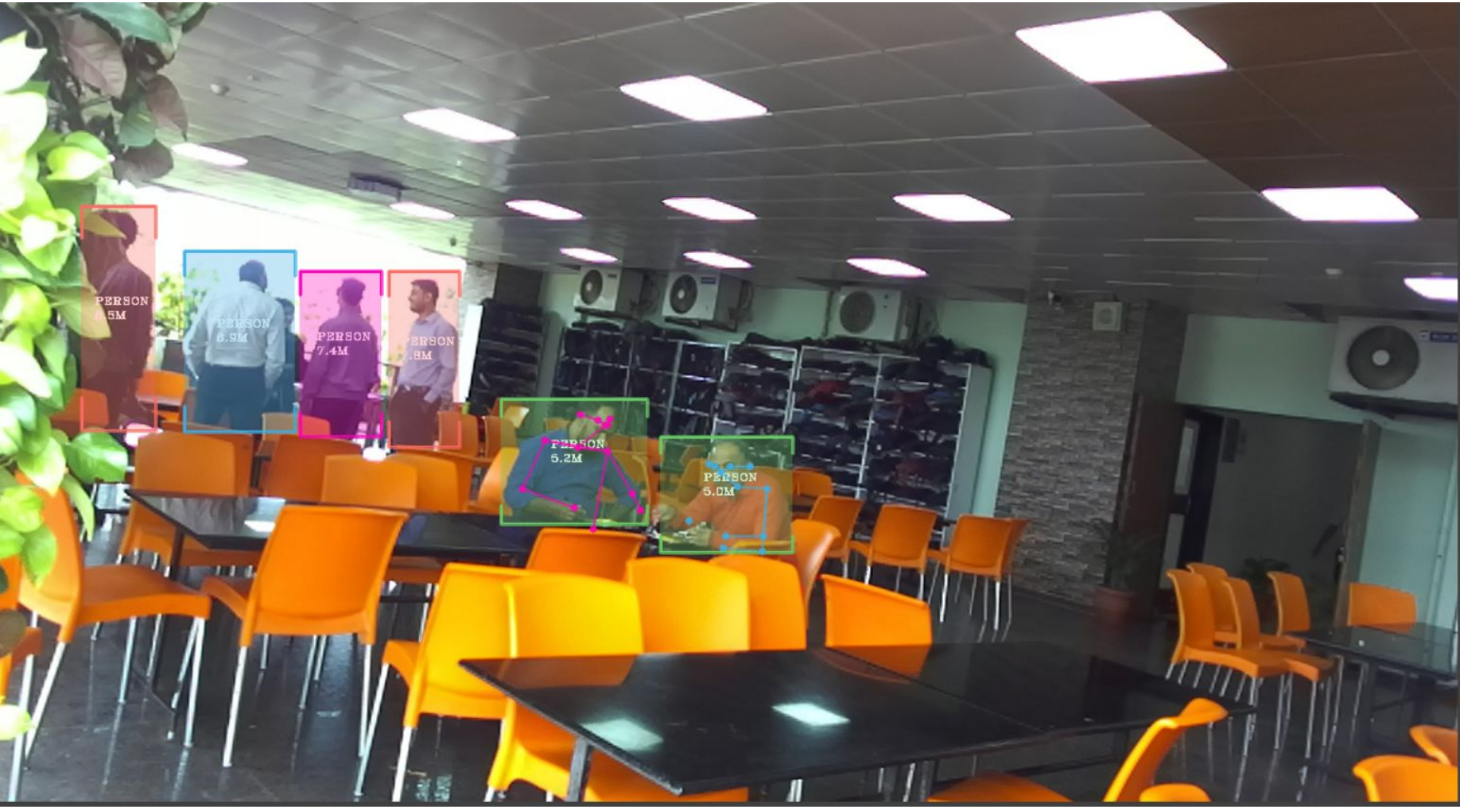
Bounding Boxes
Creates 2D and 3D boxes around the child for detection and visual overlay. Ignores irrelevant objects.

3D Localization
Provides real-world coordinates to determine the child's location in space and detects movement.

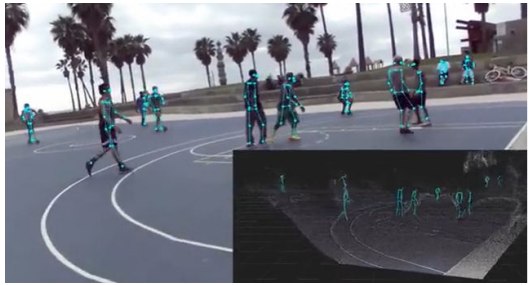
Body Size Estimation
Measures height, width, and length to differentiate children from taller adults.

