ESPROS Photonics Corporation – Key technology for the 21st century

Application Markets for 3D Cameras

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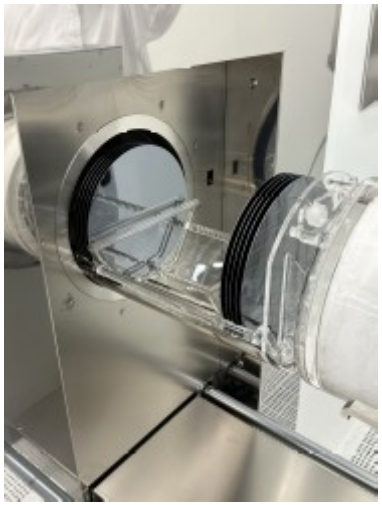
CEO ESPROS Photonics AG

Foundation and fab vision



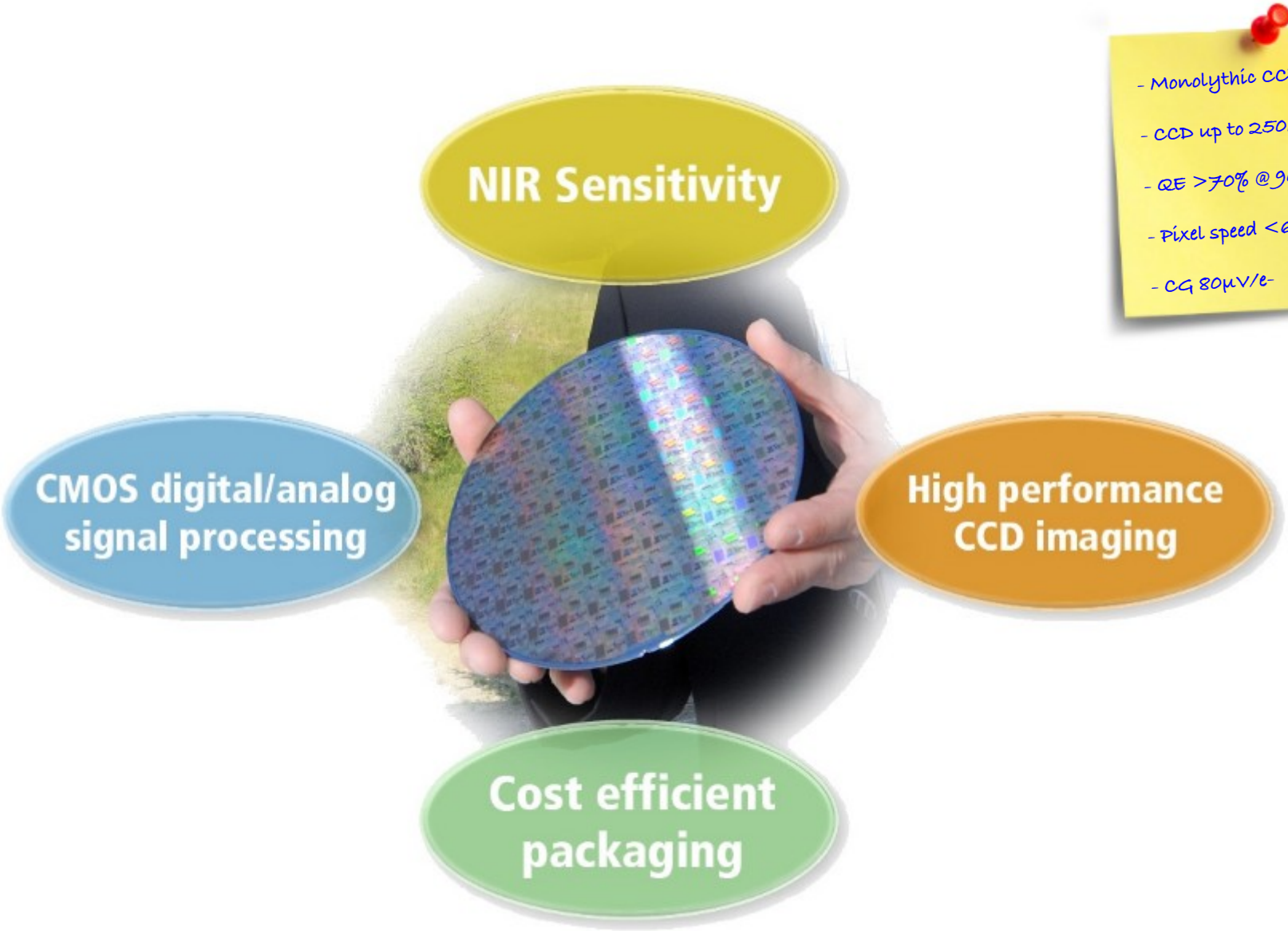
Foundation 2006

HQ Sargans, Switzerland

Activities

- Mixed signal chip design
- Camera module design
- Manufacturing of photonics chips and TOF cameras
- Marketing & Sales

