Machine Vision Systems: Industrial Applications Rise, but Trade is Hard to Track

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Machine vision systems are a key area of the so-called fourth generation of industrialization, or "Industry 4.0," which is defined in large part by its utilization of integrated machine learning systems and artificial intelligence. Rapid growth and innovation in machine vision systems has brought a wave of new industrial applications, such as testing self-driving vehicles, autonomous farm equipment, and computer-guided surgery. The impact of the rapid growth of machine vision systems on manufacturing and industrial applications has also been significant. This EBOT offers an insight into the adoption of these technologies in global manufacturing and describes some of the difficulties in tracking international trade in machine vision systems.

What is Machine Vision?

Machine vision allows a computer to automatically extract information from images. When applied to manufacturing, machine vision captures images of objects on a manufacturing line, which are then analyzed against a defined set of criteria for defects or to determine the proper action the machine should take.

Machine Vision Applications

As machine vision technologies are becoming smaller and faster, they are increasingly used in emerging automation applications like autonomous vehicles, advanced inspection technologies, and bin picking (warehousing). Manufacturers point to a variety of factors for deploying machine vision in their production processes, from the ability to work faster and more consistently, to running production lines for longer periods, thus increasing productivity of their businesses. Machine vision systems have transformed the way manufacturers conduct their inspections and coordinate with robots on the factory floor. For quality control, machine vision systems use cameras and sensors to observe, obtain, and compare images to determine the quality of the product and report any deficiencies. Machine vision systems have become especially important where manual inspections of products of relatively small size are challenging.

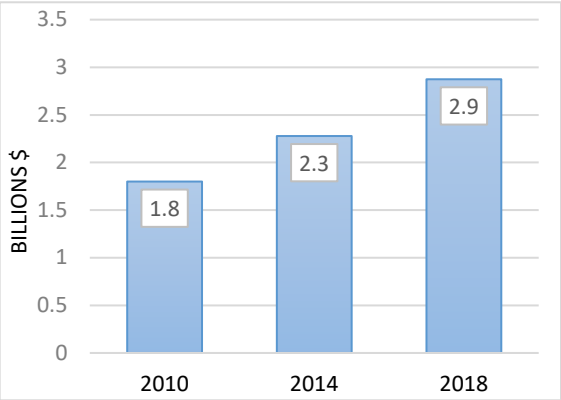
3D machine vision technology is also becoming more prevalent in manufacturing. In early 2019, Canon's 3D Machine Vision System was deployed at a mass production line of printer parts. Using 3D machine vision, the eye of the robot is able to recognize the correct part out of a pile of randomly scattered parts, analyze the best pick, and precisely select it without interfering or delaying the throughput demands. The Global Association for Vision Information (AIA) anticipates vision technologies and their components to continue to improve and be integrated into the visual intelligence that robots and other smart machines use in manufacturing.

Growth areas

In recent years, the United States has experienced rapid growth in machine vision systems, specifically in areas of advanced manufacturing. According to AIA, the overall North American machine vision market grew from $1.8 billion in sales in 2010 to $2.9 billion in 2018 (figure 1).[1]

[1] Total machine vision systems sales equals (=) total components plus (+) total machine vision systems plus (+) other machine vision sales (integrator, distributor and sales not identifiable by market).

Figure 1: Total Value of Machine Vision Financial Transactions in North America, 2010-18



Source: Adapted from AIA's "2018 Automation Market Update," 2019.

Tracking international trade in machine vision systems is difficult

Machine vision systems are made up of many components that are provided in a range of headings of the U.S. Harmonized Tariff Schedule (HTS). Cameras are included in HTS subheading 8525.80 (television cameras, digital cameras, and video camera recorders), scanners are in HTS subheading 8471.60.80, and lasers could be found in HTS Chapters 85 and 90. Under specific subheadings, 3D cameras that may be used for industrial purposes are grouped with consumer and recreational digital cameras.

The difficulty of tracking global trade of machine vision technologies is made even more challenging by the complexity of the supply chains. Some facilities handle component procurement, system assembly, software loading, quality control, and shipment of product to customers worldwide. Many times, however, third-party manufacturers (domestic or foreign) may perform component procurement, system assembly, and initial testing, and then ship a semi-assembled or fully-assembled product to another facility where the software is loaded onto the product, thus making it difficult to determine whether its end use is specifically for machine vision applications or for other consumer or recreational purposes.

Machine vision systems globally

The North American machine vision systems market is part of an expanding global market that in 2018 was worth around $8.9 billion and is expected to grow to $14 billion by 2025. Driving this growth is the need for improved product inspection and quality control in the manufacturing sector, as well as the growing demand for smarter collaborative robots in manufacturing and warehousing. The North American market is the second largest market for machine vision systems, only behind Europe, which accounts for about one-third of the total market revenue share. Together, North America and Europe hold more than half of the total market. The majority of growth in recent years, however, has occurred in the Asia Pacific region, particularly China, where the market for machine vision systems has grown at around 48 percent on an annualized basis for the last decade. In 2018, sales in China increased to $1.23 billion, an increase of 21 percent from 2017. Cognex, one of the largest U.S.-based global suppliers of machine vision systems, software, sensors, and industrial barcode readers used in manufacturing automation, reported that Asia represented 29 percent of its 2018 global revenue.

Table 1 Selected global machine vision system manufacturers, by country

Company name	Key machine vision systems and components supplied
USA: Cadence Design Systems, Cognex, Intel, Microscan Systems, National Instruments, Teledyne Technologies	• Vision systems • Software • Processors • Sensors • Scanners
Japan: Keyence, Omron, Panasonic, Sony	• Vision systems • Sensors • Cameras • Software • Image-checkers
Germany: Allied Technologies, Basler, MVTec Software, Sinoptix, Xenics	• Cameras • Software • Embedded vision systems • Sensors
China: Daheng New Epoch Technology	• Vision systems • Laser applications • Optoelectronics • Sensors

Sources: AIA, "North American Machine Vision Market Grows Nearly 10% in 2018, Hits Record Numbers for Sixth Straight Year," March 29, 2019; AIA, "Canon 3D Machine Vision Deployed at Mass Production Line," May 9, 2019; AIA, "Introduction to Machine Vision," July 22, 2011; Cision PR Newsire, "Global and China Machine Vision Industry Report, 2019-2025," May 7, 2019; Cognex Corporation, 2018 Annual Report, 2019; Global Association for Vision Information, "2018 Automation Market Update," accessed August 21, 2019; Globe Newswire, "Global Machine Vision Market to 2025 with Focus on the Chinese Industry," May 10, 2019; Imaging & Machine Vision Europe, "Chinese vision market Y8.39bn in 2018, up 21%," March 8, 2019; Imaging & Machine Vision Europe, "Machine vision system market to reach $15bn by 2025, new report finds," July 26, 2019; The Robot Report, "Machine vision market grows 10% in North America," March 29, 2019.