Confidence Scoring
Outputs a 0–100 score to show confidence in each child detection.

Pixel-Level Masking
Generates binary masks to segment the child from complex or crowded backgrounds.


PERSON
6.5M
PERSON
7.4M
PERSON
5.2M
PERSON
5.0M

Body Tracking



AI-Driven Body Tracking

Keypoint Detection

AI extracts skeletal keypoints in 2D and 3D, representing joints from 18 keypoints following the COCO18 skeleton representation.

Head Positioning

AI calculates precise 3D head center position.

Confidence Scoring

AI assigns confidence values to detected body points.

Head Bounding Box

AI defines 2D and 3D bounding boxes around the head for facial and identity tracking.

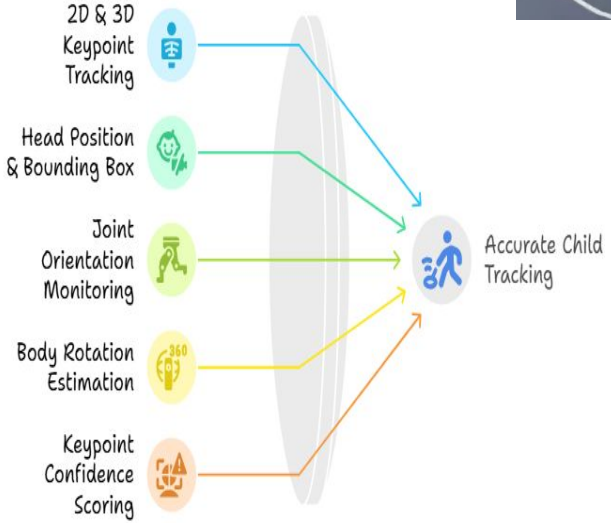
Joint Motion Understanding

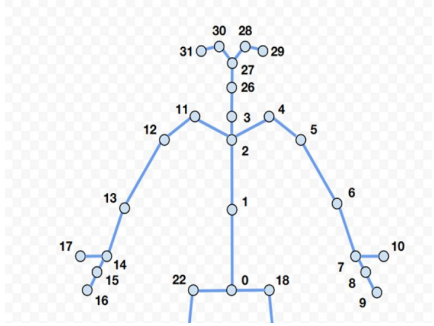
AI tracks the local position and orientation of body joints in 3D using AI.

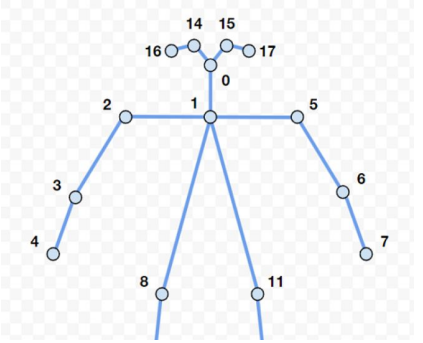
Global Orientation

AI estimates the global rotation of the body's root joint help understand the direction of child facing

Application in Child Movement Analysis







Spatial Mapping

Spatial Mapping Capabilities

Custom Resolution & Range

Adjusts resolution for optimal mapping at long distances from 1–12 cm (detail) and 1–12 m (distance) to suit application needs.

Real-Time Mapping

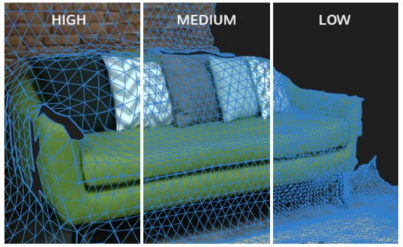
Continuously scans and updates 3D maps in both indoor and outdoor environments.

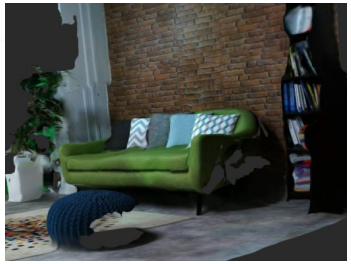
Mesh Filtering

Three presets (High, Medium, Low) to clean, simplify, and optimize 3D models.

