

Webinar

Smart sensing: How 60GHz radar
increases safety in robotics

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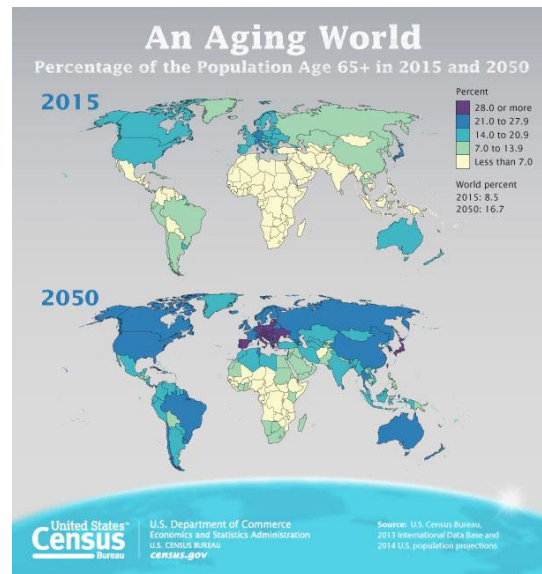
Commercial Director, Algorized



How to help global labor shortages

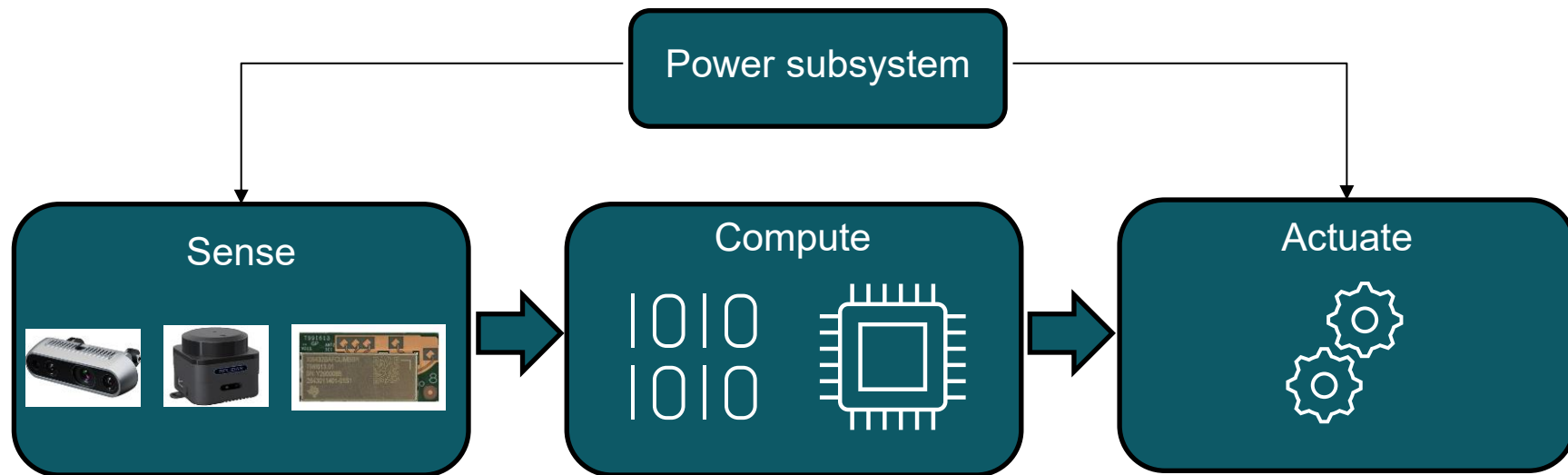
- Rampant labor shortages across key industries can be addressed with robotics. Key areas include:
 - Manufacturing and logistics
 - Healthcare
 - Skilled Trades
- Advances in physical AI and humanoids are making this a reality
- Humanoids CAGR 76%, 300K units in service by 2030 [1]

Robots are alleviating labor shortages



Source: United States Census Bureau
<https://climatechange4fork.blog.brooklyn.edu/2023/03/07/population-decline-impacts/>

Robotics block diagram



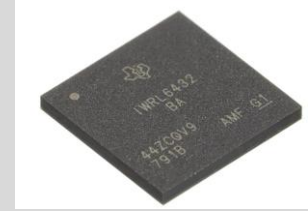
What is mmWave radar?



