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Empower your embedded vision

Presenter Aling Wu

Dated June .2017

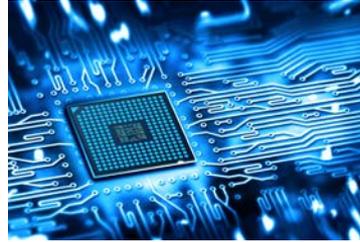
Rev 0.1

are you
up for **UP**?

What did embedded vision do?



automotive



semiconductor



Food packaging



Logistic



Security & Surveillance



Medical/ Pharmaceutical

What is happening in embedded vision?

TYPHOON H PRO
intel REALSENSE



Cameras in the market

INTERFACE

Interface:

- USB 2.0
- USB 3.0
- USB 3.1 Gen. 1
- GigE

Software:

-- All --

HOUSING

Family:

-- All --

Design:

- board level
- housed

Lens mount:

-- All --

IP code:

- IP30
- IP65/67

OPTIONS

Features:

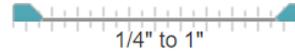
- HDR
- PoE
- NIR

SENSOR

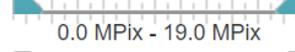
Sensor:

- color
- monochrome

Optical class:



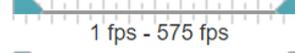
Resolution:



Pixel size:



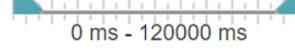
Frame rate:



Min. exposure time:



Max. exposure time:



Shutter:

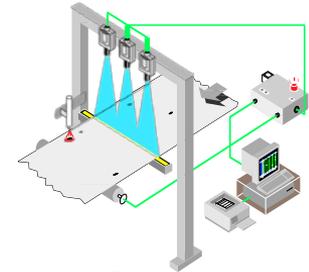
-- All --

Manufacturer:

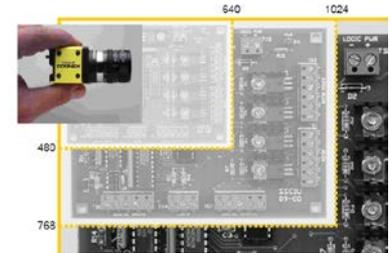
-- All --

Model:

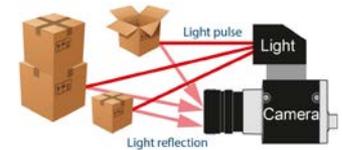
-- All --



1D camera

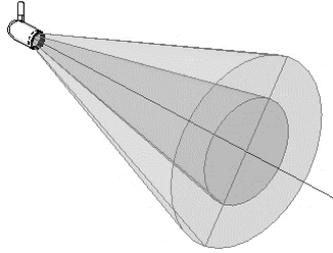


2D camera

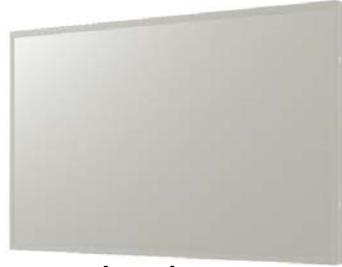


3D camera

Key parts of machine vision system



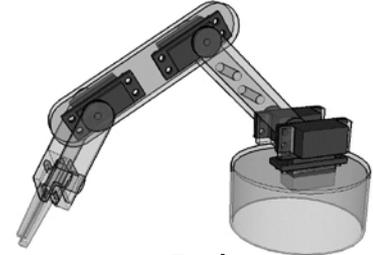
Light source



display



Cloud



Robot arm



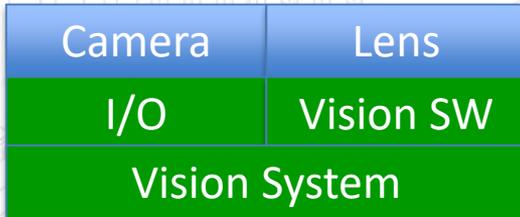
Camera



Lens



Embedded PC/ PLC



Solution from UP

www.up-board.org



All thanks to high-speed USB3.0

UP
bridge
the gap



1x USB3.0

UP²
bridge
the gap



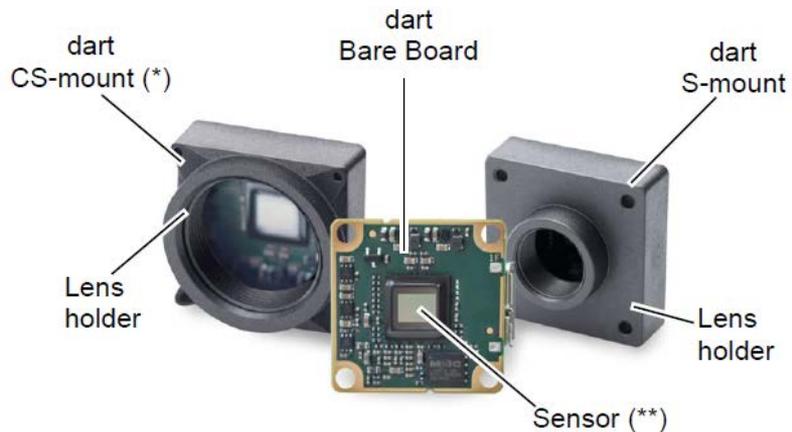
4x USB3.0

UP^{Core}
bridge
the gap



1x USB3.0

UP
bridge
the gap



Linux



ubinux



ubuntu



Person



SLAM



OBJECT



bridge the gap

- ▶ Low weight ✓
- ▶ Small size ✓
- ▶ Low power consumption ✓
- ▶ Open mount (board level) concept ✓

New platform - New options available

- ▶ Target markets below the ace ✓
- ▶ High volume markets ✓
- ▶ New applications – or even existing ✓

Perfect fit for the entry level

Basler camera specs (daA2500-14uc)

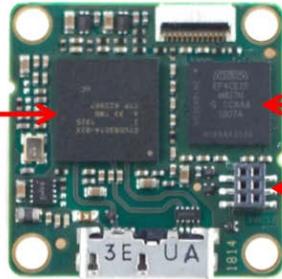
Resolution (H × V pixels)	2592 × 1944
Sensor	Aptina MT9P031
Sensor Size (optical)	1/2.5"
Sensor Technology	CMOS, rolling shutter
Pixel Size [µm]	2.2 × 2.2
Frame Rate [fps]	14
Mono / Color	Color
Video Output Format	YUV 4:2:2 Packed (YCbCr 422), Bayer 8, Bayer 12, RGB 8
Interface	USB 3.0
Synchronization	Via external trigger or free-run
Exposure Control	Via external trigger or programmable via camera API
Housing Size (L×W×H)	20 × 29 × 29 mm (S-mount)
Housing Temperature	Up to 50°C
Lens Mount	S-Mount
Digital I/O	2 Fast-GPIO
Power Requirements	Via USB 3.0 interface
Power Suspend Mode	Yes, less than 20 mW, configurable
Power Consumption (typical)	~1.3 W
Weight (typical)	S-mount model: <15 g

USB3 PHY

- Reliable & fast data transmission
- Re-sends possible due to buffer concept

FPGA

- Features
- USB3 Vision protocol



USB3 connector

- ## Trigger/IO
- 2 x GPIO

USB 3.0	USB 2.0
✓ Continuous Bursting	✗ No Bursting
✓ Dual-simplex; unicast	✗ Half-duplex; broadcast
✓ Asynchronous notifications	✗ Polling
✓ „Streaming“ for bulk endpoints	✗ No Streaming capability
✓ Enters low-power state whenever needed	✗ Controlled by the host
✓ Informs the host on latency tolerances	✗ No support
USB 3.0	USB 2.0
✓ Handles error detection and recovery at the link and the protocol levels	✗ Handles at protocol level only
✓ Supports +350MB/s	✗ Supports ~35MB/s
✓ Power: 4.5W, 5V, 900mA	✗ Power: 2.5W, 5V, 500mA
✓ Uses two shielded (twisted) differential pairs	✗ Uses one unshielded twisted pair
✓ USB 3.0 screw-lock Micro-B connector specified by USB3 Vision	✗ No screw-lock on connector
✓ Cable length up to 8m (Basler test setup)	✗ Cable length up to 5m
✓ Industrial hubs available	✗ Mostly non-industrial hubs

pylon Viewer 64-Bit

File View Camera Tools ?