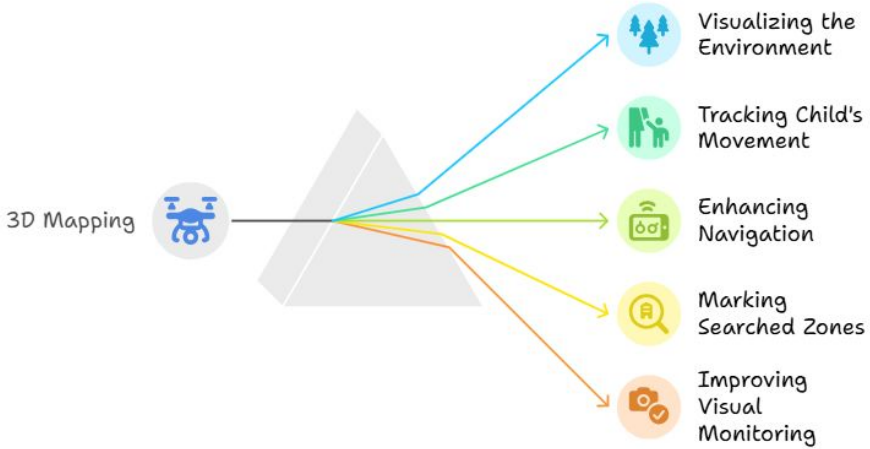
Textured Models

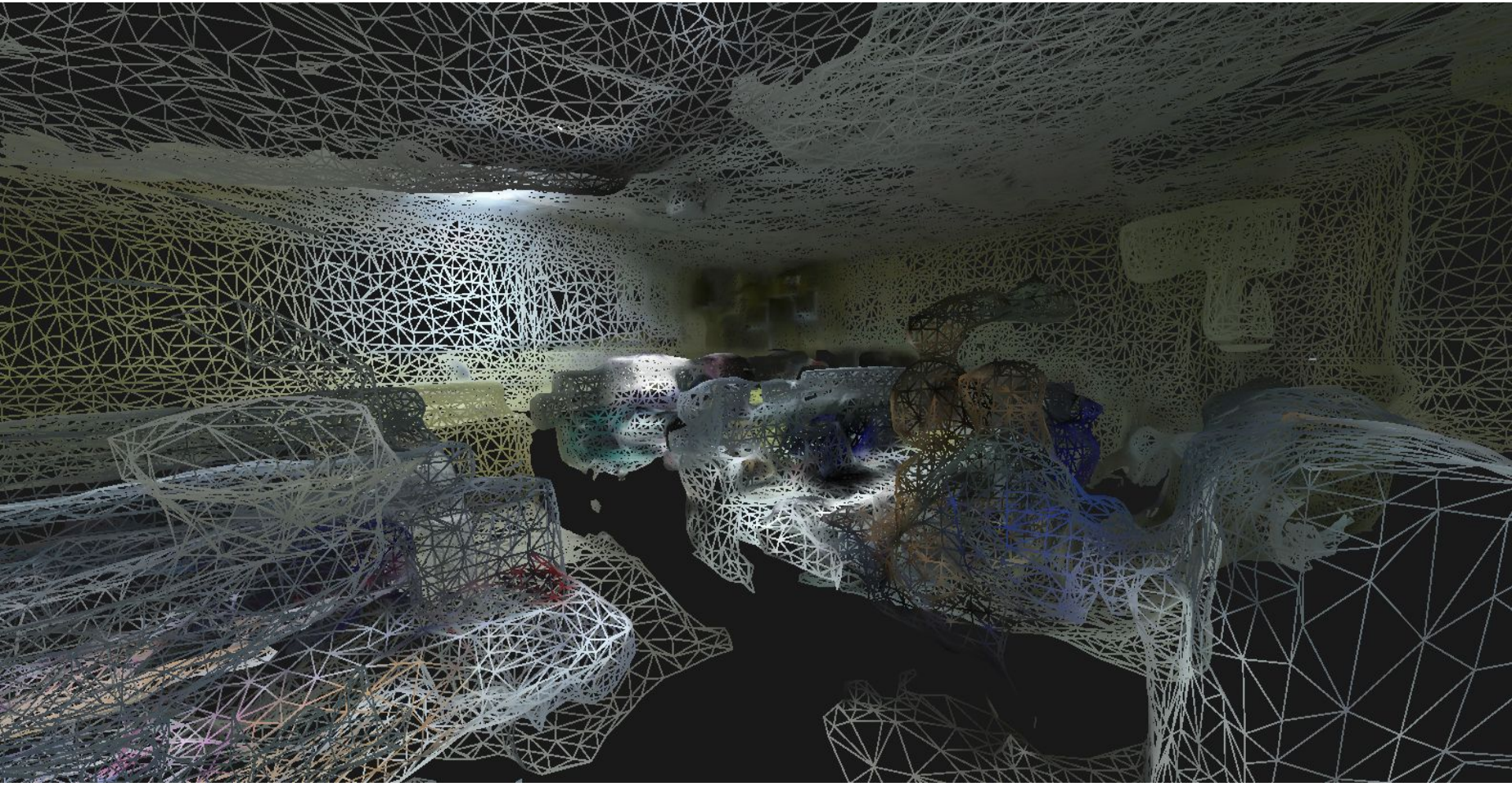
Uses camera images to apply realistic textures to 3D surfaces for visual accuracy.





