Luxonis
Product Guide

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Introducing Robotic Vision

Robotic Vision (or Robot Vision) is what enables robots to "see", allowing machines to identify, navigate, inspect, or handle parts or tasks. It combines camera hardware with computer algorithms to allow a robot to process what it sees, and then physically react appropriately based on its programming. It relies on other technologies, such as Computer Vision and Machine Learning, which are enablers for Robotic Vision.

'Robotic Vision' is often used interchangeably with 'Machine Vision', though the two terms do not strictly refer to the same thing. Like Robotic Vision, Machine Vision combines camera hardware with computer algorithms, but it isn't necessarily linked to robotics. Robotic Vision incorporates additional techniques and algorithms compared to Machine Vision, which enable the robot's ability to physically react to what it sees.

There are 5 key elements to Luxonis Robotic Vision:

Embedded

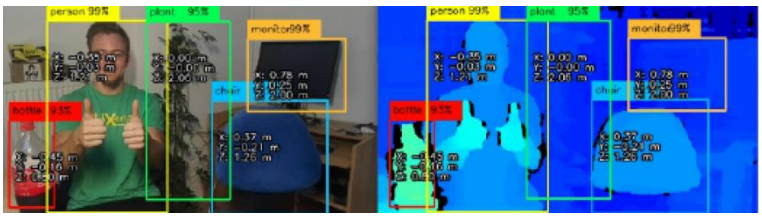
- Small size
- Low weight
- Low power
- Fast boot
- Keem Bay ready

Performant

- 48MP
- Up to 10 cameras
- High framerate
- Low latency
- IMUs, Microphones

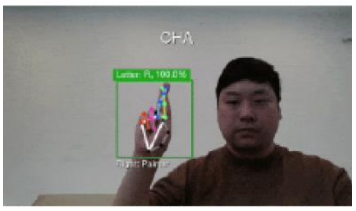
Spatial

- Disparity Depth
- LIDAR
- Time of Flight
- Structured Light
- Object Tracking



AI

- Neural Inference
- Object Detection
- Semantic Segmentation
- Face Recognition

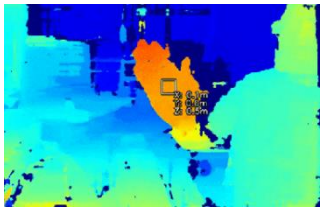
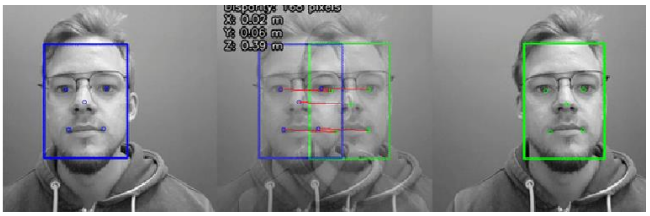
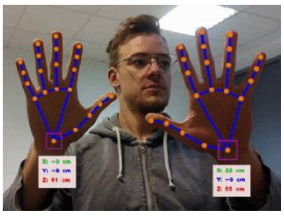
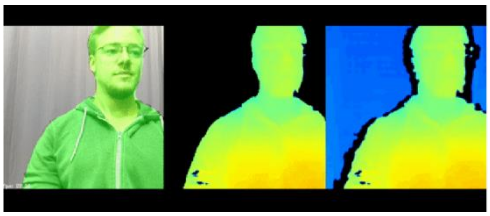


CV

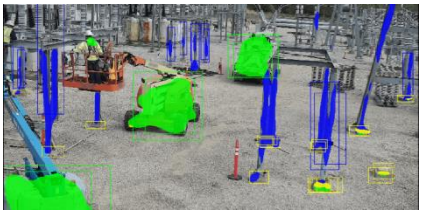
- Feature Extraction
- Motion Estimation
- Edge Detection
- Optical Flow

Applications and Features

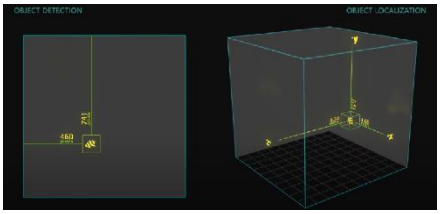
The below table provides example applications for the Luxonis DepthAI platform and OAK cameras, but the possibilities are extensive:

Spatial depth / location calculation	Stereo neural inference
	
Facial landmark detection & expression / emotion detection	**Hand tracking**
	
Human pose estimation	**3d landmark localisation**
	
Semantic segmentation of depth	**On-camera object detection**
	

Multi-class segmentation



Object localisation



Road land segmentation

Optical character recognition

Industries

Example industries that the Luxonis DepthAI platform and OAK cameras might be used within:

Retail

- In-store surveillance, tracking, and activity monitoring
- Autonomous checkout / scanning

Sports

- Object / ball tracking, speed and trajectory tracking, and performance monitoring
- Pose estimation for form improvement

Agriculture

- Pest detection and elimination robots.
- Growth / performance observation and measurement
- Crop size yield predictions

Drones / UAV

- Inspection of retail spaces
- Area or building mapping
- Recreational / competitive flying

