The Advantages of 2D Imaging

A White Paper By Datalogic Mobile Inc.

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Introduction

Bar code technology has increased efficiency and accuracy in a wide variety of manufacturing, retail, service, logistics and warehouse applications over the past four decades. With the introduction of two-dimensional (2D) bar code symbologies and high-quality imaging scanners, end users can now access even greater amounts of data, further enhancing existing applications and creating new opportunities to leverage the technology for more complex data collection systems.

Definition

Traditional linear bar codes are created using the familiar series of black bars and white spaces. These bar codes — such as the common U.P.C. code found on items at the grocery store — are termed one-dimensional (or 1D) codes, as the bars are presented along only the length of the code. Two-dimensional (2D) codes consist of a much wider variety of patterns (squares, dots, hexagons and other geometric shapes). Because data is encoded in both the height and width of the symbol, 2D codes can store a much larger amount of data than is typically found in a one-dimensional symbol — anywhere from 93 to as many as 2,500 characters or more, approximately 25 times the amount of data found in a 1D code. Common 2D codes include PDF417, Data Matrix, MaxiCode, QR Code, Macro PDF, RSS and Aztec Code.

Unlike the laser scanners used to read linear bar codes, 2D codes are read with camera-based imagers that take successive black-and-white images of the code, isolate and decode it, then relay that information to the application. Imaging technology is available in rugged mobile computers, hand-held and presentation scanners.

Benefits

Although 2D bar codes and imaging scanners previously were just a small part of the automatic data collection market, the technology has become more mainstream over the past few years, and according to industry analyst VDC is expected to grow 18% annually through 2012.

2D bar codes have been adopted within the aerospace, automotive, electronics, semiconductor, sanitation and telecommunications industries, as well as by government agencies like the U.S. Department of Defense and NASA.

End users are now able to purchase reliable imaging scanners at a much lower cost than was previously possible, and the scanners themselves have improved in terms of scan speed, read range and motion tolerance, providing performance on par with laser scanners.

The combination of 2D bar codes and high-quality imaging scanners has produced a number of benefits for enterprise users, including:

Increased data capacity: Because they can provide a larger amount of data in a much smaller footprint, 2D bar codes enable a wide variety of track-and-trace and other applications. With more information about a marked item, scanning the code can auto-populate forms in a number of field service, maintenance, inspection and customer applications; provide valuable traceability data; and improve data access for remote applications. Their relatively small size means these codes can be directly marked on everything from delicate electronic circuit boards to automotive parts with uneven or curved surfaces.

2D codes can store a much larger amount of data than a one-dimensional code.

Omnidirectional scanning: Imagers can also read codes regardless of the orientation of the scanner or the label, a critical capability for manufacturing, logistics and maintenance applications where workers may need to scan hard-to-reach codes on packages, meters, heavy equipment, or within an engine chassis. Image-based presentation scanners provide this same functionality for point-of-sale applications.

Once the code has been read, the scanner typically generates an audible "beep" so that the end user knows it has successfully been decodes. In noisy environments (such as in a manufacturing facility, for example), a visual indicator can provide confirmation. Datalogic, for instance, provides a patented "Green Spot" technology in its imaging scanners that uses a separate LED to provide visual confirmation of a successful scan.

The same technology can be used for applications in hospitals, doctor's offices and libraries, where silent scanning may be preferred. The Green Spot can also help users target a single code from a group of codes or to position a single code inside the reading area — an especially helpful feature in logistics and package tracking applications, where one label may include several 2D and linear bar codes.

Durability: Unlike laser scanners, imaging scanners have no moving parts. In rough-and-tumble industrial and retail environments, that translates into fewer repairs and less downtime as the devices are heavily used and (in some cases) abused in the field.