Devices

- USB
 - acA2500-14uc (21330175)
 - acA1300-30uc (21379579)
 - acA1300-30um (21280965)
 - acA2000-50um (21111112)

Features [acA2000-50um (21111112)]

Feature

- acA2000-50um (21111112)
- Transport Layer
- Stream Parameters

User Level: Expert

Bandwidth Manager

Camera	Bandwidth (MB/s)	MB/s Received	fps Sent	fps Received	Images	Errors
USB						
- Renesas Electronics USB 3.0 Host Controller ~360						
- Renesas Electronics USB 3.0 Hub						
✘ acA1300-30uc (21379579)	419	78	31,76	31,77	48	0
✘ acA1300-30um (21280965)	419	57	41,16	41,16	62	0
✘ acA2000-50um (21111112)	240	86	49,81	49,82	75	0
✘ acA2500-14uc (21330175)	419	73	14,61	14,60	22	0

Reset Statistics

Analyzing bandwidth.
You can limit the amount of bandwidth used by a camera using the controls in the **Bandwidth (MB/s)** column.
Click **Stop Analysis** to stop the analysis.

Stop analysis after 30 Second(s)

Stop Analysis

Close

data can be discarded by the ...

Image acquisition on "acA2000-50um (21111112)" failed! Error: 0xe2000212 "Payload data has been discarded. Payload data can be discarded by the ...

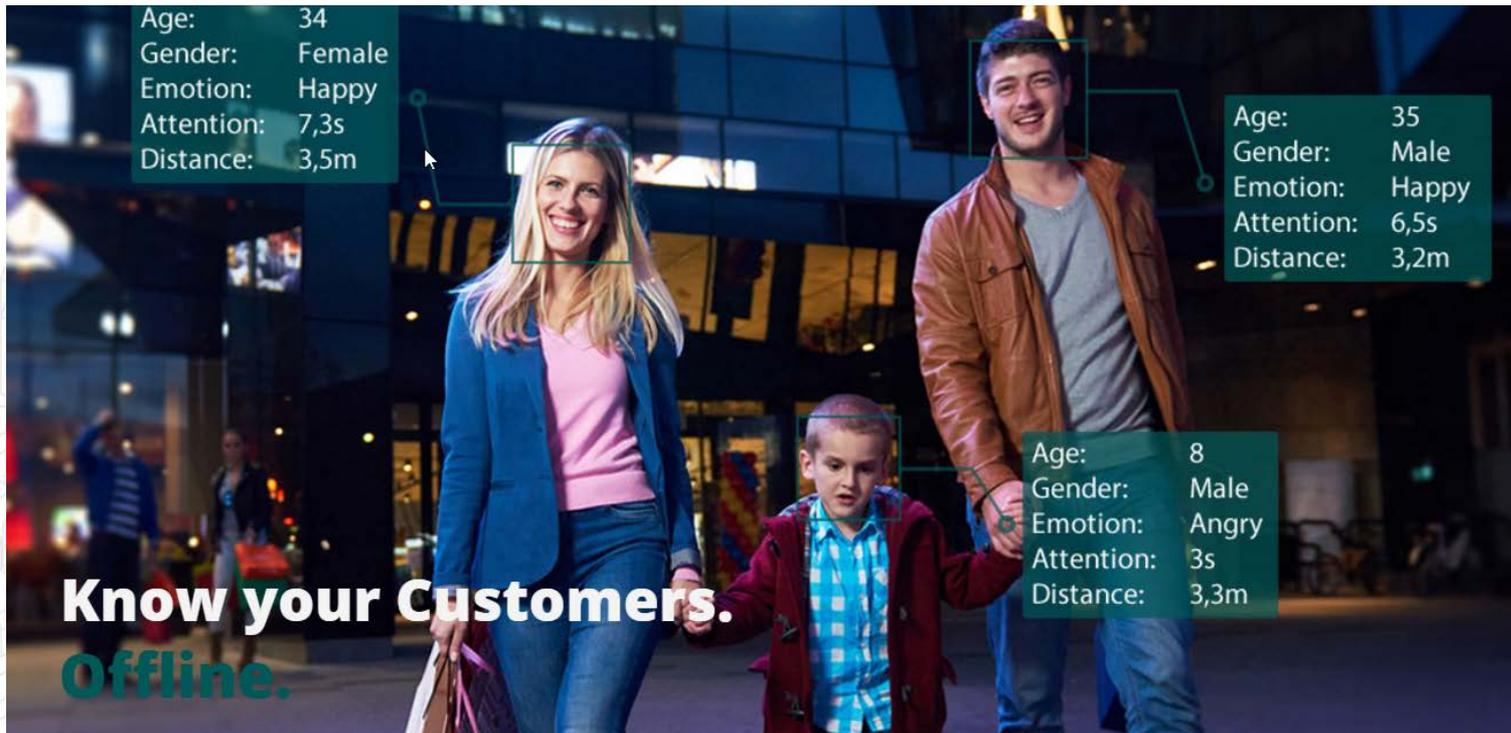
Image acquisition on "acA2000-50um (21111112)" failed! Error: 0xe2000212 "Payload data has been discarded. Payload data can be discarded by the ...