1886: Discovered radio waves could detect metallic objects

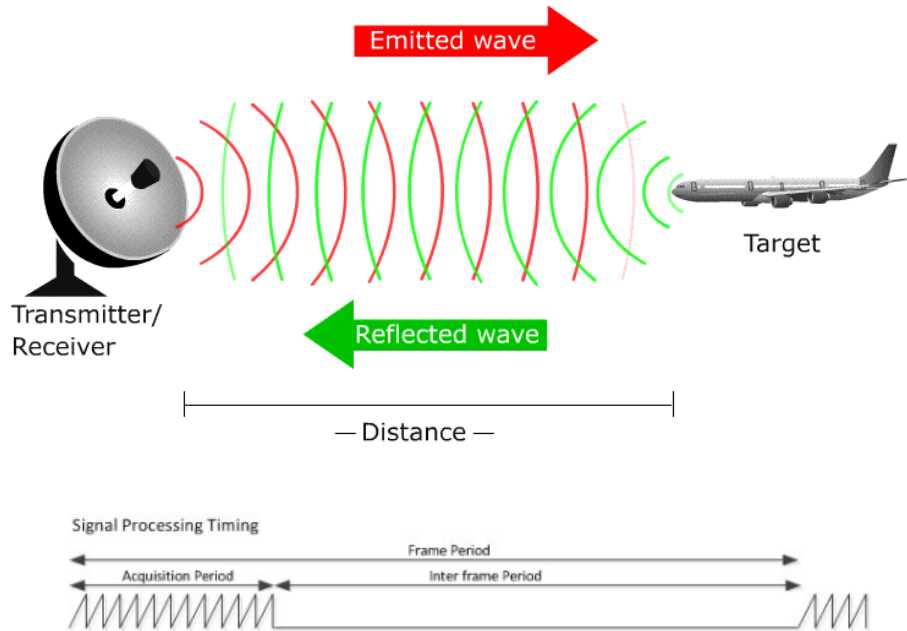


1970: Adoption of radar in vehicles for collision avoidance



Today: TI's integrated radar system on chip (SOC) measuring 11 x 7 mm

What is mmWave radar?



Key features

- High frequency (60/77 GHz) electromagnetic waves
- Can detect **range**, **velocity** and **angle**
- Multiple 'Chirps' in a single frame allow instant velocity detection
- Multiple transmit antenna per radar allow increased range and better angular resolution

When to use mmWave radar?

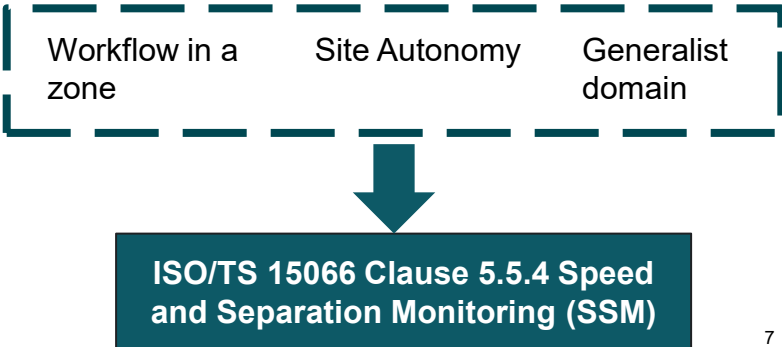


	2D Lidar	Camera	Radar
Principle of Operation	Active light based	Passive light based	Active radio waves
Range	0 – 200 m	0 – 150 m	0 – 250 m
Accuracy	2 – 5 cm	Variable	2 – 10 cm
Angular Resolution	0.10° – 0.15°	~ 0.01° or finer	1.0°-15.0°
Environmental Robustness	Impacted	Impacted	Unaffected
Transparent Materials	Missed Detections	Missed Detections	Able to Detect
Price	> \$10	> \$10	< \$10
Average Power Consumption	> 2W	>2W	< 2W

