

Integrated Vision

MAKE THE VISION SYSTEM INTEGRATION PROCESS AS SMOOTH AS POSSIBLE. By Greg Hollows



A well-written system spec will help to wade through the wide variety of products on the market, creating a short list of components needed to build the correct system. Source: Edmund Optics

Vision system integration has come a long way. With increased processing power, more powerful algorithms, and lighting and optics designed for more demanding requirements, more applications can be solved today than ever before. Even with all of these

advances, however, deploying a complete inline inspection system can be a daunting task. Being armed with the right tools will make the process much easier, and it will yield

tech tips

- ▶ A well-written spec is essential when it comes to producing the right amount of image quality for the application.
- ▶ A high-priced system can quickly repay itself through higher throughputs, higher reliabilities, reduced cus-

the desired results in a more cost effective manner in the long run while reducing delays.

Vision is an incredibly powerful tool that can be used to solve a variety of applications. An enormous

range of products is available today with an ever-growing base of manufacturers. To add to the complexities, for many applications, products from a variety of manufacturers need to be employed in order to produce the best solution. For example, some optics manufacturers carry upwards of 300 lens options in order

to cover the wide breadth of applications and even with this many options they still may not be able to solve every

need presented to them.

As a consumer of these products one must come to the table prepared with the right information and questions in order to discern which products and supplier are best suited to meet application needs. This upfront information generally breaks into three areas: specific application requirements, the type of short or long term support required, and of course, the budget. Often the application requirements will drive the type of support needed.

APPLICATION REQUIREMENTS

Generally these are specifications that are directly related to the parts under inspection, the desired information to be extracted from those parts, and what is to be done to the parts or processes after the results are collected. A system spec or a statement of work can be generated from this information. How comfortable the operator is with the system spec will, in the long run, determine the system's success. Determining the system spec will drive most of the decision making that needs to be done in terms of products to be integrated.

What actually is needed to write a good system spec? First, put together a complete list of everything the sys-

tomer returns, increased customer satisfaction, reduced reworks and reduced system downtime.

- ▶ Ensure that each area gets the time it deserves and that long-term support is sorted out both internally and externally.

tem should be able to inspect, the type of data that it should collect and the accuracy of the data that needs to be collected. Next and more importantly, list the reasons for each area of inspection, as well as how important each inspection is relating to the desired outcome.

After this information is assembled, the operator must take what may be the hardest step of the application—break the list into two parts, what the operator wants the system to do and what it needs to do. Of course, everyone wants the system to do as much as possible, but in the long run adding what seems to be small feature sets that are not really required for ultimate system success can lead to greatly increased cost, or jeopardize the accuracy obtained in the critical portions of the application.

True system integrators are generally good at identifying what will be high-cost operations to perform or what can be system deal breakers and should be consulted at this point of the application development. For systems that require high levels of measurement accuracy, long working distances, highly reflective parts, complicated part geometry or finishes, or different parts sizes on the same line, it is strongly recommended that the operator contacts optics and lighting experts. For many applications the camera and software are the brains of the systems, while the optics and lighting are the heart and soul. Both have equal levels of importance and need to be matched correctly in order for the system to perform optimally.

After the spec is written for the inspection, two other critical factors must be considered. First, where will the system physically be placed in the operation and to what ends will



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it communicate or facilitate material handling issues? These issues can drive initial costs as well as cost over runs more than anything in the system. This area is something that needs to be worked out from the start as it will drive a lot of the components chosen for the systems.

Finally, consider the budget for the system. All areas of cost savings should be considered to obtain a true feeling as to what it will cost not to build the system. In many cases a good, robust system's cost can be a little shocking. In most cases, though, even what appears to be a high price can quickly repay itself through higher throughputs, higher reliabilities, reduced customer returns, increased

customer satisfaction, reduced reworks, reduced system downtime and reduced human interaction with the manufacturing process.