Application of spatial mapping in child detection system





Other features

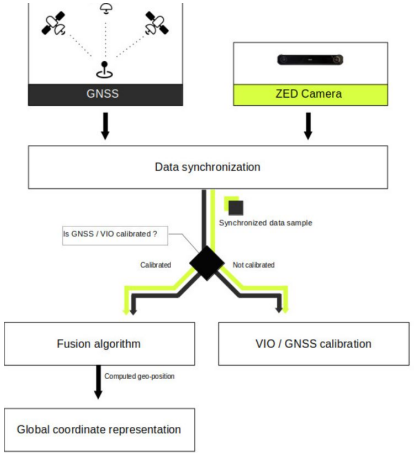
GEO TRACKING CAPABILITIES

Geo-Aligned Detection

Allow's GNSS data access for robust localization capabilities.

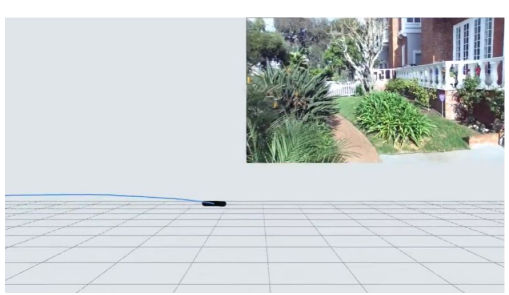
Area Memory Support

Enables consistent positioning by supporting area memory and map reloading.



AI Powered Tracking

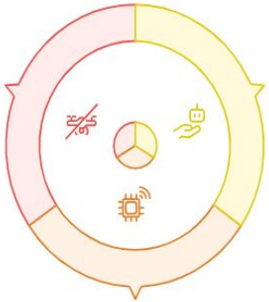
Anchors tracking using AI and visual-inertial SLAM.



Positional Tracking Capabilities

Auto-Relocalization

Recovers tracking automatically



Six Degrees of Freedom

Offers Position (X, Y, Z) + Orientation (Roll, Pitch, Yaw) tracking in 3D space.

AI-Powered Tracking

Integrates AI-driven visual odometry and IMU data (ie gyroscope + accelerometer) for stable tracking.

Plane Detection Capabilities

Detect Areas

Helps detect areas where a child might be seated, lying, or hidden (e.g., floor, bench, wall base).

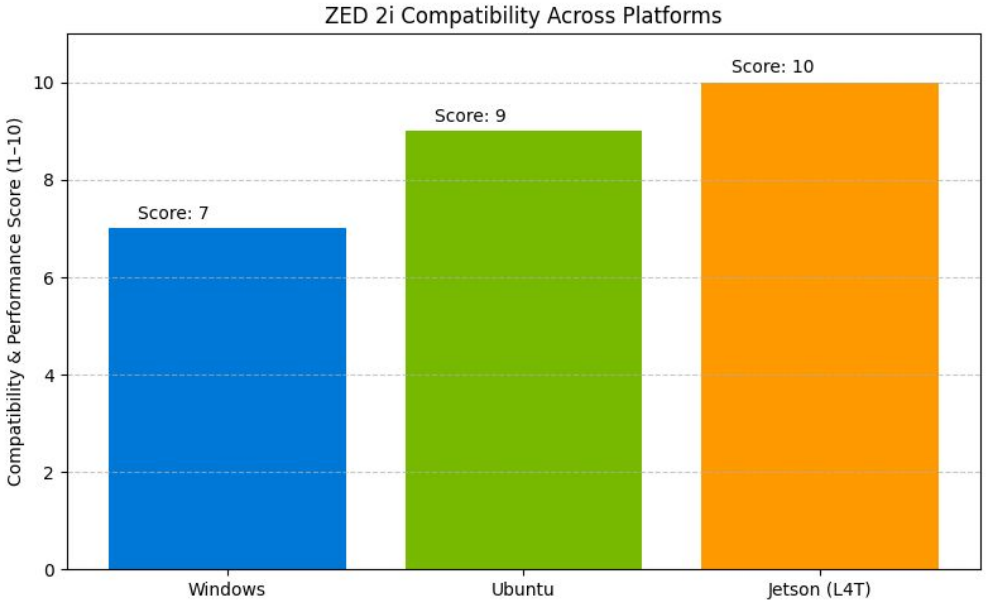
Detect Surfaces

Detects horizontal and vertical flat surfaces from the 3D point cloud in real time.