When to use mmWave radar? Continued

Beijing Humanoid Robot Innovation Center T/CIE 298-2025

	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
ADAS	No Autonomy	Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Autonomy
Humanoid	Teleoperation	Basic skill in a cell	Single task family	Workflow in a zone Site Autonomy Generalist domain		



ISO/TS 15066 Clause 5.5.4 Speed and Separation Monitoring (SSM)

Where is radar used today in the factory?



Industrial Robot



Mobile Robots



Collaborative Robot

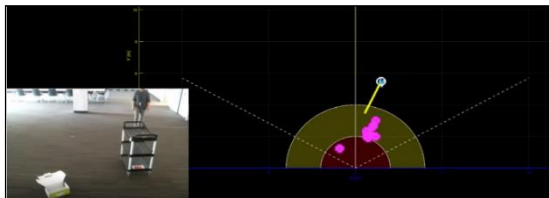


Humanoid Robots

Evaluation – How to get started

Stationary Robot:

Defines **safety access zones** around stationary robots that enhance **efficiency**



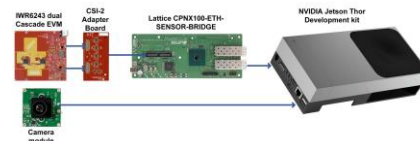
Mobile Robot:

Provides intelligent omnidirectional monitoring and collision prevention.



Camera Radar Sensor Fusion:

Improved detection, classification, localization, and tracking for navigation



Tools & Resources

1. Watch [Area Scanner use case video](#)
2. Evaluate the performance
 - a) [IWR6843AOPEVM](#)
 - b) [Area scanner Lab with static object detection](#)
 - c) [Radar vs Lidar Experiment](#)

Tools & Resources

1. Watch [AGV use case video](#)
2. Evaluate the performance
 - a) [IWR6843AOPEVM](#)
 - b) [360° Safety Bubble with ROS Lab](#)
 - c) [IEC 61496-5 Tests](#)
 - d) [Sense and Avoid Lab](#)

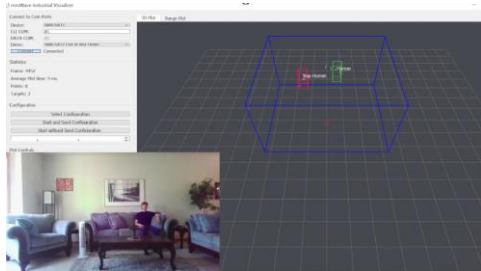
Tools & Resources

1. Read [Real Time AI Raw Sensor Fusion](#)
1. Evaluate the performance
 - a) [IWR6843AOPEVM](#), [NVIDIA Jetson Thor](#), [AM62A](#)
 - b) [IWR6843AOP + AM62A Edge AI Camera Radar Fusion Demo](#)

TI mmWave Offering for Edge AI

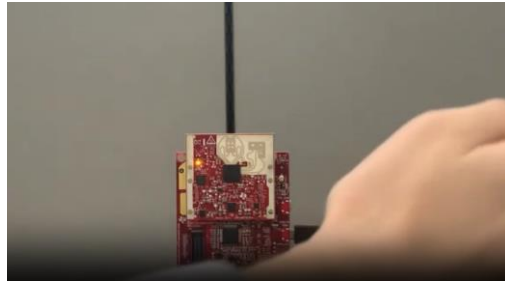
Human vs non-human Classification:

