Considerations: Evaluating Three Identification Technologies

A variety of automatic identification and data collection (AIDC) trends have emerged in recent years.
While manufacturers have relied upon one-dimensional (1D) bar codes as an efficient, cost-effective means to encode identifying information on the products they make for more than 30 years, a variety of automatic identification and data collection (AIDC) trends have emerged in recent years, including:

- Identification by vendor supplied codes versus LPN (license plate number)
- Reduced code footprints
- Tighter product gaps and increased conveyor speeds to boost throughput
- Higher read accuracy demands to reduce handling errors
- Addition of two-dimensional (2D) matrix codes to the traditional 1D bar codes
- Increased case- and item-level RFID tagging
- Decreased tolerance for poor quality bar codes
- Code grading and image storage for root cause analysis

Recognizing these trends, AIDC solutions manufacturers have continuously improved traditional laser scanning capabilities, while simultaneously developing new, complementary technologies—including image-based code readers and radio-frequency identification (RFID)—to help manufacturers and DCs better meet these new identification challenges and help achieve the desired process improvement goals.

But selecting the most appropriate AIDC technology—or combination of technologies—can be a confusing proposition. Each offers specific advantages that may make them better suited to meet the application requirements and cost objectives of a given installation. How can you ensure the best match between your AIDC needs and the available technologies?

This white paper provides an overview of these three AIDC technologies, explains their benefits and limitations, and offers examples of potential applications to help prospective users determine the best, most cost justifiable investment for their operation. It also offers a list of questions to help determine the specific characteristics of an application critical to the selection of the ideal solution.

**The Technologies: An Overview**

Laser-based, camera/image-based and RFID data capture technologies all have a place in a modern handling operation. When properly applied and installed, any of these technologies achieves read rates of 99.5%, or even 99.9% in some operations. It is important to understand their differences in order to identify which offers the best performance for the applications within your supply chain while minimizing the investment. The following section presents an overview of each.
CONSIDERATIONS: EVALUATING THREE IDENTIFICATION TECHNOLOGIES

Comparison Table

<table>
<thead>
<tr>
<th></th>
<th>Laser</th>
<th>Camera</th>
<th>RFID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1D bar code</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2D code</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Transponders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line of sight</td>
<td>required</td>
<td>required</td>
<td>not required</td>
</tr>
<tr>
<td>Costs of a label or tag</td>
<td>&lt; $0.01 (label)</td>
<td>&lt; $0.01 (label)</td>
<td>&gt; $0.10 (tag)</td>
</tr>
<tr>
<td>Capacity of the code carrier</td>
<td>low</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>Maximum reading field width</td>
<td>large</td>
<td>large</td>
<td>average</td>
</tr>
<tr>
<td>Depth of field</td>
<td>high</td>
<td>low</td>
<td>average</td>
</tr>
<tr>
<td>Omni-directional reading</td>
<td>min. 2 devices needed</td>
<td>well suited</td>
<td>very well suited</td>
</tr>
<tr>
<td>Maximum object speed</td>
<td>16.4 feet-per-second</td>
<td>19.6 feet-per-second</td>
<td>application dependent*</td>
</tr>
<tr>
<td>Sensitivity to external light</td>
<td>very low</td>
<td>low</td>
<td>no influence</td>
</tr>
<tr>
<td>Impairment by dirt, wear</td>
<td>medium</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>Read interference by surrounding metals/liquids</td>
<td>none</td>
<td>none</td>
<td>potential</td>
</tr>
</tbody>
</table>

*depends on which operation(s) (read/write/both) & how much data you need to transfer during the “RFID event.”

Laser Scanners: The dominant 1D code reading technology for the past 30-plus years, laser scanning is often the lowest cost, lowest maintenance way to achieve the highest read rates in many operations—assuming reasonable bar code quality. Well-suited for industrial use, lasers offer a large field of view (up to 60°); meaning a single device can cover most conveyor belt widths. Laser scanners can achieve scan rates in excess of 1200 scans per second, making them ideal for application travel speeds up to 700 feet-per-minute.

Line scanners direct a laser beam along one line; raster scanners direct a laser beam along several parallel lines. These scanners detect the intensity of the laser light reflected from the light and dark elements of the bar code. The devices can be used in applications as diverse as identifying a single carton by its UPC code up to full coverage of a pallet due to their inherent installation flexibility. Laser technologies work in virtually any lighting condition—from no external lighting to sunlight, extreme cold (-30° F) or high heat (120° F) with no loss in reading performance and no additional calibration required.