Image acquisition on "acA2000-50um (21111112)" failed! Error: 0xe2000212 "Payload data has been discarded. Payload data can be discarded by the ...

Image acquisition on "acA2000-50um (21111112)" failed! Error: 0xe2000212 "Payload data has been discarded. Payload data can be discarded by the ...



Application case

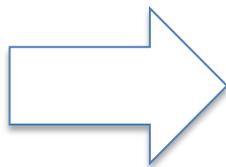


WIFI ANALYTICS INTERACTIVE PATH RFID
 VIDEO ANALYTICS TOUCH SCREENS ANALYTICS DISPLAY
 DIGITAL SIGNAGE BARCODE SCANNING CONTENT CREATION
 BEACONS SATISFACTION SURVEY

DETECT OTS

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VIDEO ANALYTICS

MALE DETECTED

Anonymously identify the gender, age and dwell time of your customers and trigger content accordingly.

Analytics collected include:
 ✓ Gender ✓ Dwell time
 ✓ Age range ✓ Opportunity to see (OTS)

beabloo
 Communicate everywhere



Giving your machine the ability to better understand and interact with its environment.

INTEL® REALSENSE™ CAMERA

Provides **3D depth sensing** with the ability to comprehend **position and orientation**, giving devices and machines a more realistic view of the world



MIDDLEWARE

Enables the ability to **Locate, Sense, Identify and Interact** in both real and virtual worlds



DEVELOPER'S GUIDE AND TOOLS

	SR300	R200	SR300	R200	ZR300	RDk
Developer Platform	Windows®10 Threshold 2		Linux®			
Developer's Resources	Intel® RealSense™ SDK		Intel® RealSense™ Cross Platform API (also known as librealsense)			
SDK/LibrealSense Overview	Camera stream capture (Depth, Color) Projection tool, libraries, and tutorials		Camera stream capture (Depth, Color) and data from motion tracking sensor. Projection tool, tutorials and libraries (ZR300 only)			
Available middleware libraries	BGS, Hand (Cursor) Face, 3D Scan	3D Scan, Scene Perception Enhanced Photography	None		SLAM, Person Tracking and Object Recognition	None
Available framework and programming language support	C++, C#, Unity, Web support, Java and Processing		C++, ROS, JavaScript, OpenCV, PCL			
Developer's Guide	https://software.intel.com/en-us/intel-realsense-sdk-support/documentation		https://github.com/IntelRealSense/librealSense		https://software.intel.com/sites/products/realsense/camera/developer_guide.html	https://software.intel.com/en-us/realsense/robotic-development-kit
Getting Started	https://software.intel.com/sites/default/files/Getting_Started_0.pdf		https://github.com/IntelRealSense/librealSense#installation-guide		https://software.intel.com/sites/products/realsense/intro/getting_started.htm	https://01.org/developerjourney/recipe/intel-realsense-robotic-development-kit



PERSON LIBRARY

Goal: allow machines to **sense** and **recognize** people, **understand** what they do, and **interact** with them.