Using microdoppler radar identifies humans vs other moving objects



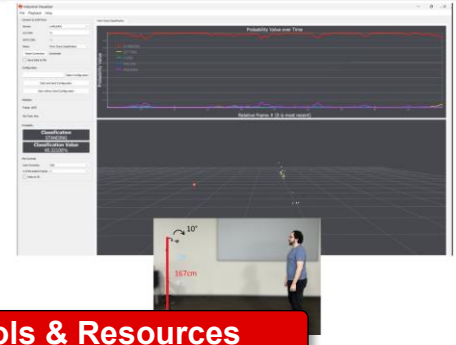
Gesture Recognition:

Using training data, user can classify gestures such as hand movements



Fall Detection and Pose Estimation:

Detect if a person is sitting, standing or fallen based on micro doppler



Tools & Resources

1. Read Application Brief [Understanding Artificial Intelligence and Machine Learning in Radar Applications](#)
2. Evaluate the performance
 - a) [IWRL6432BOOST EVM](#)
 - b) [Human vs non-human Classification Demo](#)

Tools & Resources

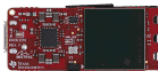
1. Watch video on [60GHz Gesture Recognition](#)
2. Evaluate the performance
 - a) [IWRL6432BOOST EVM](#)
 - b) [Gesture with Machine Learning Demo](#)

Tools & Resources

1. Watch video on [Intelligent fall detection with mmWave Radar](#)
2. Evaluate the performance
 - a) [IWRL6432BOOST EVM](#)
 - b) [Pose and Fall Estimation Demo](#)

How to get started – Hardware

Reference design



IWR6843AOP



IWRL6432

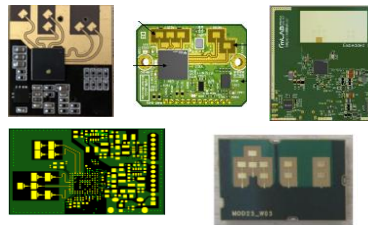
- Full reference design including radar, power management, passives, antenna etc.
- TI provides design files, layout, gerber, pcb stack, simulation and test results
- IWR6843AOP reference design
- IWRL6432 reference design

Evaluation Module (EVM)



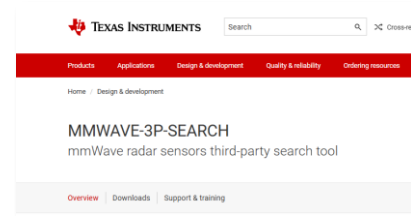
- Antenna only reference design
- Pre-validated antenna design from a TI EVM or non validated antenna design from TI's radar database
- TI provides
 - Layout
 - Dfx files
 - Simulation results
 - PCB stack-up
 - Design reviews
 - Radome reviews
 - EVM test results

System-on-module



- Pre-qualified module including power management, passives, PCB, Xtal etc.
- Customizable antenna designs
- Various sizes and radar performance

3rd party network



New TI partner search tool:

- Go to ti.com/tool/MMWAVE-3P-SEARCH to easily find radar partners to fill development gaps and accelerate time to market

Partners include:

- Turnkey designs – complete hardware & software
- Services – hardware & software design services

ALGORIZED

Learn more at [TI.com/radar](https://ti.com/radar)