Key ingredients for high performance TOF & LiDAR imaging

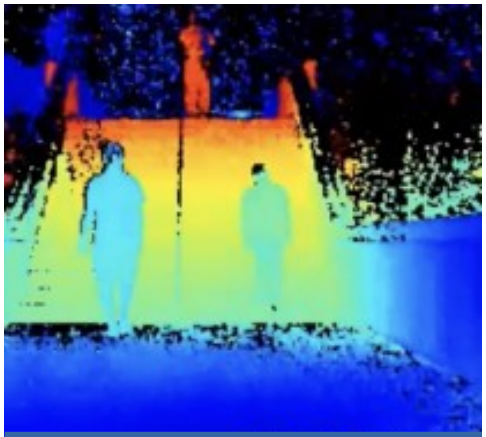


See the difference – epc660 is the ideal near field outdoor LiDAR sensor

Unrivaled outdoor performance...

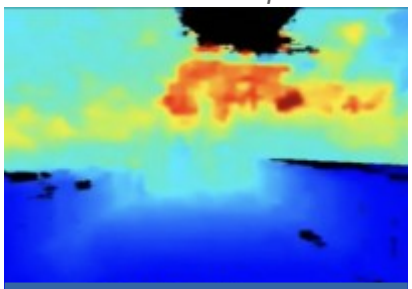
Scene with strong ambient light. The illumination of the TOF camera competes with sunlight - ranging is very challenging. In addition, the person with black clothes is hardly visible.

From 2D to a 3D image with ESPROS' camera in full sunlight

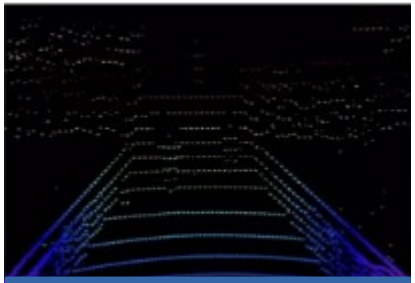


The TOFcam-660 shows all three persons and its ranging capability is not affected by thge sunlight. Even the person with the black clothes is perfectly visible.

...and what our competitors see (same scene)



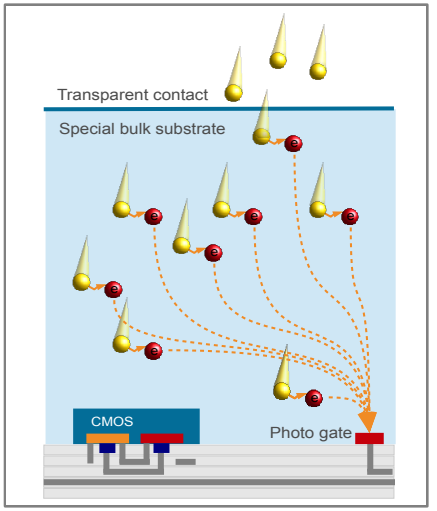
Competitor A:
Blurred image



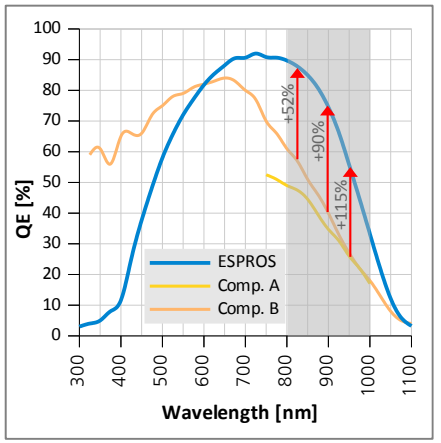
Competitor B:
Too low vertical resolution

Competitor C:
Operation is jeopardized by the sunlight

ESPROS' strategic technology advantage



ESPROS' OHC15L backside illuminated CMOS/CCD technology achieves unsurpassed sensitivity in near infrared (NIR)

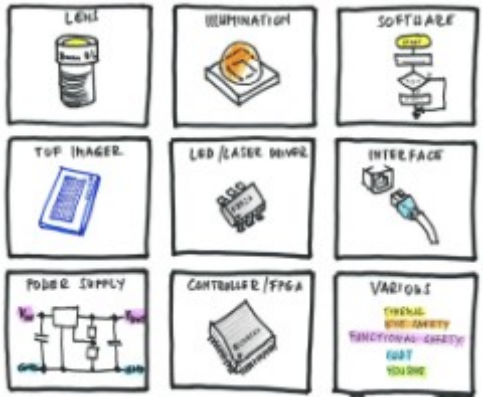


Note:
The performance comparison between the ESPROS TOFcam660 and of well-known competitor cameras. The scene was captured under full sunlight conditions in Pittsburg / PA and illustrates the performance advantage of OHC15L technology in terms of ambient light suppression, operating range and resolution. This comparison clearly shows why ESPROS' technology has achieved a breakthrough for outdoor applications. The study was independently carried out by the Carnegie Mellon University in Pittsburg/USA (https://www.cmu.edu).

