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PMPA
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# Insights Into Vision Systems

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Can you assemble an inexpensive vision system for use on precision machine products? Yes, but with limitations. There are three basic components of a vision system:

1. Video System – camera, lens, monitor and cables

2. Lighting

3. Staging – an area to place the part for viewing

The above list is for a basic vision system that will allow you to view small visual nonconformities at a well-illuminated, magnified level. This system provides improved viewing of the workpiece for evaluation.

To get to the next level of capability, a computer and software should be added to the system. These will give you the ability to interpret what is being viewed and to determine if the specified acceptable criteria are being met.

The software and hardware can notify you with either an audible alert, or with red or green lights. In some installations, the electrical signal to the lights can be used to actuate a gate, arm or marker to indicate pass/fail for the examined part.

1. Video System. There are two types of vision systems available: a computer-based system and a stand-alone system.

The computer-based system is comprised of a personal computer (PC) terminal, video processor and a vision software package. This type of system tends to be used for lower volumes and is often found in quality control labs.

A stand-alone system is designed specifically for vision systems, with the program and processors integrated into one unit. Most stand-alone systems are better able to withstand a day-to-day shop-floor environment when compared to PC-based systems.

Cameras. There are many camera choices available today. Be aware that the cameras and lenses are usually sold as separate components. Some companies refer to cameras

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as "sensors." A major consideration to be addressed is camera or sensor resolution—either high resolution or standard resolution.

With a high-resolution camera, the user has the capability to make accurate dimensional measurements, especially when it is paired with a short-wavelength, blue light source. If you decide to go with standard resolution, you will lose the dimensional measurement capability but will be better able to view product features.

Lenses. To make the camera work, one or more lenses are needed. Some of the lens options available are fixed magnification lenses and zoom lenses, which allow several different magnifications within the same lens. The choice of lens should always match the specific application.

A compromise lens will yield compromised results. It is false economy to save money on optics (lenses) only to get inferior performance. The quality of the lens will also affect your vision and measurement capabilities.

2. Lighting. The most important element in any vision system is lighting. If you cannot properly illuminate the object of interest, the system will not operate to your satisfaction.

There are multiple styles and types of lighting available to inspect precision metallic parts. These include LED, fluorescent ring lights, bar lights, low-angle lights and coaxial vertical lights. Continuous lighting and strobe lighting are also options. You will have to determine which type of lighting best suits your application, depending on the types of materials (steel, aluminum, brass) or product characteristics being viewed.

3. The Stage. The stage is the place where it all comes together. The workpiece will be presented to the camera within the illumination field. At its most basic, the stage can be a desktop with a V-block.

A more elaborate setup with a moveable stage can be used to better adjust the location of the part to the camera and lighting.

Most vision systems have a fixed reference point (cross-hairs). This can be generated by an outside device or software for the camera. Or, it can be marked within an eyepiece if the system is configured like a microscope.

Image processing is how computer and software replace the human element in an automated vision system. Edge detection is a common image processing technique and is analogous to what is done with an optical comparator and a template. Pattern matching relies on a comparison to a stored pattern by the scan of the workpiece. Additional capabilities can be had by methods such as gray-scale conversion, image normalization and other techniques.

As with all new technology, vision system components are improving daily. Affordability (performance/dollar) is increasing as the markets and applications for these systems continue to grow. The availability of cameras, optics, illumination systems, stages and workholding equipment, software, size, options and companies specializing in vision systems continues to expand.

There are still limitations as to what can be done with today's vision system technology. The uses of vision for internal characteristics are somewhat limited. The availability of systems for examining external characteristics continues to grow, and many part features can be scanned and checked within seconds. These capabilities all come with a price.

"As with all new technology, vision system components are improving daily."

Affordable, shop-assembled vision systems can be created with readily available components and software. There are limitations depending on your requirements, application and budget. From a simple illuminator magnifier to ease operator viewing to a fully automated image processing system with the capability to mark or segregate nonconforming product, the technology is only a few clicks (and dollars) away.

Systems do not have to be purchased all at once. You can add or upgrade components and capabilities as your business needs change, as budgets allow or as part of an ongoing continuous improvement process.