ALGORIZED

Nervous System for Physical AI



OEM PARTNERSHIP WITH
KUKA

BACKED BY
amazon

LOCATIONS



Innovation with safety at its core

ALGORIZED CONTACTLESS MONITORING
Vital Signs & Position



VITAL SIGNS

♥ HEART RATE
—

~ RESPIRATION
—

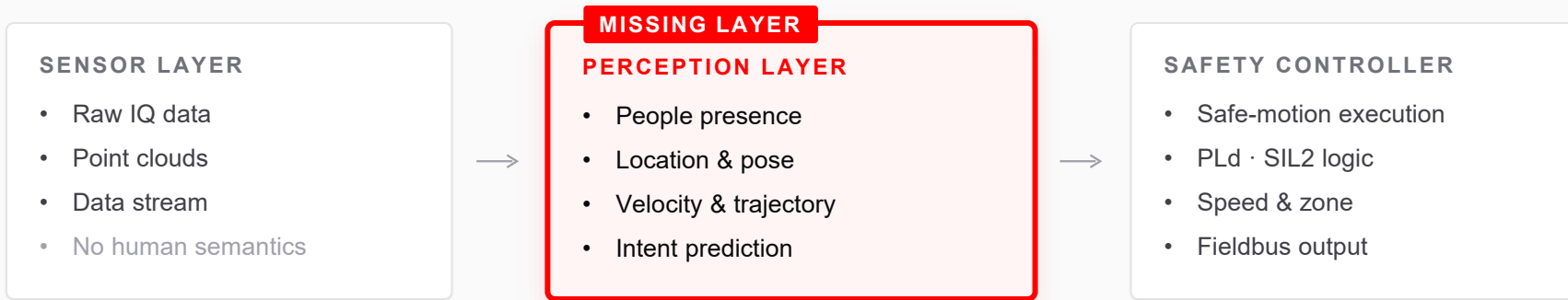
POSITION

■ COORDINATES
+0.2;1.5
X ; Y - metres from sensor

■ DISTANCE
1.5_m
range to subject

INTERNAL - FOR ALGORIZED USE ONLY SETTINGS

Gap between sensor and controller



Without this layer, sensors produce data — **not safety decisions**

| Speed & Separation Monitoring requirement

ISO/TS 15066 SSM requires answers to five questions.

QUESTION	SENSOR OUTPUTS	WHAT SSM NEEDS	STANDARD
Where is the human, exactly?	Point cloud	Body-outline tracking, limb-level position, ≤ 100 ms	ISO/TS 15066 §5.5.4
How fast are they moving?	Doppler	Per-body velocity vector for PSD	ISO/TS 15066 §5.5.4
Where are they going next?	Reactive only	Approach vector + estimated contact zone	ISO 13855:2024
Is it a human or a machine?	Point cloud	Human / machine classification	ISO 10218-2:2025
Is the output safe enough to act on?	Not certified	Certified safety output	ISO 13849 PLd · IEC 61508 SIL2

