MJ Engineering and Consulting

Since 1988

MJ ENGINEERING

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MACHINE VISION BASICS

First I want state it is NOT my intent to promote one vision manufacturer over the others. It is our normal procedure to test every vision application presented to us before we provide a quote. Quite often we test the application on multiple systems to verify that we will be providing the best option for the application. Usually we find that you will have options for solving your vision inspection application.
The following is a list of vision related topics that I find are common.

- Misconceptions
- Levels of vision systems
- Lighting
- Optics

Common Misconceptions - One common misconception for many people new to vision inspection is; if you can see it or read it with your eyes it should be easy for a vision system to perform the evaluation. The problem with this expectation is that your brain is thousands of times smarter and faster that any vision system. You are using a lifetime of past experiences to help you evaluate the image you see. Every vision system on the market uses only data that we program into it to aid in evaluating the image.
Another thing that most people don't realize is the standard vision system is black and white, and it will evaluate what it is presented based on contrast. Due to a lifetime of experience evaluating images in color it is usually a little difficult to see the same image the vision system will. This can create a little confusion at times, sometimes what we can see with our eyes the vision system has a hard time distinguishing because of a low contrast level. The opposite is true more often than not, the vision system is able to see defects that we have a hard time manually identifying.
Certain color combinations can make this task more difficult than others. Below are a couple of examples of how a monochrome vision system will look at the image we see with our eyes.

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Levels of Vision Systems - There are a few basic "levels" of vision systems, I will try to describe them here, without sending everyone to vision training.
The first and most basic system is typically referred to as a vision sensor. These units are usually designed to be installed, programmed and maintained by someone with limited to no vision experience. Often these systems are a "reduced" version of a standard vision system from the same company. These sensors usually have very few lens options and a limited toolbox. These units are usually designed to operate as a stand-alone unit, with built-in lighting, optics, IO and network connectivity. One last limit that we find in many of these units is the resolution of the image, you will usually not have any resolution options and what is available will tend to be at the lower end. This may sound like I have a very negative opinion toward vision sensors, actually most applications require only the basic capabilities that these systems provide.

The next level is what I would refer to as a group of Smart Camera's. At this level you usually will find a full complement of image evaluation tools, often including OCR. The lens choice for these units is almost endless due to the simple fact that most manufacturers are using a common c-mount lens. Like the vision sensor, these are pretty much self contained units other than now the lighting usually is external. This alone greatly improves the flexibility of any vision system.

The highest level vision system is usually pc based; this allows for an almost limitless selection of hardware to meet the specific application needs. The cameras may be selected from a list that has some common specifications such as GigE or firewire. The lens choice will also be almost un-limited, as long as it is compatible with the camera selected. The image acquisition hardware will possibly even be open to selection. The benefits of this system are flexibility and expandability. Where each of the other systems I described are usually a single camera system, this system has the ability to utilize multiple cameras. These cameras can all be focused on a single part or they may all operate independently, triggered by their own logic and performing completely different functions.

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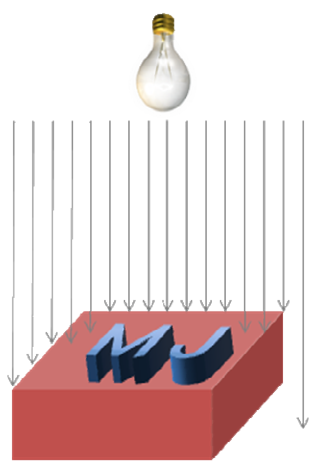
Lighting - I know you have heard, lighting is the key to successful vision applications. I agree with this statement 100%. What it doesn't tell you is exactly what defines good lighting for your application. I will tell you this can be both good and bad, or in other words, inexpensive to very costly. GOOD Lighting can range from a large portion of the total project cost or it may even just utilize your existing lighting. The only way to tell is to complete some basic product testing. Now I also need to point out that the lighting "quality" is usually directly related to the speed of the inspection and the size of the defect you are looking for. So, for example, if you have a line speed of 1000ppm or you are looking for a 1mm defect on a 300mm square part you should expect to pay a little more for quality vision lighting.

