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White Paper

The Unmet Need for Low-Cost Lidar in Industrial Automation

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Introduction

The use of Light Detection and Ranging (lidar) technology, which leverages lasers and photodetector sensors to interpret a three-dimensional space, has seen a tremendous increase in demand over the past several years due to the emergence of applications requiring high-performance virtual mapping features.

Driven by the market's impressive potential size, the demand in the autonomous vehicle industry has been the main driver of lidar technology to date, causing a rise in the number of lidar sensor manufacturers. Velodyne, Ouster, and many more successfully meet the automotive market need with advanced scanning and solid-state solutions that provide high-resolution optical mapping.

Yet, the rise in demand for high-performance lidar in autonomous vehicles also has a downside. The application requires demanding computational resources and must meet strict automotive industry regulations and environmental design requirements, making the technology relatively expensive. There has been less focus on the needs of original equipment manufacturers in emerging industrial applications that also aim to employ lidar sensing in their products but don't require the same level of sophistication and compete in a more cost-sensitive market.

Industrial Lidar Applications

In the industrial sector, lidar is a critical component in numerous use cases. Some of the most important and earliest deployments were in process control applications. Two examples include scanning barcodes to confirm products are in the correct location on a production line and haven't missed critical processes and monitoring equipment to ensure a manufacturing cell is in proper working order.

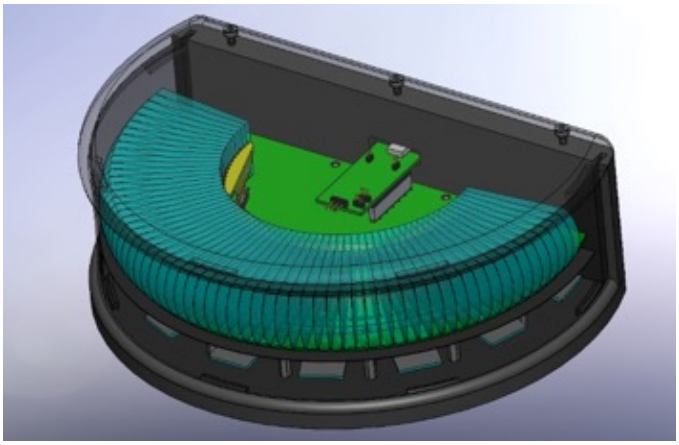

Figure 1: A short-range, low-cost solid state flash lidar subassembly sporting 64 lenses for each IR PIN photodiode

More contemporary uses of lidar range from autonomous robotics to process and motion control, transforming factories in the Industry 4.0 manufacturing revolution. Numerous organizations implement robots and collaborative robotics (cobots) that help humans perform functions across the production line, move objects, or complete various repetitive or low-skill tasks in a safe and controlled way. Electronic manufacturing facilities often use autonomous solutions to shuttle circuit boards from one end of the facility to the other. Some organizations have even introduced "lights out" fully automated facilities to handle logistical duties that require no human presence on-site.

The Need for Low Cost, Low-Resolution Sensors

In these industrial applications, lidar performs a similar function to those in autonomous vehicles but on a smaller scale. For example, in autonomous vehicle applications, lidar must create a comprehensive image around the vehicle and detect objects at 200 meters or more away. Accurate, high-performance, high-speed

scanning, lidar can map an entire hemisphere one pixel at a time due to its powerful processing hardware and software. This type of lidar allows the vehicle's computer systems to perceive stationary and moving objects and adjust the vehicle's trajectory to keep the driver and pedestrians safe and the vehicle on the correct path.

For robotics applications, the need for advanced vision capabilities to identify and define objects still exists. The technology only needs to be capable of sensing objects within a limited range, usually five to 50 meters. These applications also require far less precision and their systems offer limited computing power due to their constrained form factors. These differences are easy to visualize when you consider autonomous vehicles can travel at speeds of 55 mph, whereas an automated forklift moves at four mph.

Despite their more modest requirements, today's robotics and automation equipment manufacturers are compelled to purchase expensive high-end lidar technology with features they don't necessarily need. To remedy this lack of options for lower-end lidar solutions, many manufacturers are exploring alternatives.

Industrial Lidar Solutions

There are ways to meet the need for lidar technology in the industrial sector. One approach many manufacturers are using today is to incorporate off-the-shelf (OTS) automotive-grade lidar sensors and disregard many of the features in favor of a limited data set. This strategy makes OTS solutions feasible and reliable from a performance perspective but is not cost-effective.

What's truly needed is an alternate approach that meets the low cost, small form factor, and computational power limitations that will make lidar easier to integrate into existing technology of all shapes and sizes. This type of solution also makes manufacturing, tuning, and preventative maintenance simpler, further decreasing costs.

The Benchmark Difference—When It Matters

Benchmark is the ideal choice for innovators seeking a partner that understands the unmet needs of the complex industrial market. We have a wealth of knowledge and experience in both the design and manufacturing of lidar and other vision and perception systems across a wide variety of applications, leveraging critical expertise in advanced optics modeling, simulation, design, prototyping, production, and global supply chain management.

Benchmark's design and manufacturing processes for optical technologies result in a quality solution tailored to meet each application's specific needs and at the target cost and schedule. Our long-time partnerships with robotics and automation customers across the industrial sector also provides us unique insight into the industry. And for industrial manufacturers interested in designing after-market autonomous solutions for legacy industrial technologies, our advanced capabilities in electronics miniaturization help reduce the size, weight, and power (SWaP) of technology that can be integrated into an existing design.

Conclusion

The industrial sector is now in its fourth revolution, representing the optimization and control of the value chain using digital technologies. Lidar technology is a crucial driver in the revolution, enabling smart products and factories. Still, lidar is currently driven by the autonomous vehicle industry with vastly different requirements and price margins. By meeting the challenge of developing cost-effective lidar solutions that facilitate autonomy, Benchmark pushes the industry forward faster, serving as a partner who can produce the right sensing solution and effectively integrate it into each application.

To learn more about Benchmark's capabilities in optics, custom electronics, and advanced miniaturization, please visit us at www.bench.com.

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