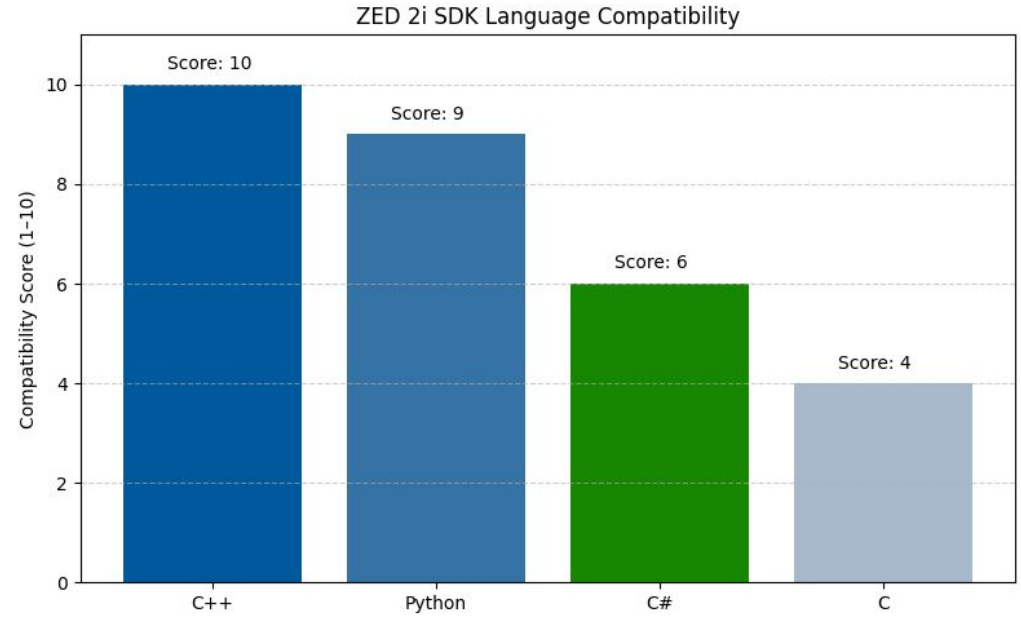
AI Filters Data

AI filters noisy data and isolates reliable planes using geometry and depth fusion.