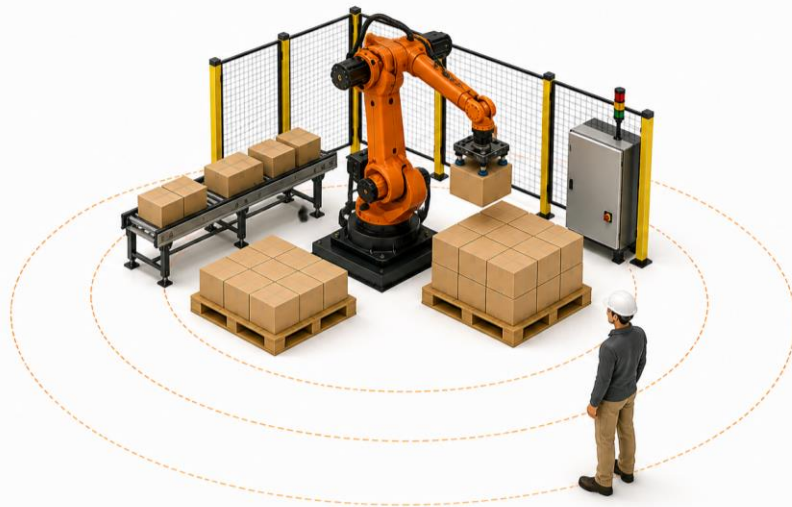


| Robot Systems - 01

Fixed Robot Systems

GOAL

Maximize
throughput



TOP-DOWN VIEW

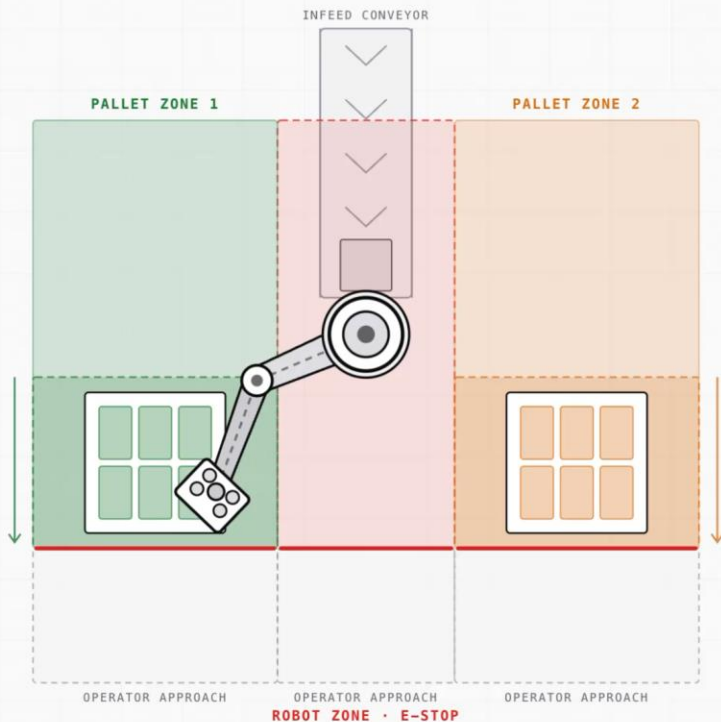
Cell safety zones

Robot working

Pallet zone 1

Arm speed

1.8 m/s



CAM-PAL-01 • REC



SAFETY STATE

E-stop

Robot zone breached — motion halted

Reduced speed

Pallet zone broken — slow until reset

Aware

Operator approaching, presence tracked

ACTIVITY

6 events

Cleared — worker PAL-W1 exited area

Distance 5.8 m

14:32:26

E-stop — worker PAL-W1 broke robot zone

Distance 3.7 m

14:32:20

Tracking — worker PAL-W1 approaching Pallet Zone 1

Distance 6.0 m

14:32:00

| Robot Systems · 02

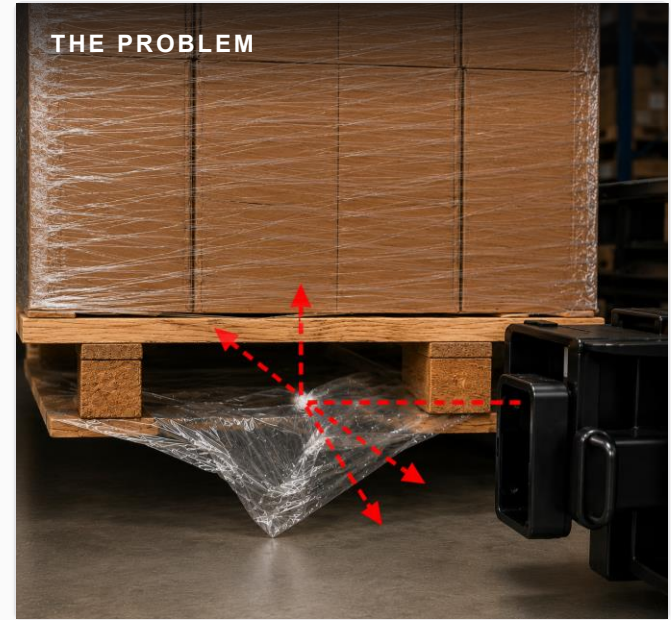
Mobile Robot Systems

GOAL

Minimize false positives

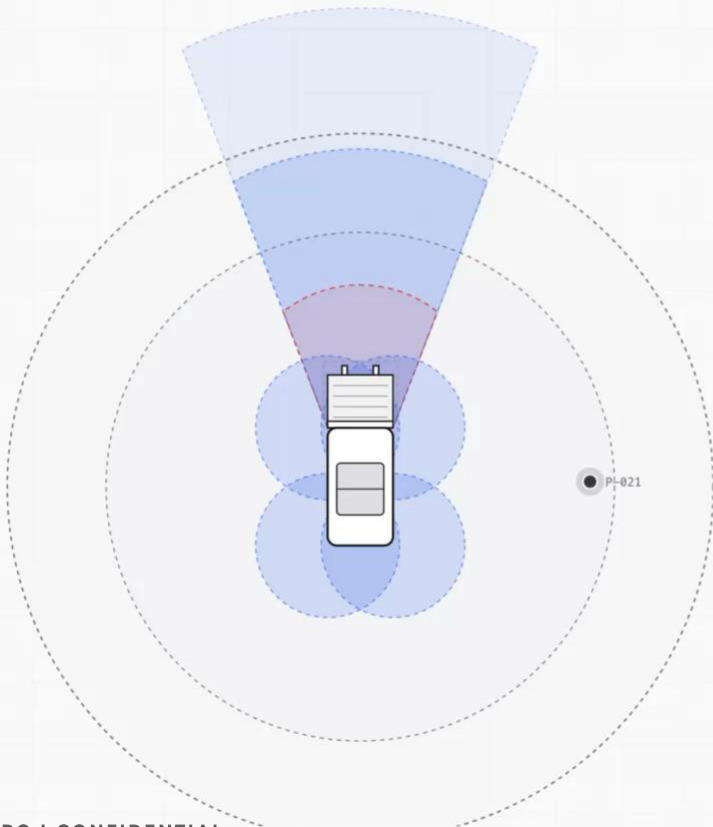


| Context-aware mobile robot behavior



TOP-DOWN VIEW

Live safety zones



ALGORIZED TECH INTRO | CONFIDENTIAL

CAM-01 ● REC



SAFETY STATE

Safety Zone

Inner Safety zone human detection

Adaptive

Speed reduced, operator alerted

Aware

Presence tracked, no action

ON

ACTIVITY

10 events

Cleared — Pedestrian P-014 exited area

Distance 7.8 m

14:32:00

Tracking — Pedestrian P-021 entered monitoring

Distance 5.4 m

14:32:12

Hard stop — Pedestrian P-014 inside Safety Zone

Distance 2.8 m

14:32:09

| Testing and validation with our partners



| Testing and validation with our partners



| Testing and validation with our partners



| Integration Path

IN

TI 6843AOP

Point cloud / raw IQ data

01

Algorized Lens