Cameras: Also known as image-based code reading technology, cameras can read both 1D bar code and 2D matrix codes omni-directionally (in any orientation), as well as plain text. They also capture and store live images for analysis and data archiving, and can read poor quality codes. Because this technology must first take a picture of the code in order to read it, the cameras can be used to flag bad codes and the resulting images stored for analysis and visual evidence to work with suppliers about code quality issues. The ability to both grade and capture images of codes on the fly is one of the primary reasons to invest in this technology.
Individual cameras are often limited to a relatively small field of view or depth of field, requiring multiple units to solve a single application. Relative to laser scanners, that means cameras require a significantly higher investment in order to achieve a coverage area comparable to that of a laser scanner. Further, cameras require proper illumination of the scan area, as well as regular maintenance and routine adjustment to keep the camera and lens functioning consistently, particularly in applications subject to shock and vibration. There are two primary types:

- **Area Array Cameras**: These cameras capture a full image of an entire region at one time, similar to a snapshot taken with a standard point and shoot digital camera. Image area is measured in pixels (a 1600 x 1200 pixel sensor captures a rectangle-shaped image at that resolution). Depending on the capabilities of the individual device, the camera takes multiple pictures—capturing anywhere from five to 100+ images per second—making it more suitable for interpreting damaged codes. The images are decoded by the camera, which transmits the information to upper level control systems. Due to image speed limitations and constrained field of view (generally less than 16 inches wide), a single area array camera fixed over a conveyor line is typically not sufficient for code reading. To ensure that a code is fully captured, two to six area array cameras must be set up side-by-side with a minimum 4-inch overlap of fields.

- **Line Array Cameras**: Utilizing a single line of pixels on the sensor, this camera technology acquires slices of the image progressively as the item moves through the illumination field, offering an inherently large image size with low depth of field. Often times an input device gives the camera feedback so it can focus at the correct distance due to this lack of depth of field. Because these cameras are capable of performing 30,000 scans per second, they can produce extremely high-resolution images, even at very high transport speeds. This high-resolution image is ideal for reading the widest range of codes possible. The lines are assembled into a two-dimensional image of the code, which is ideal for optical character recognition (OCR) or other external image processing.

Integrated code grading tools also tend to be more accurate and consistent in line array camera systems than those in area array cameras due to continuously adjusted focal distance and improved illumination consistency throughout the field of view. Because of how they function, line array cameras are typically more costly than area array cameras; however a single line array camera can cover a 40-inch wide conveyor with 36-inch tall cartons—a space that would require up to four area array cameras, making it the more cost-effective solution with premium performance.

**RFID**: Unlike laser scanners and cameras, RFID does not use optics, laser light beams and imaging sensors to decode data from visible codes on objects. Instead, passive RFID employs tags that do not utilize any batteries for their source of power. Alternatively, active tags have an integrated battery and work by periodically broadcasting their identity. Data can be encoded to identify objects to the item level. This information is stored in a microchip attached to a small, and most times hidden, antenna. RFID read/write devices (a.k.a. interrogators) transmit and receive
data to and from tags by using electromagnetic waves over an “air interface.” One popular form of the technology employs ultra-high-frequency (UHF) radio waves broadcast in a band from 860 to 960 megahertz. The specific operating frequency band depends on the local radio frequency regulations of a given country or region. Because it relies on radio frequency technology, RFID does not necessarily require direct line-of-sight to read or write data, and properly designed systems can identify hundreds of tags per second simultaneously. Indeed, following best practices for attaching and locating tags (transponders) to objects and employing the correct antenna design for proper interrogation, RFID enables fast, accurate verification of case packed inventory without opening the box. It is also ideal for use in extreme temperatures and dirty environments. Although rugged and priced more affordably than ever before, RFID tags are still more expensive than printed 1D or 2D codes.

Application Evaluation: Questions to Consider

Before evaluating the AIDC technology possibilities, take a look at the application at hand. The process, the data to be captured, and the items upon which the information is placed are all important considerations. Consider the following to help define the task:
The answers to these questions will help you select the optimum AIDC technology, or combination of technologies from both an application and an economic perspective. Diagrams 1A and 1B below show a typical range of performance for each technology in sample applications.

1A: Example application in the area of container identification

1B: Example application in the area of load verification
Summary

Matching the correct laser, camera or RFID technology to the appropriate application offers significant operational benefits—from automating receipt of products and vendor compliance programs to accurate routing, high speed sortation and divert verifications, and to efficient picking, packing and shipping label print-and-apply. Working with an AIDC vendor partner who offers a full solution portfolio across a single platform—with common connectors, configuration and visualization software—can help with the selection process to ensure that the right solution is applied to your application.

Need more help selecting the right AIDC technology for your application? Email or call your SICK Sales Representative, or contact John Ashodian at john.ashodian@sick.com.

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