

# Scanning Products into 3-D

3-D scanning technology reduces costs and speeds up product development with new technology advancements.

**3-D** scanners analyze real-world objects or environments to collect data on their shape and appearance. The collected data can then be used to construct digital 3-D models that can aid in product development.

3-D scanners share several traits with cameras. Like cameras, they have a cone-like field of view, and can only collect information about surfaces that aren't obscured. While a camera collects color information about surfaces within its field of view, a 3-D scanner collects distance information about surfaces within its field of view. The "picture" produced by a 3-D scanner describes the distance to a surface at each point in the picture. This allows the 3-D position of each point in the picture to be identified.

The global 3-D scanning market is estimated to grow from \$2.06 billion in 2013 to \$4.08 billion by 2018, at a CAGR of 14.6% from 2013 to 2018, according to a MarketsandMarkets report. Recent trends in the industry show 3-D scanning as improving, with a huge demand. And 3-D scanning with services like reverse engineering, rapid prototyping and quality inspection, makes it suitable for most verticals. The enhanced efficiency, affordability and faster and more accurate results are some of the advantages and offerings of this technology. Portability and ease-of-use are also important features.

While the costs of 3-D scanning devices aren't decreasing, companies are offering a wider solution range at a wider price range. Manufacturers, such as LMI Technologies, Creaform, MakerBot Industries and

specialized devices for embedded systems, they are becoming closer to complete 3-D camera systems. This allows for a much greater ease-of-use from industries, as they can get a complete 3-D scan in seconds.

## Technology advancements

While there's always a need for larger high-precision devices, the miniaturization of cameras, controllers and processing technologies has enabled a new generation of small scanners that can be used in a mobile or handheld manner of scanning objects in their natural positions.

LMI Technologies' HDI 120 3-D Scanner is the smallest advanced 3-D scanning system on the market using blue LED projection technology. Designed for industry applications that depend on accurate and repeatable scanning results, the HDI 120 is useful for reverse engineering, 3-D inspection measurement and visualization. With a solid aluminum body that is dustproof and water resistant (IP67 rated), this scanner is pre-calibrated to produce repeatable 3-D scanning results while operating in harsh environments.

In the past, a majority of 3-D scanners used laser dot or laser line technology. As structured-light 3-D scanning technology started to emerge, there wasn't much user product knowledge surrounding the differences between a laser 3-D scanner and a structured-light 3-D scanner. However, today almost half the 3-D scanners introduced are based on different forms of structured-light technology (typically white or blue LED technology). LED light sources are now the standard lighting technology for 3-D scanning technology due to their small size, long lifetimes and low heat emission. Prior to LED, the standard was metal-halide lamps.

In addition to a shift to LED light sources is the move from CCD imagers to new high-performance CMOS global shutter sensors. Traditionally, CMOS sensors were only used in low-end imaging applications, "but we see more high-performance CMOS-based imagers," says Daniel Brown, product manager at **Creaform Inc.**, Newark, Del. Their main advantage is that for a significantly reduced cost, they provide high frame rates at relatively high resolution, require much less complicated electronic drive circuits and have lower power consumption. The 3-D scanner industry, according to Brown, also benefits from other advances in consumer electronics such as high-bandwidth USB3 communication channels and powerful embedded processors. In the lower end of the 3-D scanning technology spectrum there's a trend towards directly using consumer electronics 3-D sensors coupled with specific software applications. "But to meet the accuracy and resolution needs of the industrial market, high-end 3-D scanners still need to rely on higher-quality discrete components," says Brown.

Another important technological enhancement is the increase in computation power. As scanners get faster and capture larger amounts of data, there's more information to process and the bottleneck is often the computer. "The constant evolution in computation power and optimization algorithm means it's possible to deliver better data generated by a given device without changing its hardware," says Brown.



Creaform Inc.'s HandySCAN 3D being used in a laboratory environment.

NextEngine, are introducing more affordable solutions to complete their offerings and attract new customers.

