This document describes the advantages of a LiDAR sensor versus camera, radar and thermal system for use in security and object tracking applications.

LIDAR VS VIDEO SURVEILLANCE CAMERAS

Benefit No. 1

Accurate 3D Mapping & Distance Measurement

- LiDAR emits laser pulses and measures the time it takes for them to bounce back, creating a precise 3D "point cloud" of the environment.
- This allows **exact distance calculation** to every object in view, regardless of lighting or texture.
- Camera systems only produce 2D images. While depth can be inferred via stereo vision or AI models, it's less accurate and can be error-prone.

Benefit No. 2

Works in Complete Darkness or Harsh Lighting

- LiDAR operates by sending its own light (laser) source - it doesn't depend on external lighting.
- It's fully operational in complete darkness, dusk, dawn, tunnels, or shadowed areas.
- Camera performance declines sharply in low-light unless supplemented by artificial lighting, which adds cost and complexity.

Benefit No. 3

Privacy-Preserving

- LiDAR data consists of anonymous 3D point clouds, which represent objects and people as blobs or outlines.
- It provides functional detection and tracking without identifying facial features or license plates, reducing legal and ethical concerns.
- Ideal for GDPR or CCPA compliant security setups in public or semi-public environments (e.g., airports, campuses, office buildings).

Benefit No. 4

Reliable Intrusion Detection & Tracking

- LiDAR can detect size, speed, and direction of movement in real time, which improves false positive rejection (e.g., animals vs. people).
- Zoning is more precise: LiDAR can detect if someone is climbing over a fence or crawling under one - things camera analytics might miss.
- Cameras can be deceived by occlusion, changes in lighting, or camouflaged movement.

Benefit No. 5

Robust in Adverse Weather and Conditions

- LiDAR systems can penetrate fog, rain, dust, smoke, and even partial obstructions (like mesh fences).
- Cameras can become nearly useless under such conditions, with blurred or obscured views.
- Especially critical for outdoor perimeters, industrial sites, or wildfire zones.

Benefit No. 6

High Update Rate (Low Latency)

- LiDAR sensors typically scan and update tens to hundreds of times per second, making them responsive to fast-moving intrusions.
- This is essential for real-time threat detection and triggering alarms with minimal lag.
- Cameras can suffer from motion blur or low frame rates in challenging settings.

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LIDAR COMPARED TO THERMAL VIDEO SURVEILLANCE CAMERAS

Less Processing Power

- LiDAR outputs a structured 3D point cloud with data that is depth-aware and noise-free. This requires a lot less processing power to detect and to track objects.
- LiDAR can use edge-processing to minimize total cost of ownership.
- A camera system requires a high resolution RGB image with high framerate to track object which requires a lot more processing power to track and identify objects while having the risk of degrading performance in poor lighting condition.

Benefit No. 1

3D Spatial Awareness (Depth and Positioning)

- LiDAR delivers real-time 3D point clouds, meaning every detected object has an exact location in space (X, Y, Z coordinates).
- This allows for precise intrusion zone detection, elevation tracking (e.g., climbing), and multi-object separation.
- Thermal cameras provide 2D heat maps - there's no depth perception or reliable size estimation unless objects are calibrated against known heat signatures and distances.

Benefit No. 2

Higher Classification Accuracy (Non-Heat Based)

- LiDAR classifies objects based on shape, size, movement pattern, and location, making it more reliable for distinguishing people, vehicles, and animals.
- Thermal cameras rely on temperature differences, which can be fooled by:
  - Heated equipment or surfaces,
  - Sun-warmed objects,
  - Animals with similar thermal profiles as humans.

Benefit No. 3

Environmental Independence

- LiDAR performance is unaffected by ambient temperature or external thermal noise.
- Thermal cameras can struggle in hot environments where everything radiates heat, or during weather transitions (e.g., dawn/dusk) where thermal contrast is low.

Benefit No. 4

Better Zoning and Custom Area Detection

- With LiDAR, you can define precise virtual fences, 3D volumes, or zones of interest, even on multiple height layers (e.g., roof, ground, crawl space).
- Thermal cameras are limited to a 2D plane and have difficulty segmenting areas accurately - especially in crowded or layered environments.

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LIDAR COMPARED TO RADAR

Benefit No. 1

Much Higher Spatial Resolution

- LiDAR creates dense 3D point clouds, capturing fine details of object shapes, outlines, and surfaces.
- Radar typically offers coarse resolution, detecting the presence and rough location of objects, but not their exact size, shape, or silhouette.

Benefit No. 2

True 3D Mapping and Object Profiling

- LiDAR gives millimeter to centimeter-level depth accuracy and can reconstruct full 3D models of a scene.
- Radar gives range and velocity but generally lacks the spatial detail to build a usable 3D map.

Benefit No. 3

Better Object Differentiation in Cluttered Environments

- LiDAR can resolve multiple closely spaced objects (e.g., two people walking side-by-side) due to its higher angular and spatial resolution.
- Radar suffers from multi-path interference and signal blending, especially in environments with lots of metal or movement.

Benefit No. 4

Richer Data for AI and Analytics

- LiDAR outputs structured 3D data that is ideal for machine learning, computer vision, and behavior analysis.
- Radar provides sparse numerical data (range, speed, angle) that lacks the richness required for visual analytics or smart security features.

Benefit No. 5

More Intuitive and Visualizable

- LiDAR data can be visualized directly in a way humans understand (3D maps, moving objects in space, heatmaps).
- Radar data is abstract and harder to interpret, requiring additional processing to make it human-readable.