Signal cleanup and regularization

02

Algorized Foundation Model (AFM)

Edge-native inference — presence, intent, trajectory

03

Algorized Heads

Zone classification, speed trigger, threat level

OUT

Robot Control Policy

Aware / Adaptive / Stop



Product roadmap and certification path

NOW-2026

Gen 1 Integration

AFM human-presence sensing

H2-2026

Certification

PLd / SIL2 path

H1-2027

Gen 1 Safety Stack

PLd / SIL2 release target

2027+

Gen 2 Predictive

PLd Cat.3 runtime

GEN 1 · NOW

ACTIVE — ONGOING

Detection + Zones + Safety Trigger

- Human presence and location
- Body-level pose and velocity vector
- 3-zone adaptive response: Warn / Slow / Stop

DEVELOPER KIT

GEN 2 · 2027

IN CERTIFICATION PIPELINE

Trajectory Prediction + PLd Certification

- Probabilistic human intent prediction
- Approach vector + estimated contact zone
- Safety-certified output (TÜV-evidenced PLd path)



| Product · Developer Kit

01 · CONFIGURATION

Multi-sensor setup

- Safety-graded hardware (mmWave)
- Per-site calibration

02 · ZONES

Dynamic 3D safety zones

- Per-cell zone authoring
- Beyond the three standard envelopes

03 · TUNING

Model head training

- Use-case specific heads
- Site adaptation

04 · ANALYTICS

Fleet analytics

- Cross-robot human presence rates
- Safety / interruption / zone-trigger analytics only

05 · DEPLOYMENT

SI deployment tooling

- Provisioning & license assignment
- Rollout workflows



ALGORIZED

Nervous System for Physical AI

Algorized.com





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