Improved Error Correction: When 1D bar code labels are damaged, ripped or faded, they can be difficult if not impossible to decode. In order to read a partially damaged 1D code with a laser scanner, the scanner must be carefully aimed at an undamaged portion of

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the label. Since 2D codes feature enhanced error correction (and in some cases provide data redundancy within the code), they can still be read even if significant portions of the label are damaged or missing. Imaging scanners present pictures of the entire code to the decoding library. Logic is used to piece the images together, much like a puzzle, and compare those pieces to codes in the library. This allows even damaged 1D codes to be read by compiling different parts of the same code.

Investment Protection: Many of the industries that have adopted 2D bar codes still utilize a mix of 1D and 2D codes. Using imaging scanners allows end users to read a wide variety of codes, as well as perform other functions. Datalogic has developed a range of hand-held and presentation scanners that leverage imaging technology for both retail and industrial applications. Datalogic's scanners can decode both linear and 2D bar codes, capture digital signatures or images, and in some cases read multiple codes simultaneously. In this way, imagers protect a company's data collection technology investment in markets that have emerging track-and-trace requirements.

Imagers can also read codes regardless of the orientation and feature enhanced error correction to read even if significant portions of the code are damaged or missing.

Applications

2D bar code technology provides many advantages to end users, but it is not suitable for every project; for items that only have to be marked with a simple serial number of SKU, 1D bar codes are still sufficient.

Where 2D technology excels is in applications that require a higher degree of functionality, and where the bar code has to accommodate a much larger amount of data. In track-and-trace applications — where users must maintain an up-to-date location history of items like parcels, shipping containers, pharmaceuticals and other goods — 2D codes can be used to provide a wider variety of item-specific data, such as lot number, a date code, manufacturing location, routing numbers, and other information. A number of industries have widely deployed 2D codes for these advanced traceability systems.

Manufacturing

Manufacturers in the automotive, aerospace, pharmaceutical, electronics and other vertical segments have deployed 2D bar codes. These industries rely on the larger data capacity of the 2D codes for assembly and process control, work-in-process, anti-counterfeiting, asset tracking and other applications.

In some industries, manufacturers utilize direct part marking of 2D codes to provide part traceability for items that are either two small for traditional labeling or that operate in harsh environments (within an aircraft engine, for example) where labels would rapidly deteriorate.

In these applications, 2D bar codes can be printed or etched on parts with complex or curved surfaces. Because the codes can contain a variety of data — serial numbers, batch numbers, material information, service history, etc. — they can aid in a number of post-assembly service and safety applications. In the aerospace industry, for example, 2D codes can be used to track the repair history and hours of service for airplane components that have to be regularly maintained and replaced per federal safety guidelines. In the automotive industry, manufacturers can utilize the tracking information on each component to better target safety recalls.

In related field service applications, 2D codes can provide model and serial numbers to field technicians, and can automatically link those technicians to repair information held in electronic manuals or on the Internet. The technicians can also update service history data so that the information can be accessed even if employees are unable to access offline databases

Several industries have mandated use of 2D bar codes. For example, the U.S. Department of Defense requires that certain of its assets be permanently marked with Data Matrix codes as part of its Unique Identification (UID) initiative, and the Air Transport Association's (ATA) Spec2000 traceability standards include 2D codes.

Retail

Most retail applications (i.e., check-out scanning and inventory management) rely on 1D U.P.C. codes, and laser scanners continue to dominate this market because of their relatively lower cost and familiarity. But 2D imagers are beginning to infiltrate the check-out counter, enabling a number of other value-added applications. For example, the majority of states in the U.S. include a PDF417 code on their driver's licenses, and these codes can be used by checkers to verify a customer's age when selling restricted items like cigarettes and alcohol. The content in those bar codes (which includes the customer's name, address, and other information) can also be used to automatically complete registration forms for customer loyalty programs or credit card applications, saving valuable time at the check-out. In each case, an imaging-based presentation scanner could be used for both POS and additional applications.