The four basic lighting techniques are referred to as;

1-Direct - this method directs the light at the target to be inspected to directly illuminate it. This is good for color and surface.



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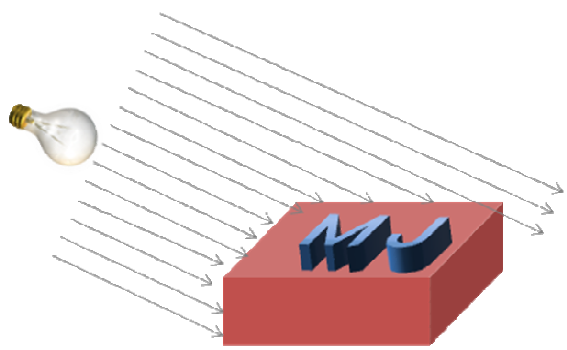
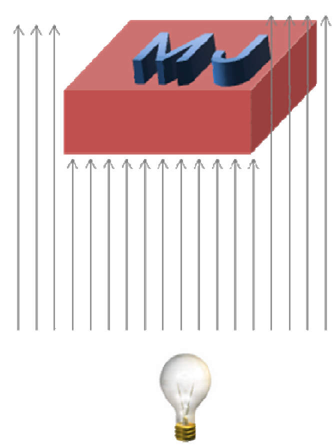
The four basic lighting techniques—CONTD:

2-Low Angle - This method of lighting uses low angle lights to emphasize height changes in the part. Flat surfaces are dark and height changes will be bright.



3-Back Light - This method provides a good outline of the part to be inspected. This can be used for shape verification and dimensional measurements.



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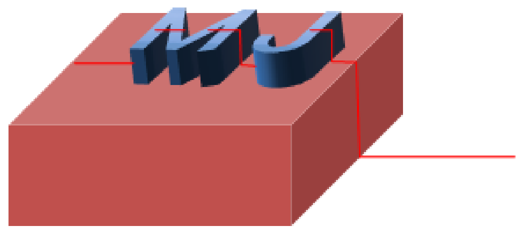
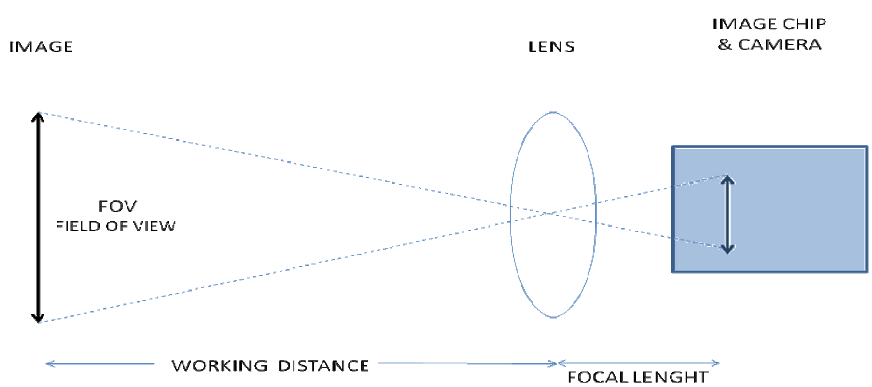
4-Structured Light – This is using lighting such as a line laser to highlight a specific characteristic, such as measuring height or length.



Optics (Lens) - The basic procedure for selecting the correct lens for the application is simple, usually the manufacturers have all of the information available that you will need to select the correct lens to match your camera and application. What tends to put a little fog on the task is the fact that no two manufacturers present the specs in the same manner. This may cause a little extra searching or a phone call or two.
To pick a lens, follow these steps; first indentify the Field of View and the distance the camera will be mounted from the target. Once you have this information you can calculate the focal length needed.
Usually the lens is specified by the FOCAL LENGTH, this is an indication of the ratio of distance and size of image to be viewed.
Focal Length = (Working Distance x Camera Imager Width)/ Horizontal Field of View



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