The Time-of-Flight Camera Basler blaze in Logistics

Time-of-Flight (ToF) cameras capture objects and scenes in three dimensions based on the time-of-flight method and can be used in a wide range of applications. In logistics, the use of 3D vision solutions creates new possibilities for optimizing the measurement, identification and position recognition of objects and packages, among other things. blaze, the robust, precise and fast ToF camera, is precisely optimized for this field of application and enables economical, highly automated logistics solutions.

Content

1. 3D Vision Solutions in Logistics

1.1 Requirements for the logistics of the future

The increase of eCommerce and the increased requirements for flexibility and speed in order processing are strongly driving automation in warehouses, logistics centers and transshipment points. The use of robots for (de)palletizing, order picking and packing, and sorting processes continues to increase in logistics. The systems must become more intelligent and, for example, know the position of the robot arm in relation to the product as well as the optimal gripping point. Mobile robots and autonomously driving transport systems -- both in intralogistics and in the flow of goods toward the customer (e.g. in last-mile delivery) -- also need intelligent solutions for fast and safe orientation and navigation.

This is exactly where machine vision comes into play. In logistics, there are numerous use cases for both 2D and 3D image processing systems. Examples of 2D vision in this environment include the recognition and reading of barcodes on packages and the identification of containers and/or transport containers based on their individual markings.

3D image processing systems capture not only the X and Y values in an image, but also the depth values of the scene or object. 3D vision is particularly suitable when volume, shape or the 3D position of objects are to be analyzed. In logistics, 3D vision solutions can perform the following tasks, for example

- Obstacle detection and „human“ navigation of autonomous driving vehicles
- Robot-controlled gripping tasks on conveyor belts or bin picking
- Presence detection, checking and counting of objects in containers/boxes even if the items do not have any contrast to the background
- Volume measurements and position detection of various objects

1.2 Importance of ToF camera technology

In the field of 3D imaging, several technologies exist with different properties, which should be selected depending on the requirements of the respective application. Due to their properties, time-of-flight cameras have proven to be a particularly suitable 3D technology for use in logistics.

Advantages of Time-of-Flight technology for logistics tasks:

- Recording of entire scenes without scanning
- High real-time capability
- 2D and 3D image in one multipart image
- High X/Y resolution
- Compact system without moving components
- Also suitable for scenes with low light
- Eye safety
- Also suitable for low-contrast and unstructured objects
- Large working distances possible
- Low total system cost

If a time-of-flight camera is selected for the appropriate task and optimally integrated, it allows for more than 9 million distance measurements per second with millimeter accuracy! There is no faster way to capture a space.

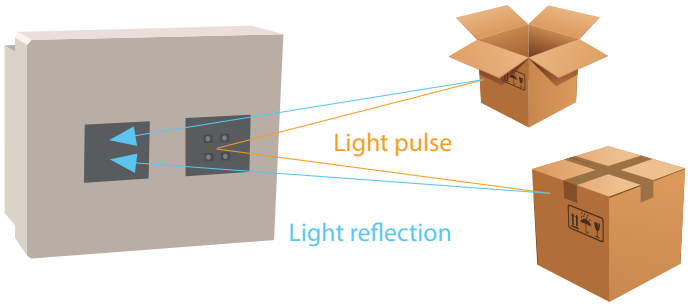

Fig. 1: Time-of-Flight (ToF) is a very efficient technology to generate depth data and measure distances.

2. Advantages of the Basler blaze in logistics

With the blaze 3D camera based on time-of-flight technology, Basler offers the perfect solution to meet the complex and diverse image processing requirements in logistics. The blaze impresses with a number of important features.

Fig. 2: Basler blaze: The perfect 3D camera for applications in logistics, here in combination with a Basler ace color camera.

2.1 Precise capture of entire scenes in real time

The basis of the blaze is the powerful Sony DepthSense™ IMX556 sensor, which allows precise optical measurement (+/-5 mm) of objects at up to 30 frames per second. This allows, for example, packages on a conveyor belt to be detected in real time and their volume measured to determine freight costs. The Sony DepthSense sensor is a backside-illuminated CMOS sensor that can capture incident light better than conventional CMOS sensors. In combination with Sony's own ToF pixel technology CAPD (Current Assisted Photonics Demodulation), a significantly higher accuracy of the 3D depth data can be achieved compared to conventional ToF cameras. The processing of the depth data is already done in the camera to reduce the computational and data load.