Another example is in the pharmacy. Because pharmaceutical manufacturers have begun marking drugs with 2D codes in order to secure their supply chains, retailers can utilize the technology to verify the authenticity of the merchandise and provide additional traceability information. The European Federation of Pharmaceutical and Industries Association (EFPIA) is currently piloting a system

in which pharmacies use 2D codes to validate drug authenticity against a manufacturer database. Several states in the U.S. are also developing "e-pedigree" requirements for pharmaceuticals that would mandate similar traceability requirements.

2D codes have also found their way into the produce and meat departments of many grocery stores. In the wake of several high-profile product recalls of everything from beef to spinach to powdered milk, 2D codes are being utilized to provide farm-to-fork traceability. With improved visibility into where food was produced and distributed, manufacturers and retailers can quickly respond to any food safety recalls, pulling food out of circulation that might pose a health risk while avoiding throwing out uncontaminated product.

2D imagers enable automated drivers license verification as required by some states for selling restricted items like cigarettes or alcohol.

Healthcare

In addition to tracking pharmaceuticals, the healthcare industry has adopted 2D bar codes to improve patient safety within hospitals.

Bar code technology is heavily used within healthcare facilities to ensure the "five rights" of patient safety — that the right patient receives the right drug, at the right time and the right dose, in the right form. In these applications, bar coded patient ID bracelets are scanned and matched to pharmaceuticals, intravenous medications and even blood bags.

Other facilities are using 2D codes to track assets within the hospital, and even to process valuable surgical tools in the operating theater. Several hospitals have piloted systems using 2D codes to track everything from anesthesia equipment to scalpels as they move from the OR through the sterilization process and back into storage.

Logistics

Companies like UPS and FedEx have leveraged 2D Aztec Code, Data Matrix, PDF417, and MaxiCode (along with linear bar codes) to track packages throughout their distribution networks. By arming delivery drivers with portable imaging scanners, these companies have also been able to capture digital signatures for proof of delivery and even take photographs of damaged packages.

The United States Postal Service uses 2D bar codes for electronic postage metering. The 2D codes in the USPS application can include the amount of postage, as well as a cryptographic digital signature for offline e-postage systems, security information, and data about the postage meter that generated the electronic stamp. 2D imagers are used at mail processing centers to verify postage by reading the bar code and using optical character recognition technology to evaluate printed or hand-written address information.

Summary

2D imaging scanners are being deployed in a variety of applications to read both linear and 2D bar codes. As an increasing number of applications within the retail, manufacturing, logistics, healthcare and other sectors leverage 2D bar codes to improve traceability, imagers will play a larger role in automatic data capture deployments. Because of their ability to read a variety of codes, their durability and the need to "future proof" scanner deployments in industries where traceability standards are evolving, the role of 2D bar codes continues to expand.

About Datalogic Mobile Inc.

Datalogic Mobile is a global manufacturer of mobility solutions for retail applications, assisted shopping, warehouse solutions, and field-force automation.

Our diverse product range of rugged mobile computers includes pocket-sized computers, pistol grip computers, and industrial PDAs designed to keep workers connected to their enterprise inside or outside the four walls. Our mobile computers use Cisco® Certified CCX radios for maximum levels of: RF security, data throughput, and efficiency. Datalogic Mobile computers use the latest technologies for voice and data communications giving mobile workers on-the-go connectivity.

Datalogic Mobile is the worldwide leader in Assisted Shopping. Over 350 retail stores have implemented Datalogic Shopevolution™ software and the Datalogic Joya™ handheld pod as their assisted shopping solution. Datalogic assisted shopping gives retailers a competitive advantage while reducing their operational costs. Joya makes shopping a multimedia experience that increases consumer loyalty.

Datalogic Mobile has worldwide presence in over 30 countries and over 800 business partners worldwide. A leader in technology, Datalogic has growing portfolio of over 850 patents, eight research and development centers, and 300 engineers.

See us on the web at www.mobile.datalogic.com
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