**LMI Technologies**, Canada, has seen a growth in snapshot 3-D scanning, which has driven much interest in the desktop, industrial and consumer 3-D scanning markets. While 3-D scanners have traditionally been

3-D scanning advances will continue to follow camera advances: connection and communication standards, as well as optical component stability/quality. For electronics, there's a requirement for smaller sensor FOVs and a driving requirement for speed. The ability to inspect small parts at a high speed is a continued trend.

In the past three years there's been a trend in increasing speed, especially with handheld 3-D scanners. "The typical speed increased from a few thousand points per second to hundreds of thousand points," says Brown. "This improvement was reached in part through the use of higher-performance imagers, but most of the increase comes using more complex structured laser or white light patterns that cover the entire field of view of the scanner instead of only using a single laser trace." In addition to advances in pattern projection technologies, new light coding techniques were developed to enable spatial decoding of the pattern, which is the basis of single-frame full-field 3-D imaging. Advances in high-speed image processing, as well as in real-time surface reconstruction and visualization, were also key in the development of highly portable and accurate handheld 3-D scanners, according to Brown.

### Reducing costs, speeding up product development

3-D scanners provide complete measurement information of objects, in the fastest way possible. It saves considerable time when modeling existing objects in CAD software. And 3-D scanning provides R&D/product development teams with both time and cost reduction when designing, enhancing and testing products.

In the manufacturing space, 3-D scanning is a critical component in inspection and quality control systems. Detecting errors in part production early is critical. The further along a bad part moves down the production chain, the higher is the chance that part may cause further damage downstream and incur cost increases. "Having a 3-D sensor that can 'see' what's happening, and trigger an appropriate remedy quickly, is a key cost-saving benefit," says Thomas Tong, global sales manager of HDI products at LMI Technologies.

However, not only do 3-D scanners offer cost-saving benefits to the manufacturing industry, but they also offer speed in product development. 3-D scanners have a wide adoption in the product design and CAD desktop space. The ability to capture real-world objects in the digital domain and then create new CAD drawings based on existing information is significantly faster than creating CAD by hand. "Often it's a critical way to design parts that will be sure to physically match or interface with existing parts," says Tong.

3-D scanning technologies streamline the 3-D modeling process, allowing designers and engineers to considerably reduce time-to-market.

### Software growth for 3-D scanning technology

While physical 3-D scanners are well understood, the processing of 3-D scan data is still "a black art" or unsolved problem for many industries, according to Tong. More industry-specific packages for processing and understanding 3-D scan data are hitting the market. From simple things like finding the size of a drill hole to finding and analyzing metal stampings, manufacturers are seeing an ever-expanding software need to understand what gets captured by 3-D scanners.

As the scope of 3-D scanning technologies become wider, dedicated applications requiring dedicated software are starting to appear. "For instance, Pipecheck, a software program especially made to analyze pipeline external damages due to corrosion, was key to implement 3-D scanning technology into that market," says Creaform's Brown. Having the right dedicated software to perform integrity assessment analysis is what successfully drove the HandySCAN 3D in the oil and gas industry. "A similar phenomenon is happening with our OEM partners in the health care equipment industry," says Brown.


Furthermore, 3-D scanning technologies and CAD software are attempting to cover a user's entire workflow when it comes to creating CAD models from existing objects. In general, CAD software is integrating 3-D scan data processing functionalities, and 3-D scanning software is integrating more CAD functionalities. "At Creaform we offer a simple, yet powerful 3-D scan processing software module that is fully integrated with our 3-D scanners that delivers only the features necessary to complement our customer's CAD software," says Brown.

### The future

In the past, the core questions were scanning accuracy and scanning speed. As technology moves ahead, manufacturers see more choices along different paths such as smart sensors, embedded modules and scanner mobility. Users will see more real-time capture of scan data, so they don't only get complete data sets, but also see more 3-D scan data captured as video.

Advancements in portability, ease of use, accuracy, resolution and speed, as well as more accessible 3-D scanning solutions for "prosumers" and more integration between hardware and software will also be seen in the near future.

—Lindsay Hock



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