Vertical integration is a competitive advantage but challenging

Implementation challenges

- 3D camera design is full of pitfalls and thus challenging. It starts with the definition of the requirement specifications and goes on with the implementation of
  - Optics
  - Electronics
  - Mechanics
  - Firmware and software
  - Thermal design
  - Machine safety
  - Eye safety
- ESPROS has gained huge expertise in the implementation of cameras since 2013 with the support of almost 800 design-in projects
- This expertise is a strong competitive advantage against upcoming competition in the module business
- ESPROS is faster on the market with a highly predictable outcome



ESPROS' market offerings

This is the challenge!

Level 3

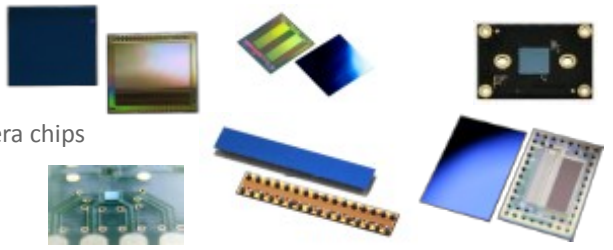
System
- Plug and play system, containing
  - Camera
  - Image processing and filtering
  - Application software
  - Artificial intelligence for decision making and data reduction
  - Cloud interface

Level 2

Module
- TOF camera module, including
  - Optics, Mechanics
  - Electronics
  - Firmware, Software
  - Application support
- Dedicated sensor module

Level 1

Semiconductor
- TOF imager chips
- Line Imager Chips
- TDI imager chips
- Ultra high speed camera chips
- Photodiode arrays
- Amplifier chips



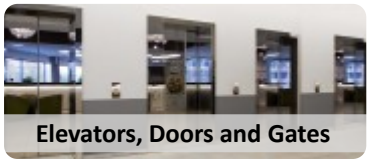
Partnering
Planned to increase our market scope to gain direct market access

ESPROS core competence:
Well established and wide product portfolio in component level, increasing portfolio for customer specific applications

Industrial sensing

ESPROS serves a broad range of end-markets and applications and is best positioned to address tomorrow's image sensor needs

ESPROS' strategic end markets

	Automation Sensors	Angular and Linear Encoders	Diagnostics	Elevators, Doors and Gates
Applications served today	 ▪ Light barriers ▪ Triangulation sensors ▪ Optical communication ▪ Safety sensors ▪ Edge detection ▪ Surface scan	 ▪ Rotary and linear encoders ▪ Very high resolution and accuracy angular measurement devices	 ▪ Ophthalmology sensors ▪ Hyperspectral imagers ▪ Ultra high speed imaging ▪ Fluorescence lifetime imaging (FLIM)	 ▪ Elevator door protection ▪ Passenger safety ▪ Escalator auto start/stop ▪ Elevator car positioning ▪ People counting ▪ Passenger monitoring ▪ Security (tailgating)
Tomorrow's new normal	▪ Intelligent automation devices ▪ Preventive maintenance sensors  **Lead customer** An international family-owned sensor technology business	▪ Automatic mapping anytime and anywhere ▪ Micro-robots with high accuracy micro-encoders  **Lead customer** Global leader in sensor solution for high precision dimensioning	▪ Spectral sensing in sugar cube size ▪ Hyperspectral imaging from UV to NIR in one imager device ▪ Dermatology sensor  **Lead customer** Technology forerunner in OCT scanning	▪ Building access control ▪ People traffic control ▪ Tailgating monitoring ▪ Preventive maintenance sensing  **Lead customer** Global leader in elevator sensors