Entertainment

- 3D engagement for children in locations such as museums, art galleries, or amusement parks
- Interactive gaming

Drones / UAV

- Inspection of retail spaces
- Area or building mapping
- Recreational / competitive flying

Healthcare

- Patient vitals monitoring; breath, heart rate, or activity
- Pose estimation for orthopaedics
- Disability assistance; sign language reading or area mapping for visually impaired

Autonomous Vehicles / Robots

- Forklifts; detect palette location for easier orientation and pick-up
- Lawn mowing; distinguish between grass and hazards
- Submarines; ocean floor mapping
- Recreational racing or puzzle solving

Industry & Manufacturing

- Safety monitoring. Track moving objects (eg. people/forklifts/robot arm), their trajectories, and signal a warning (alarm) or auto-shutdown if on a collision path
- Check whether workers are wearing safety equipment
- Quality assurance. Inspect products against pre-trained models to determine if they are made correctly
- Barcode and QR code scanning

Click the product images to go to the related Luxonis product page for more information:

USB Cameras

OAK 1

OAK 1 Lite

OAK 1 W

OAK D

OAK D Lite

OAK D S2

OAK D W

OAK D Pro

OAK D Pro W

PoE Cameras

OAK 1 PoE

OAK D PoE

OAK D S2 PoE

OAK D W PoE

OAK D Pro PoE

OAK D Pro W PoE

Development Kits (for connection of custom camera configurations and stereo baseline distances):

OAK-FFC-3P

OAK-FFC-4P

OAK-FFC-6P

OAK-D CM3

OAK-D CM4

Function Glossary

All OAK cameras offer standard functionality, plus additional functionality depending on the model. Below are top-level definitions of these functions, followed by a table detailing the cameras that offer them.

Neural Inference: run any Neural Network (NN) on the camera.

Warp/Dewarp: image distortion correction.

Object Tracking: following objects as they move through space in real time.

H264 / 265 Encoding: significantly reduces video bandwidth by up to 250 MPixels / second.

Feature Tracking: detection of features and tracking them between consecutive frames using optical flow, by assigning a unique ID to matching features.

MJPEG Encoding: reduces video / image bandwidth size by up to 500 MPixels / second.

Lossless Digital Zoom: zooming in or out on specified area when motion is detected.

Corner Detection: identify edges and corners on the frame

Python Compatible: on-board Python scripting. Use Python scripts for business logic, which allows for complex pipelines to run fully on-device.

OpenVino Compatible: OpenVino is an open-source tool kit for optimising and deploying AI inference

Wide FOV: support for wide FOV cameras.

3D Object Localization: finding objects in 3-dimensional space.

3D Object Tracking: tracking objects in 3-dimensional space.

Stereo Depth: perceive depth from a stereo camera pair using disparity matching.

9-Axis IMU Data: an internal measurement unit (IMU) to allow the device to know its position in space.

IR Illumination: infrared (IR) lighting of low-light areas (night vision).

IR Laser Projection: allows for stereo depth performance in low light.

Multiple Camera Support: easily evaluate different sensors (with dif-ferent FPS, resolution, or shutter type) and optics (FOV).

PoE Connectivity: uses power-over-ethernet (PoE) for power and communication.

Custom Baseline: allows the user to select the stereo baseline distance for closer/further depth perception.

Flash Edge / Standalone: accommodates operation without being connected to a host computer.

Standard Functionality

NEURAL INTERFERANCE

WARP DEWARP

OBJECT TRACKING

H264/264 ENCODING

FEATURE TRACKING

MJPEG ENCODING

MOTION ZOOMING

CORNER DETECTION

PYTHON

USB VIDEO CLASS

OpenVINO

FULLY COMPATIBLE

Note: All PoE models offer IP67 sealed casings for waterproofing/dust proofing.

Additional Functionality & Product Comparison

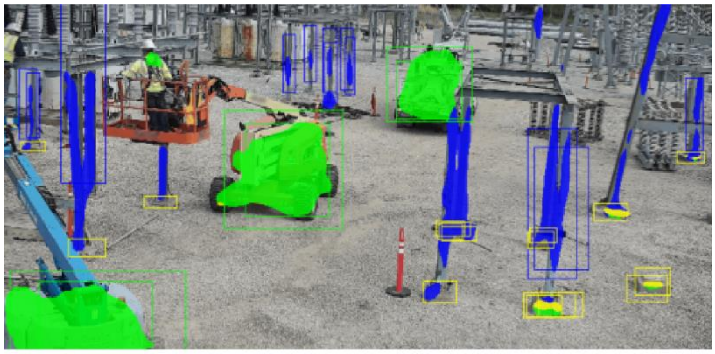
The below table details different Luxonis camera options and the functionality they include in addition to the standard:

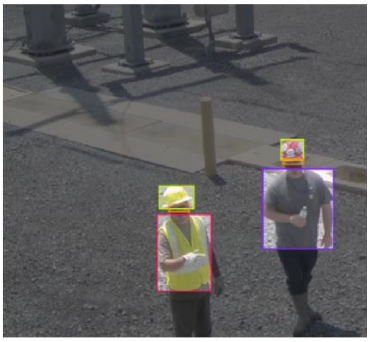
	OAK-1 OAK-1 Lite	OAK-1 W	OAK-1 PoE	OAK-D OAK-D Lite OAK-D S2	OAK-D PoE OAK-D S2 PoE	OAK-DW	OAK-DW PoE	OAK-D Pro	OAK-D Pro W	OAK-D Pro PoE	OAK-D Pro W PoE
Stereo Depth				●	●	●	●	●	●	●	●
3D Object Localisation				●	●	●	●	●	●	●	●
3D Object Tracking				●	●	●	●	●	●	●	●
9-Axis IMU Data											
Wide FOV		●				●	●		●		●
IR Laser Projection								●	●	●	●
IR Illumination								●	●	●	●
PoE Connectivity			●		●		●			●	●
Flash Edge/Standalone			●		●		●			●	●

Development kits:

OAK-FFC-3P OAK-FFC-4P OAK-FFC-6P	●	●

Case Study: Cobra Vision





Construction company specialising in power substations.

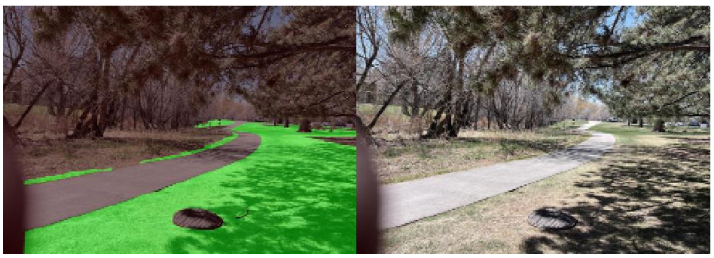
Focused on minimising collisions by utilising multiple forms of semantic segmentation to identify people, vehicles, and structures.

Simultaneously promoting improved worker safety by identifying if people on the jobsite are wearing appropriate safety equipment.

Also employing: corner detection, pose estimation, spatial depth/location, object tracking.

Case Study: Greenzie

System learning to identify edge cases in bright light.



Sidewalk and storm drain segmented as "blades off".

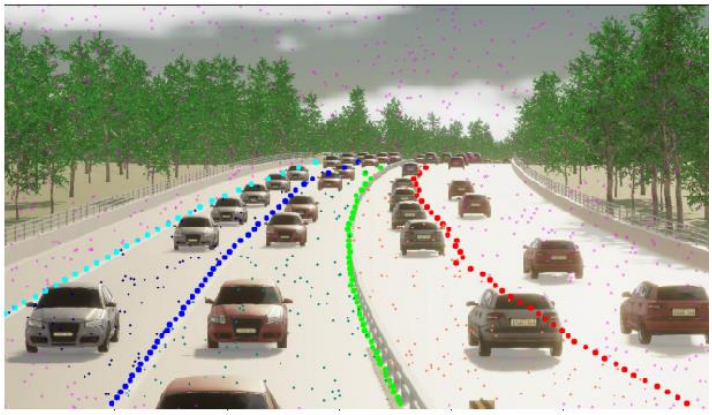
Difficult to see sprinkler head correctly identified as "blades off".

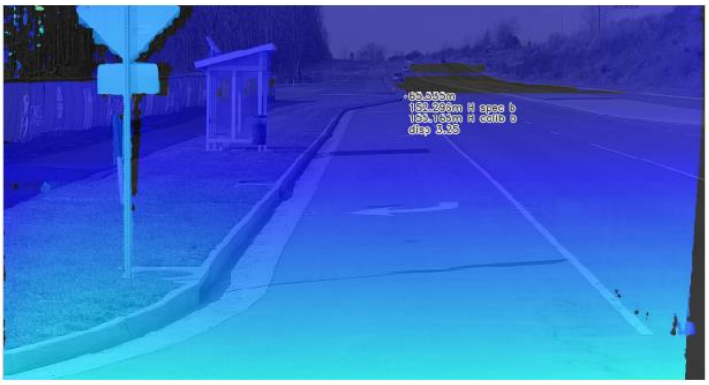
Company developing autonomous lawn mowing technology for large scale use.

Requires extensive machine learning to identify any / all scenarios that constitute a "blades on" command (grass) or a "blades off" command (object or obstacle) to avoid damage to both mowers and private property.

Relying on substantial dataset development, object detection and recognition, and semantic segmentation, as well as depth, 9-axis IMU, and feature tracking.

Case Study: Lantern





Developing an early warning system for road maintenance crews and lane painters (called “paint striping”).

Paint striping is increasing in frequency due to the growing demand of electric cars relying on clear/distinct lanes for navigation.

Painting often must be done in the midst of traffic, and the slow speed of painter vehicles increases risk for collisions.

By measuring the speed, distance, and position of approaching vehicles, Lantern’s system triggers an escalating series of warnings to alert distracted drivers.

These variables must be measured from a significant distance to give vehicles adequate time to slow down, placing added importance on depth perception performance.

Road lanes must also be properly segmented and vehicles must be accurately distinguished.

Robotic Vision, made simple with Luxonis.

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