After determining the system's spec, how the system will be deployed on the line and the material handling concerns, it is time to start matching optics, lighting, camera hardware and software components to build the system's backbone. Again a well-written system spec will help to wade through the wide variety of products on the market, creating a short list of components needed to build the correct system. At the end of the day, most applications operators will be looking to produce evenly balanced, robust, high contrast images with enough pixel information to maximize the smart camera's or system's software algorithms capabilities. Many factors need to be considered to produce these types of images.

LIGHTING

Lighting of the object is usually the first thing that needs to be tackled. In many

cases this is the trickiest area. The more complicated the object's size or geometry, the more types of materials on the object, the wider the range the material characteristics such as opaque, translucent or transparent, and the more highly reflective the object, the more difficult it is to create repeatable, even contrast within the system.

In many cases, simple objects can be illuminated by basic, cost effective, direction lighting that is fairly simple in design, and easy to use and mount. Conversely, complicated objects generally require complicated or multiple lighting solutions that require more cumbersome mounting and are more

sensitive to misalignment—not to mention more costly.

Illumination sources come with a wide range of options. They have different color characteristics, lifetimes, functionalities, variations with temperature and environment, and varying levels of ruggedness. All of these issues should be considered when building a system and need to be related to the factory environment and not to the lab where it will initially be built.

One final warning on illumination: changes to the materials used in the manufacturing process of parts can wreak havoc on a vision system's ability to perform after the changeover; most times this is related to the illumination used. If the process uses various materials, make the integrator aware of this fact up front. Additionally, if the operator is looking to roll over or change the manufacturing process after a system is deployed, verify with the integrator that everything will work or have them make the needed changes before running these new parts. If not, expect a high rejection rate, possibly 100%, by the vision system as soon as the switch is made.

CAMERAS

After the illumination is worked out, attention should turn to the imaging device or camera that will be used in the system. There are a variety of camera resolutions, imager sizes and camera features available. This range of products only grows when one brings into account the intelligence of their associated algorithms.

One of the biggest mistakes made in many systems is not having enough pixels on a given feature to yield accurate, reliable, repeatable results. Understanding where algorithms really maximize their capabilities relating to the application will go a long way toward yielding the desired results, not to mention allowing the operator to directly correlate how many pixels the imager needs.



The integrator, with the help of the smart camera/software provider, should be able to provide the camera technology to produce good results for the system's needs. Source: Edmund Optics

For example, if there is an object with group of dark circles on a light background it is easy to count how many circles are in a given area even if it only has an area of 2×2 or 3×3 pixels on each circle. Each one will appear to be a dark spot on a bright background and easily analyzed by the software. Now extend the requirement a bit. Say the operator wants to measure the roundness of each circle. Even with the most powerful blob analysis, edge detection and sub-pixel algorithms employed, highly accurate and repeatable results are basically impossible.

By simply stepping up a level in camera resolution, the operator could increase the number of pixels being analyzed by a factor four and thus greatly leverage those powerful algorithms. This also is an example of making sure that the system spec is written correctly. Obviously counting the dots is much different than measuring them. Luckily the operator will not need to figure this all out on his own. The integrator, with the help of the smart camera/software provider, should be able to provide the camera technology to produce good results for the system's needs.

After the imager is selected and the illumination is worked out, the operator is on the last part of the system that needs to be determined. While every part of the system is critical,

choosing the wrong optical solution can make all other efforts wasted.

One of the most critical things to remember here is that even if two lenses appear to have the same specification, it does not mean that they are equivalent products. For example, four different lenses could all be listed as 25 millimeter lenses with the same mounting types, same angular field of view and same F# settings. One may have been designed for the security purposes, one for document processing, one for high-end photography and one truly for machine vision.

Using the example listed above, all probably would be satisfactory for counting the dots. When taken a step further for measuring the dots for roundness, one will probably find that the lens designed for machine vision will far outperform the others. Again, a well-written spec will lead to the best choice when it comes to producing the right amount of image quality for the specific application. The most reliable way to ensure this occurs for the application is for the operator and the integrator to consult an optical expert. **V&S**

Learn more about vision integration online at www.visionsensorsmag.com.

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