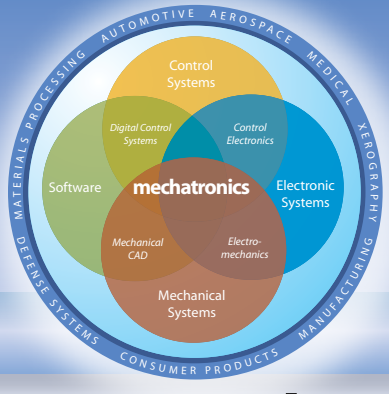
MECHATRONICS IN DESIGN

FRESH IDEAS ON INTEGRATING MECHANICAL SYSTEMS, ELECTRONICS, CONTROL SYSTEMS AND SOFTWARE IN DESIGN



Not Just for Groceries Anymore!

BY KEVIN CRAIG

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As a young boy growing up in the late 1950s, I remember well trips to the grocery store on a Saturday morning with my dad and going to the checkout line where a person would quickly read the price of the item, punch the keys on the cash register and be able to add and subtract with lightening speed if a correction needed to be made. Then there was the familiar ka-ching sound when the cash drawer opened. Most youngsters received a toy cash register as a birthday present in those days. How the world has changed! Now everything has a barcode and the world would come to a brief standstill if barcode scanners stopped working. What is this mechatronic marvel that looks like a "Star Trek" phaser and what is next in the world of automatic identification?

In a recent *Design News'* article and webcast, we explored the world of the digital camera. A barcode scanner can be considered a very specialized digital camera and, since barcodes convey digital information through a combination of narrow and wide bars and spaces, they can be viewed as the optical version of the Morse code.

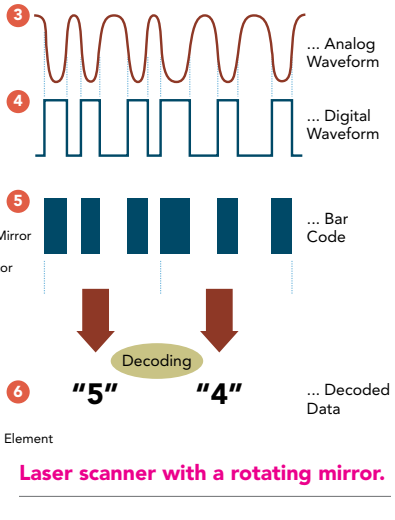
The two main types of barcode scanners are laser and CCD (charge-coupled device). Laser scanners (see figure, below right) use a laser beam as the light source and typically employ either an oscillating mirror (in handheld scanners) or a rotating mirror (in fixed-mounted scanners) to scan the laser beam back and forth across the barcode (1). A photodiode is used to measure the intensity of the light of diffuse reflection from the barcode (2). The light emitted by the reader is tuned to a specific frequency and the photodiode is designed to detect only this modulated light of the same frequency. This diffuse reflection looks like an analog wave form (3) which the barcode reader coverts to a digital wave form (4). The narrow/wide bars and spaces are identified (5) and then the signal combination of the bars and spaces is converted into data according to the barcode rules (6).

CCD readers (also referred to as LED scanners) use an array of hundreds of tiny light sensors lined up in a row in the head of the reader. Each sensor can be thought of as a single photodiode that measures the intensity of the light immediately in front of it. Each individual light sensor in the CCD reader is extremely small and because there are hundreds of sensors lined up in a row, a voltage pattern identical to the pattern in a barcode is generated in the reader by sequentially measuring the voltages across each sensor in the row. The important difference between a CCD reader and a laser scanner is that the CCD reader is measuring emitted ambient light from the barcode whereas a laser scanner is measuring reflected light of a specific frequency originating from the scanner itself.

The laser type, while larger and more expensive, has significant advantages over the CCD type including long-distance reading, a wide readable range, the ability to scan moving objects and the possibility of raster scanning.

2-D imaging scanners are the newest type of barcode reader. They use a small video camera to capture an image of a barcode. The reader then uses sophisticated digital image processing techniques to decode the barcode. Video cameras use the same CCD technology as in a CCD barcode reader except that instead of having a single row of sensors, a video camera has hundreds of rows of sensors arranged in a 2-D array so they can generate an image.

Barcode scanners are seeing continuous improvement with advances like the Liquid Polymer Scan Element that eliminates friction and wear. However, there are concerns that barcodes are vulnerable to security breaches and counterfeiting. RFID is designed to further increase the amount and complexity of data that can be encoded, the security of that data and the authenticity of the item the code or chip is attached to. Barcodes are basically free, but RF tags are not and probably never will be. So while there has been much speculation that RFID might eventually replace conventional barcodes, the general consensus is that the two methods will remain complementary for many years to come.



Laser scanner with a rotating mirror.

Mechatronics Marvel: The Bar Code Scanner. Check it out at http://rbi.ims.ca/5717-521.