Compatibility with Supported Platform

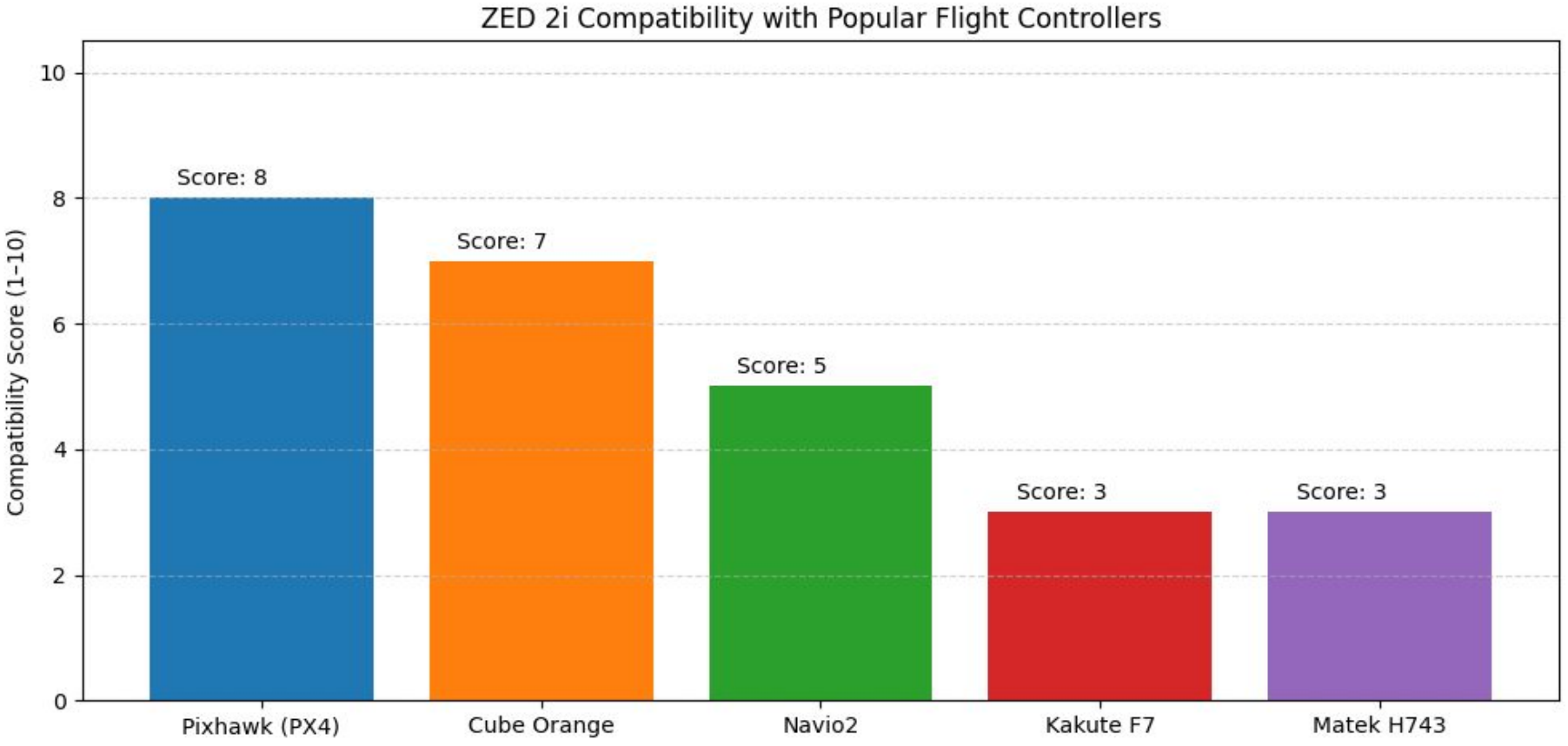


Compatibility with programing language

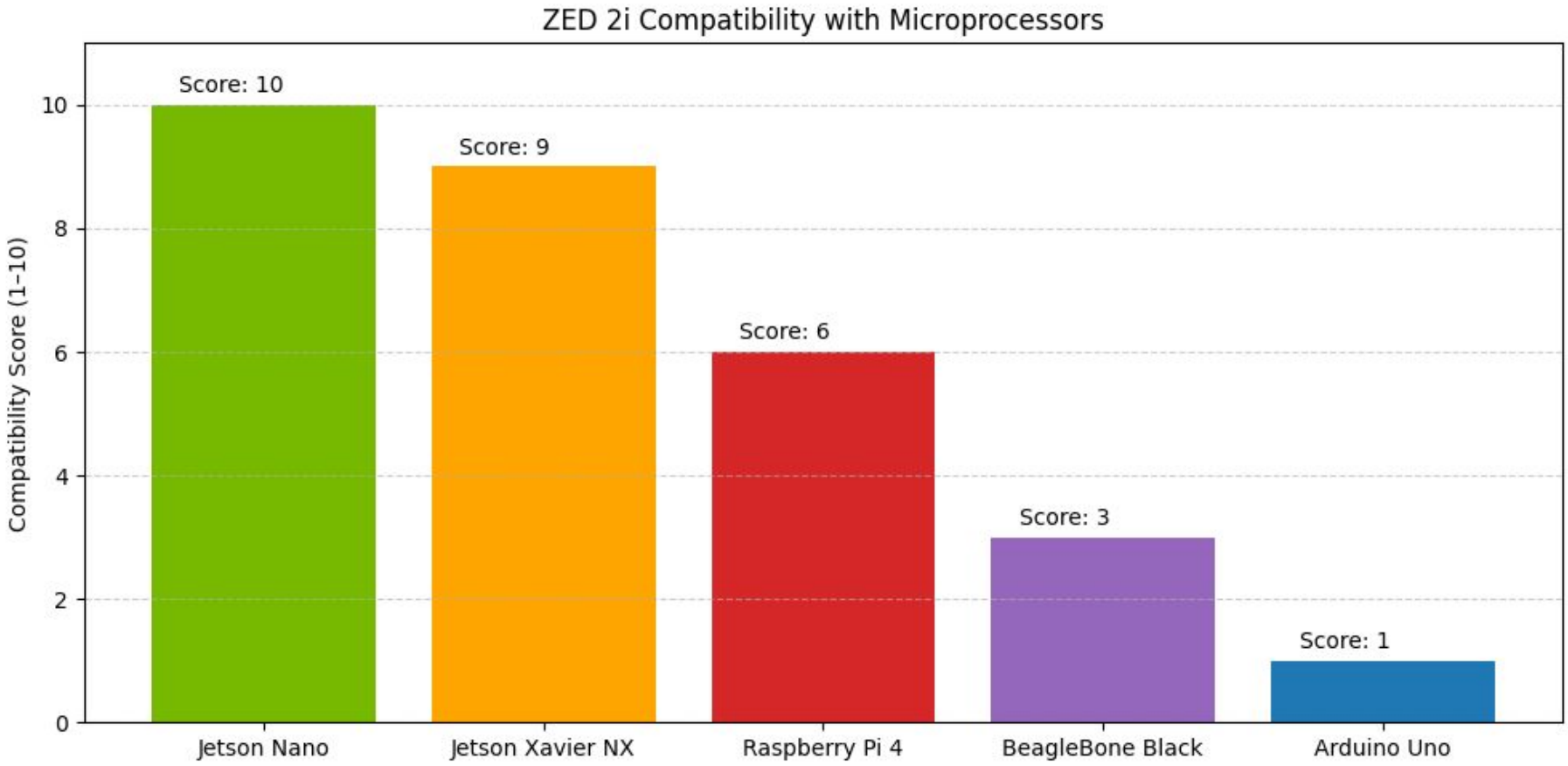


*The scores are Derived based on official SDK/API support

Compatibility with Flight controllers