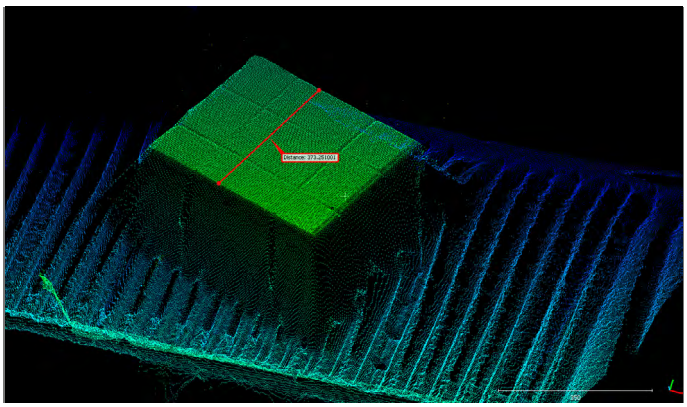

Fig. 3: Package measurement on conveyor belt with the Basler blaze (Point Cloud streaming format).

The speed of the imaging system is also crucial when using 3D vision for palletizing robots. The blaze detects position, size and gripping position in real time and, thanks to the flexible working distance of 0.3 m to a maximum of 10 m, can also capture large objects and entire scenes at once. For example, the camera can simultaneously capture the depth data for two loaded euro pallets and provide optimal support for palletizing tasks and automated warehousing.

2.2 Industrial-grade and compact for fixed and mobile robots

The working environment in logistics is harsh. Components used in this scenario must be correspondingly robust to perform their task reliably and over the long term.

The blaze meets these requirements with an industrial-grade, corrosion-resistant housing measuring just 100 mm x 81 mm x 64 mm, which is designed to be shock- and vibration-resistant as well as water- and dust-tight according to IP67 classification. Due to these features, the blaze can also be attached to fixed and mobile robots or transport vehicles. Furthermore, recalibration in the field is not necessary with the blaze.

Another significant factor is the light source pre-integrated into the camera housing, consisting of four powerful laser diodes (VCSEL); the result is a compact and simple solution with no moving components and low overall system costs. Robot solutions with the blaze naturally meet the requirements of laser protection class 1. A diffuser in front of each laser diode and a special protective glass in front of the light source prevent eye-damaging light radiation. At the same time, the light emitted by the blaze (940 nm) is invisible and non-disturbing to humans. The built-in, powerful processor also minimizes the CPU load for tasks such as vehicle control.

2.3 Robust against ambient light

Many image processing applications depend on precisely defined lighting situations and temperatures. In logistics, such fixed conditions are often not feasible due to the wide range of application locations, from warehouses to container ports.

With the blaze, the light wavelength of 940 nm was deliberately selected for the light pulses emitted by the camera. At this wavelength, sunlight is strongly absorbed by the atmosphere, so the camera works better in daylight than those ToF cameras that emit light pulses of 850 nm. This is an advantage not only in outdoor applications, such as container handling or depalletizing tasks, but also where artificial light mixes with sunlight, for example at warehouse gates. At the same time, the blaze works just as reliably indoors, preferably when illuminated with high-quality LEDs.

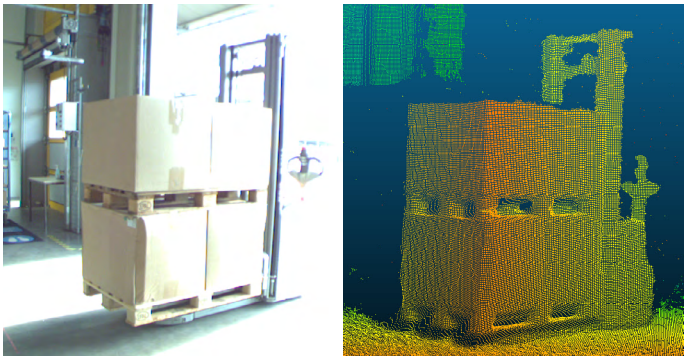

Fig. 4: Even in strong sunlight, the blaze 3D camera can reliably detect the cargo.

2.4 Reliable operation in multi-camera systems

Many logistics processes require the smooth, simultaneous interaction of several transport and image processing systems in an immediate spatial environment, such as when using autonomously driving vehicles. The ToF camera blaze is also ideally prepared for this scenario and allows reliable operation in multi-camera systems without mutual interference.

The blaze offers the possibility to use the Precision Time Protocol (PTP) function and thus synchronize multiple GigE cameras in a network.

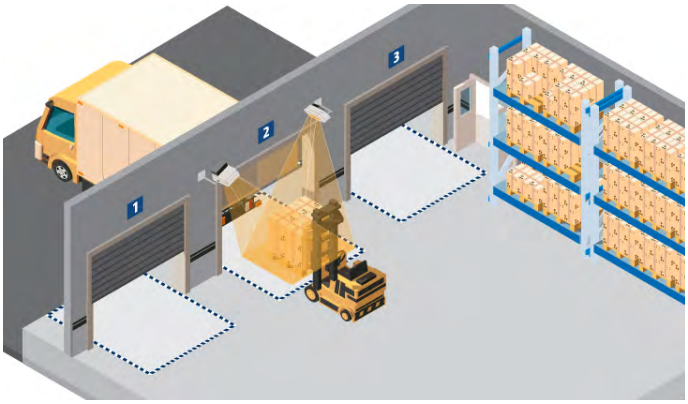

Fig. 5: Precise 3D freight measurement in passing: several ToF cameras measure the freight directly during transit without stopping the flow of goods.

