ALRAD

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Camera Selection advice guide

Introduction

Camera selection for a specific application can be a daunting task for any user. We have compiled this guide for people who are new to the use of cameras and are bewildered by the vast range of product on offer.
It is based on frequently asked questions.

Should I choose an Analogue or digital camera?

While most cameras for industrial applications these days have digital output there are still a number of analogue cameras available.

Generally the choice will be governed by the following factors:-

- Price – for those applications were you want a low cost camera, then analogue has historically nearly always been the best choice. They have been considerably lower priced than digital cameras. However, in the last few years there has arrived on the market some very attractively priced digital cameras with USB2.0 and USB3.0 interfaces. So the price advantage that analogue cameras have had over digital is slowly being eroded.

- Is your application purely to view a scene or to do measurements? If you just want to view a scene for example in a security application or in an industrial application where you are looking for the presence or absence of a part, then an analogue camera will be fine. If however you want to carry out any form of measurements, processing or analysis on an image then a digital camera will always be a better choice. Digitising the image in the camera close to image sensor will always present a more accurate reproduction of the image data and hence a better result to work with. This does not mean measurements cannot be done with an analogue camera it just means the result will not be so accurate.

What resolution do I need the camera to have?

This is governed by the amount of detail you want to see, the optical lens and the working distance (i.e.:- lens distance to object). If the object being observed is large then around standard VGA format of 640 x 480 will be fine. However, if fine detail is required (for example grain analysis in a microscopy application or small defects in glass plates) then a higher resolution will be required. A very simple rule of thumb is to decide the field of view you need and the size of the smallest detail you want to view and divide one by the other and multiply by 3 (e.g.: you are viewing

a ceramic tile of 150mm wide and you need to see a defect of 1mm – to be sure of identifying the defect you need three pixels to be covering 1mm defect so therefore you will need at least 450 pixels to see the defect. If you were looking for the same 1mm defect in a 500mm tile then you would need at least 1500 pixels. You will need this resolution in both directions and preferably in a 1:1 ratio so square pixel cameras will be desirable. As a note, the number of pixels required also depends on many aspects of lighting, optics and algorithms used for processing. Our calculation method assumes optimum conditions.

How fast does my image need to be acquired?

If the object is static this is not an issue and any camera will be suffice. If your object is moving along a conveyor it will need to be either a global shutter camera or a line scan camera. Basically there are three types of camera-

- **Rolling Shutter Camera.** If the camera uses a rolling shutter sensor, this means the image is scanned sequentially, from one side of the sensor (usually the top) to the other, line by line. Many CMOS cameras use rolling shutters sensors.

- **Global Shutter Camera.** Uses a sensor that scans the entire area of the image simultaneously. The vast majority of CCD sensors employ global shutter scanning also known as progressive area scan. In the world of CMOS sensors they are known as global shutter sensors. This type of camera has the ability to read the image as a whole.

Where on fast moving objects the rolling shutter camera gives image blur (because of the time difference in the read out of image sensor lines). The global shutter cameras read all lines within the same scan and therefore no image blur is visible.

- **Line Scan cameras.** Sometimes area scan cameras do not have the speed to capture data from a moving object. (example paper or textiles which may travel at many tens of meters a second) These applications demand cameras which can read a line of data very fast. Also normally in this application the web is very wide sometimes many meters so therefore a high resolution camera is required. To deal with these issues a line scan camera is needed. Line scan cameras are a linear image sensor (generally one row of pixels in the sensor – up to about 8000 pixels). Linescan cameras read data at many thousands of lines per second so can deal with defect detection in very fast moving objects.

Should I choose a Monochrome or Colour camera?

Generally our advice here is if you don't need colour detail always choose monochrome.
There are two reasons:-

- Colour image sensors are monochrome sensors with a matrix colour filter across them.

There are a number of different filters used but all filters will degrade the image sensor sensitivity by around 30 per cent. That means you will have to compensate with more light or lower iris setting to let more light into the optic.

- The other problem is that in single chip colour cameras the resolution of the colour is degraded. This is because the filter colour for one pixel will be different from its neighbours. By software correction the colour is corrected but it's an assumed correction so it will not be an accurate colour representation. A three sensor colour camera uses a sensor for each of the prime colours (blue, green and red) and these are converged to overlap one another by clever optical mirrors in the camera head. For really true colour representation a three chip colour camera has no equal.

What type of output should my camera have?

The type of output will be determined by how you want to read the data out from the camera.
If you want to read it out to a video monitor then an analogue output (either CCIR for monochrome) or PAL for colour will be the easiest.
If you want to take the data to a PC then the choice is huge but basically as follows:

- Analogue can still be used – you will have to interface to a frame grabber – there are number of inexpensive ones we can offer you so the cost need not be too high.
- For undemanding applications USB2.0 will be easy and very straight forward. USB3.0 output cameras arrived a few years ago and offer much higher data rates (typically 10 times faster than USB2.0). Also available is USB3.1 and they achieve output rates of 10 Gbps , which is twice as fast as USB3.0
- Camera Link- the digital interface standard for those demanding applications. Is used with many high performance digital area scan and also line scan cameras. You will need a frame grabber designed for that type of interface. The price of this interface is decreasing so is not as expensive as you may think.
- Gig-E –Gigabit Ethernet, (also called GigE or GigE Vision), is an industrial camera interface standard developed using the Gigabit Ethernet communication protocol. GigE was the first standard to allow fast transfers (1000 Mbps) of data using standard low cost cables over long lengths of up to 100 meters.
  CoaXPress - CoaXPress (CXP) is an asymmetric high speed point to point serial communication standard for the transmission of video and still images, scalable over single or multiple coaxial cables. It has a high speed downlink of up to 12,5Gbps per cable for video, images and data, plus a lower speed, 42Mbps uplink for communications and control. Power is also available over the cable ("Power-over-Coax") and cable lengths of greater than 100m may be achieved.

How do I choose a lens for my camera?

A camera is of no value without a lens or a focusing optic. In microscopy applications this is provided by the microscope manufacturer and with a suitable C mount adapter the camera can be directly coupled to the microscope.

For other applications the lens choice depends on:-

- Field of view required
- Working distance (distance between front face of lens and object being viewed)
- Size of detail required
- Depth of field required

- How you are going to use the data captured. (Accurate measurement applications for example may require the use of a telecentric or machine vision quality lens)
- Features required from lens (most lenses are manual iris and focus but other options are available such as zoom and motorised lens control.

We have two very useful lens pdf documents you can download:-

- **CCTV LENS CALCULATOR**
- **CCTV LENS TERMINOLOGY**

This guide is not extensive and is no substitute for speaking to one of experienced sales engineers who will be able to assist in the selection of the right camera and lens combination for your application. Also visit the lens section of our web site. Call our technical sales desk on 01635 30345 or email sales@alrad.co.uk

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