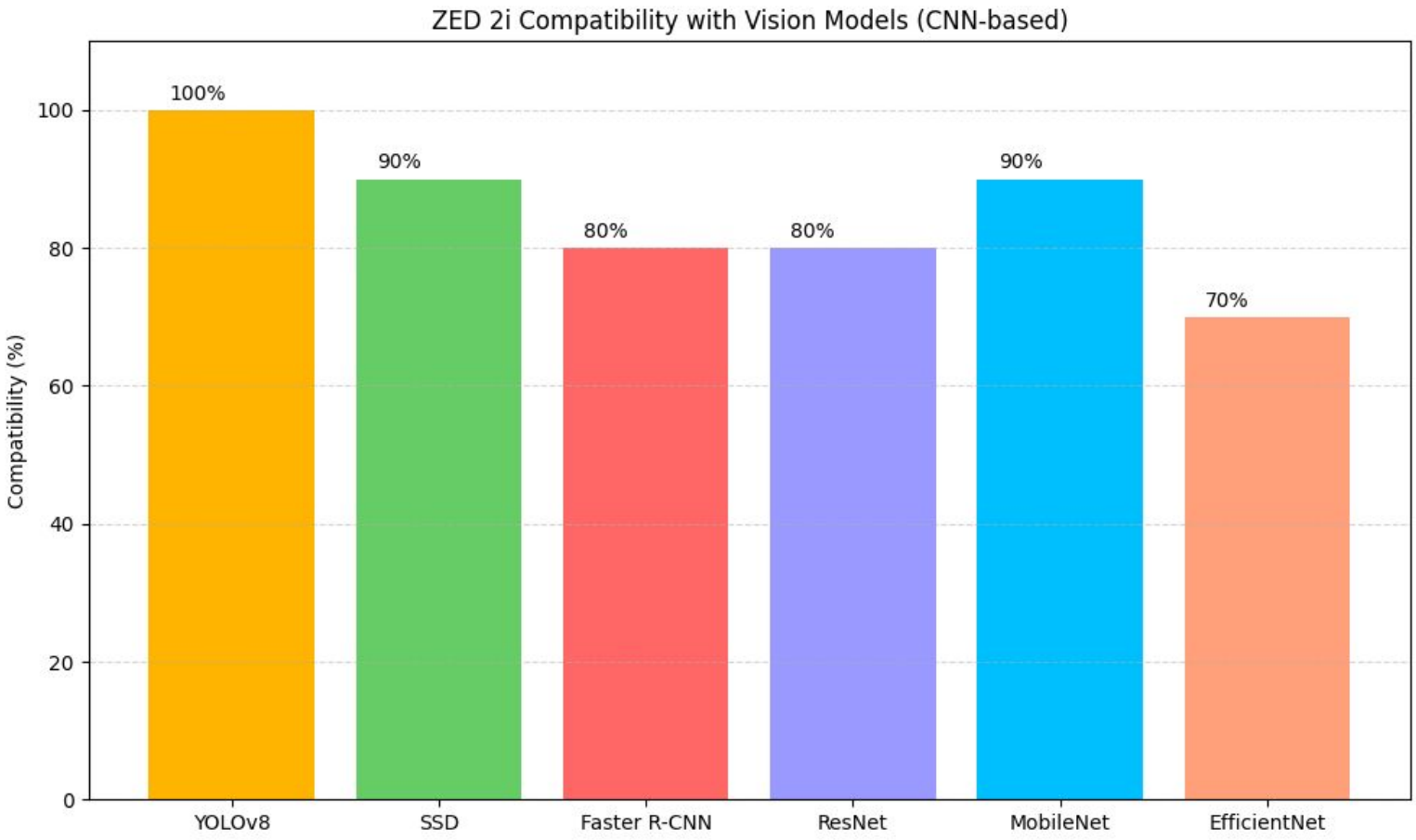
Compatibility with Microprocessors



Other Third Party Libraries & Environment

UNITY	UNREAL ENGINE 5	OPENCV	ROS	ROS 2
				
PYTORCH	**YOLO**	**MATLAB**	**ISAAC SIM**	**TOUCH DESIGNER**
				

AI Model's Compatibility Based on Integration Factor