In addition, the blaze „Multi-Camera Channel Feature“ allows up to seven cameras to operate simultaneously without interference. The advantage of this feature is that it can be used for cameras that are in the same room but not in the same network. A typical use case would be a warehouse where several AGVs (Automated Guided Vehicles) equipped with blaze cameras are moving in a confined space.

2.5 Easy integration into the overall solution

For users in logistics, the simplest possible systems integration is a key factor in getting complex systems up and running quickly and thus implementing economical solutions.

On the hardware side, the blaze time-of-flight camera offers a compact design with already-integrated light source, GigE interface, tripod thread as well as several M4 threads for mounting. It also comes ex-work calibrated. The lens is ToF-optimized and also already installed. The working distance is very flexible, at 0.3 m to 10 m. The 3D camera can also be mounted on Basler 2D cameras, thus allowing color point clouds to be displayed (fusion of 2D color data and 3D depth data). The color information can help, for example, to improve scene details where depth information is lacking.

On the software side, the blaze scores with a user-friendly Software Development Kit (SDK) that contains all the necessary tools for easy installation and integration of the camera. With the included blaze Viewer as a powerful configuration and visualization tool, all camera parameters can be easily accessed. Depth data and intensity images can be displayed simultaneously in multiple windows. Numerous sample programs are provided for quick integration. Compatibility with GenICam, GenTL and GenAPI standards also enables plug-and-play integration with popular libraries, such as ROS for Robotics.

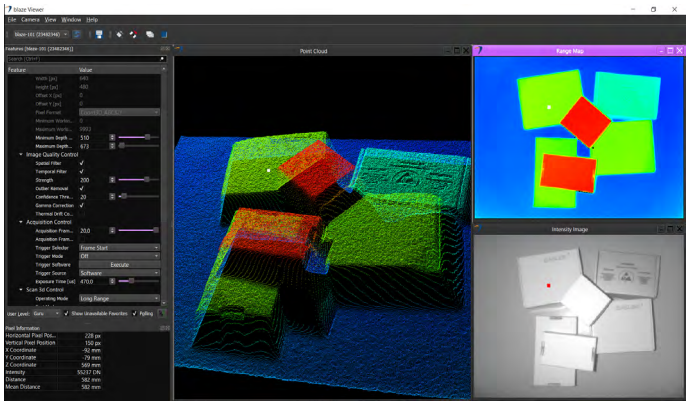

Fig. 6: The intuitive Basler blaze software environment allows easy handling as well as application-specific use of the image data as a 2D intensity image, 3D range map or 3D point cloud.

3. Conclusion

Increasing eCommerce is leading to rising demands for flexibility and speed in order processing in logistics, which can only be met with a consistently higher level of automation throughout the entire logistics chain. 3D cameras based on the time-of-flight method are very well suited for applications in logistics. The blaze offers a high-quality and industry-standard solution for generating 3D depth data in indoor and outdoor logistics tasks.

Author

Sanna Leinius has been working for Basler since 2017, first as New Business Development Manager and now as Product Market Manager for the 3D Business. In this position, she is responsible for the marketing activities of the 3D camera models. In addition, she continuously monitors and evaluates trends and requirements in camera technology as part of market analysis. Before joining Basler, Sanna Leinius worked for international medical technology manufacturers in Germany and China as Product Manager and Business Development Manager.

Contact

Sanna Leinius - Product Market Manager - 3D Business
Tel. +49 4102 463 340
Email: Sanna.Leinius@baslerweb.com

Basler AG
At the Strusbek 60-62
22926 Ahrensburg
Germany

Basler AG

Basler is an internationally leading manufacturer of high-quality cameras and accessories for applications in factory automation, medicine, traffic and a variety of other markets. The company's product portfolio encompasses line scan and area scan cameras in compact housing dimensions, camera modules in board-level variants for embedded vision solutions, and 3D cameras. The catalog is rounded off by the user-friendly pylon SDK and a broad spectrum of accessories, including a number developed specially for Basler and optimally designed for the Basler cameras. Basler has 30 years of experience in the area of computer vision. The Basler Group is home to approximately 800 employees at its headquarters in Ahrensburg, Germany, and its additional sites in Europe, Asia and North America.

Basler AG
Germany, Headquarters
Tel. +49 4102 463 500
Fax +49 4102 463 599
sales.europe@baslerweb.com
www.baslerweb.com

Basler, Inc.
USA
Tel. +1 610 280 0171
Fax +1 610 280 7608
sales.usa@baslerweb.com

Basler Asia Pte Ltd.
Singapore
Tel. +65 6367 1355
Fax +65 6367 1255
sales.asia@baslerweb.com

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