PERSON DETECTION



Locating people in a scene

- All people in scene

BODY TRACKING



Tracking body part movements

- **NOW:** 6-points of interest
- **FUTURE:** Skeleton tracking

PERSON TRACKING



Following people in space

- COM, direction and speed
- Handle occlusions and out of FOV

BODY GESTURES



Understanding pre-defined body movement

- **NOW:** point, wave
- **FUTURE:** stop, and many more

PERSON RECOGNITION



Identify a person by ID

- Database size = ~30

FACE TRACKING



Tracking face movements

- Landmarks tracking
- Face direction (Yaw, Pitch, Roll)
- **FUTURE:** Expressions (Neutral, Happy, Sad)

BODY POSTURE



Understanding a person's posture

- Body direction (Front, Side, Back)
- Posture (Sitting, Lying, Standing)



SLAM - SIMULTANEOUS LOCALIZATION AND MAPPING

6DOF TRACKING



6DoF tracking with **real world scale**, fast initialization, no prior knowledge of environment

RE-LOCALIZATION



Ability to **learn** an area, **save/load** tracking state, **recover localization** with saved area

3D DENSE RECONSTRUCTION



Uses depth data to create **live 3D models and maps** for VR/MR landscapes

2D DENSE RECONSTRUCTION

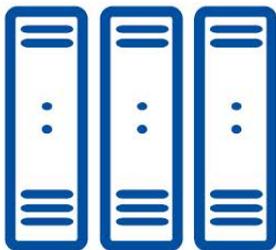


Uses depth data to create **2D occupancy maps** for input to robots



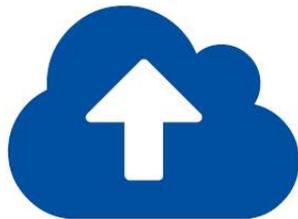
OBJECT LIBRARY

DATABASE OF OBJECTS



This includes a library of objects that can be utilized in market specific applications

DEEP LEARNING CLOUD SERVICE



Use to improve current accuracy on existing objects and for collecting data to increase the numbers of object supported

ROOM AND OBJECT LOCALIZATION



A machine will understand what objects and rooms are and where they are in the scene

OBJECT TRACKING



If the camera is moving the machine will not lose understanding of the objects of interest

Application case



RTC-700B with RealSense SDK

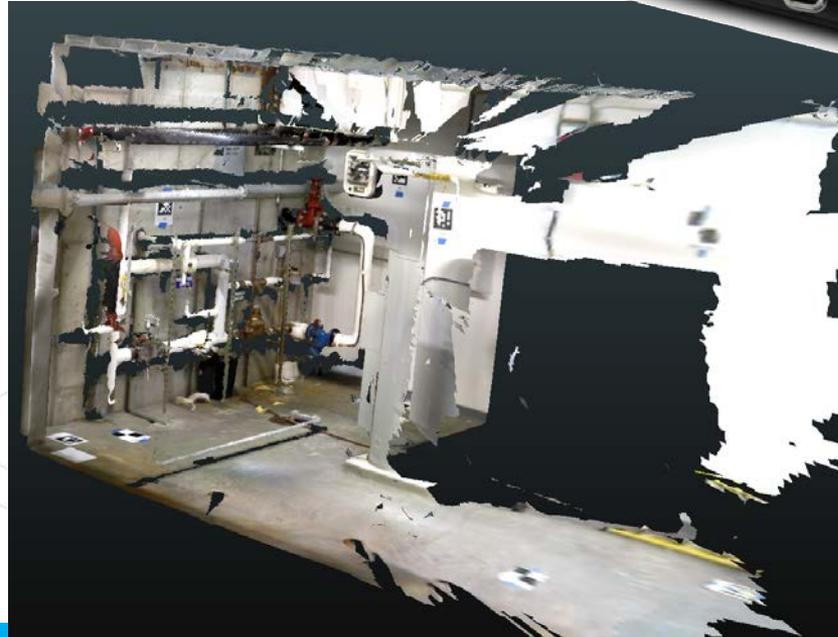
- RTC-700B with Intel® RealSense™ 3D camera
- This 1080P camera detects volume, depth, color, and motion
- The camera enables new capabilities including box or luggage measurement, object identification or retail demographics.





RTC-700B with RealSense SDK

- 3D modeling of Industrial (offshore) sites to:
 - Create a 3D service step-by-step guide
 - Survey sites without sending out a surveyor to a remote site
 - Real-time sharing opportunities
 - Off-site measurement taking



Distance: 1085 millimetres

\$315



UP Embedded Vision Starter Kit powered by Basler

Contents: Basler dart daA2500-14uc 5MPX color
5-mount lens (not pre-mounted)
UP board (2GB RAM/32GB eMMC)
USB3.0 OTG cable
Power supply



BASLER

AVAILABLE NOW

\$449



RealSense Robotic Develop Kit ZR300



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TECHNOLOGY



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