Basic Requirements for Jetson nano

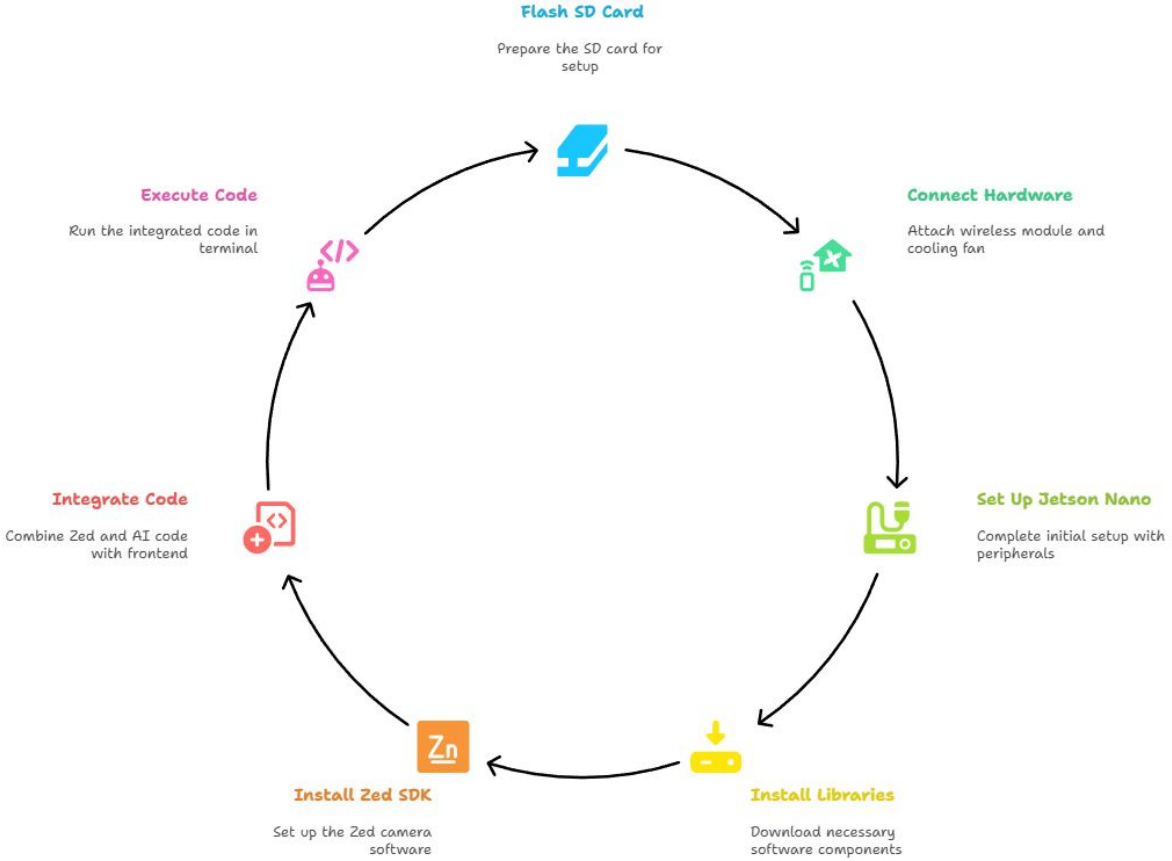
NVIDIA Jetson module and reference carrier board

microSD card (32GB UHS-1)

Ac8265 wireless nic module

Micro-USB power supply

Implementation steps




Thank
You