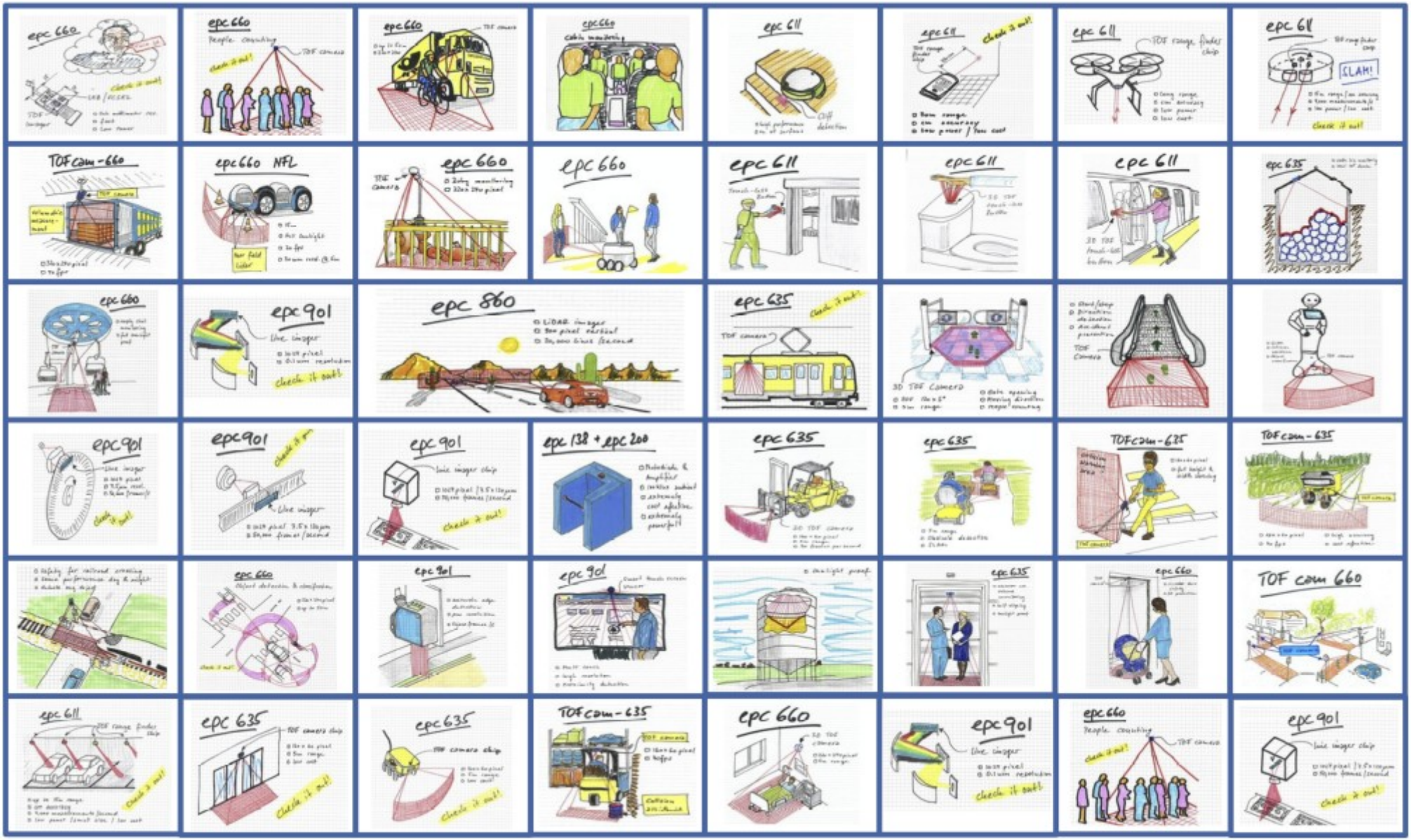
Completely new applications and markets

ESPROS serves a broad range of end-markets and applications and is best positioned to address tomorrow's image sensor needs

ESPROS' strategic end markets

	Automotive	Mobile Robotics	Warehouse logistics	Building Automation
Applications served today				
	▪ TOF ADAS solutions ▪ Full sunlight ▪ Mid range 30m (cwTOF) ▪ Long range >100m (pTOF) ▪ Night vision ▪ Vehicle interior monitoring ▪ Gesture control	▪ Range finder camera ▪ Scanning cameras ▪ Full sunlight ▪ Ground distance control ▪ Collision avoidance	▪ Light curtain ▪ Gesture control ▪ Collision avoidance ▪ Object recognition ▪ Object dimensions ▪ Spectral sensing	▪ Obstacle recognition ▪ Distance control ▪ Patient monitoring ▪ Property security ▪ People counting ▪ Passenger monitoring ▪ Security (tailgating)
Tomorrow's new normal	▪ Autonomous driving ▪ Driver assistance ADAS ▪ 360° surround view ▪ Enter- / Infotainment ▪ In-cabin monitoring	▪ Hospitality and retail robots ▪ Household robots ▪ Consumer and security drones ▪ Delivery robots and delivery drones	▪ Automatic guided vehicles ▪ Automated feed bin replenishment ▪ Logistics route optimization ▪ Simultaneous localization and mapping (SLAM)	▪ Passenger guidance systems ▪ Smart home devices ▪ Elderly residences automation ▪ Traffic control ▪ Touch-less door opening
				
	Lead customer US #1 of robotaxi operator	**Lead customer** Established US service provider	**Lead customer** Leading Canadian bin feed IoT provider	**Lead customer** Global elevator, escalator, doors and gates leader

Application sketch book



Thank you!

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