In search of the best... Broadcast PTZ Robotic Camera

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This whitepaper provides a no-nonsense understanding of key factors that can facilitate your choice of a PTZ robotic camera.

Selecting a broadcast PTZ (pan/tilt/zoom) robotic camera can be a challenge—it is critical to familiarize yourself with the technology so you can effectively weigh your options and ensure a good return on your investment. To do so, you first need to determine what you want the camera to capture, where the camera will be located and how it will be used.

Many claim—without evidence—that formal recommendations for "broadcast quality" PTZ camera terminology do not exist.

Here are some technical considerations to bear in mind when searching for a so-called "broadcast quality PTZ camera":

- Reliability
- Broadcast quality image
  - Resolution
  - Dynamic range
  - Color reproduction
  - Sensitivity and signal to noise
- Lens type and control performance
- PTZ and Focus robotic parameters and functionality
- Integration into virtual sets

There are numerous camera types to consider for indoor and outdoor applications, such as PTZ cameras, box cameras on a pan/tilt base, in-dome cameras and exposed cameras. Pan/tilt/zoom cameras are very versatile. PTZ cameras can pan left and right, tilt up and down and zoom in or out. Additionally, many PTZ cameras can vertically rotate 360 degrees to view an object directly below or above them.

In search for "high reliability," you might decide between an indoor or outdoor type—but you can also choose an option that works in either environment for best results.

A camera that can be installed either indoors or outdoors without an additional protective housing offers more than flexibility—this kind of camera is constructed in a much sturdier way versus indoor- or outdoor-only types.

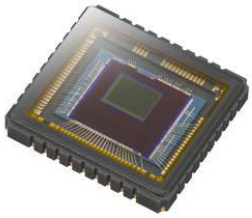
Without a doubt, dual-purpose PTZ cameras are more reliable than indoor-only cameras. The former can handle a greater range of temperatures, and they are immune to dust and other environmental contaminants caused by smoke, chemical splashes from cleaners or painters and unpredictable weather.

You may wonder if you should choose a camera that is visually prominent and appealing or one that is more hidden. This depends on your preferences—is there a particular size, look or color you like most? Some manufacturers like Telemetrics offer an unlimited number of color combinations and can also do custom textures and finishes, allowing the camera to be more concealed from the audience and making it ideal for live and reality shows and churches.

Another very important consideration is video quality. Many cameras claim to be "broadcast quality" without actually being so.

The term "broadcast video quality" has been widely used by PTZ camera manufacturers but sometimes in an irresponsible way.

The imager or sensor plays a fundamental role in terms of resolution, dynamic range, signal to noise ratio and sensitivity.



In a broadcast type camera, the imager must at least have as many effective pixels as the format has. For example, an imager of over 2 megapixels should be used for HD image acquisition.

Myth: "the more pixels the imager has the better." Manufacturers play with this number a lot. Some claim to have up to 4 megapixels when only about 2 megapixels or less are used effectively. So what?

When you put 4 megapixels on an imager surface, it means that every pixel becomes smaller in surface size to accommodate the large number of megapixels. On a 1/3 inch chip, for example, each pixel receives less light, which negatively impacts the camera sensitivity and signal to noise ratio.

Myth: "a 3 chip camera is always broadcast quality." In reality, a 3 chip camera is no longer required for broadcast quality—nor does "3 chip" guarantee this level of quality.

A single chip camera can be broadcast quality as long as it produces high quality native HD without scaling or excessive processing. In the early days of HD, three chips were required because single chips could not be made with the required high pixel count. Notice that modern high end studio and electronic cinema cameras are mostly single chip. It is the measure of noticeable detail that you see in an image that counts. The higher the resolution, the better the definition, clarity and quality of the picture.

Because published specifications are not conclusive or enforceable, a "test drive" is always the best approach to decide what camera is best for you.

There are many other quality differences in imagers' that are usually ignored overlooked, such as dynamic range and signal to noise ratio. It is not within the scope of this whitepaper to scrutinize these values, however, it can be said that a camera that has the ability to clearly show good detail and color in objects that are partially illuminated with minimized fine noise in the shaded portion has truly broadcast quality video.

Myth: "all zoom lenses perform equally well." In fact, it is very important that you verify the lens quality that is offered and not just the zoom ratio.

Another important consideration is field of view, which is a measure of how large an area the camera is capable of viewing. Also important is the focal length of the lens, which affects the field of view and the transparency.

A shorter focal length lens captures more of the scene and therefore provides a larger field of view. Conversely, a longer lens magnifies the scene more, thereby decreasing the field of view.

The transparency or speed is measured in f stops, f: 1.2 being very transparent and f: 5.6 less transparent. At every f stop the light exiting the lens doubles in amount.

Accurate control of the iris is important to control depth of field. Some cameras use a combination of shutter and mechanical iris; make sure your broadcast camera has a mechanical iris with at least 6 blades to avoid artifacts.

A PTZ camera without the ability to use a lens focus preset that relies solely on autofocus is not suitable for broadcast use.

The MTF (modulation transfer function) is very important as well. It will affect the resolution: the higher the number, the better the lens. Chromatic aberrations and geometric distortions are also important to consider when choosing. Another important factor to consider—especially if the camera is used in live production—is the ability to control and preset the lens focus. Often high end PTZ cameras with the ability to preset and control the lens Focus are called PTZF. Conventional PTZ cameras use auto-focus mode only. Zoom ratio is also very important when considering the robotics accuracy. When zoomed in with a 30X zoom, you need your pan and tilt to be capable of extremely slow movement if these images will be used on air.

Camera design and technology considerations are critical in overcoming unpredictable lighting issues arising in live events.

Because light is vital for producing a quality image, it is essential to understand your lighting conditions prior to selecting a camera.The amount and type of light in the environment will determine the amount of light required by your camera to produce high quality HD video. There are a variety of technologies available that will ensure you capture usable video regardless of the lighting conditions. In order to be safe, look for the highest dynamic range (400% or better) and good signal to noise ratio (50 dB or better).

All robotic PTZ cameras pan, tilt and zoom by actually moving the camera head and lens elements with electrical motors. But there are differences in smoothness, reliability, accuracy and speeds.

Telemetrics RoboEye

Every PTZ camera has moving parts—and as most people know, anything with moving parts will eventually fail. Therefore you want the mean time between failures to be as high as possible.

Avoid stepper motors and consider servo motors. Servo motors can triple the speed control resolution versus comparable PTZ cameras on the market.

Broadcast robotic cameras use servo motors that are extremely smooth, precise and accurate. This construction minimizes vibration and rough motion that not only looks bad on video, but also reduces wear on motors. High end users will always recommend servo systems over stepping motors for a plethora of reasons.

Advanced broadcast PTZ cameras using servo motors can also perform a preset-recall convergence, where all axis movements (pan, tilt, zoom and focus) start and stop at the same time in a smooth, human-like choreographed fashion, so that motion between presets can be used on-air.

The servo controls also provide high resolution outputs of positional feedback for virtual systems (VR) or augmented reality systems (AR).

As a rule of thumb, cameras that have a wider operating temperature range have more reliable components and are more reliable overall.

Unreliable mechanical components inside conventional PTZ cameras can freeze up if temperatures plummet, like air filtering in through a partially open window in winter, or stop working at high temperatures that may be found in summer or in a TV studio when installed near lighting devices. You need to consider the possibility of a temperature range that varies widely.

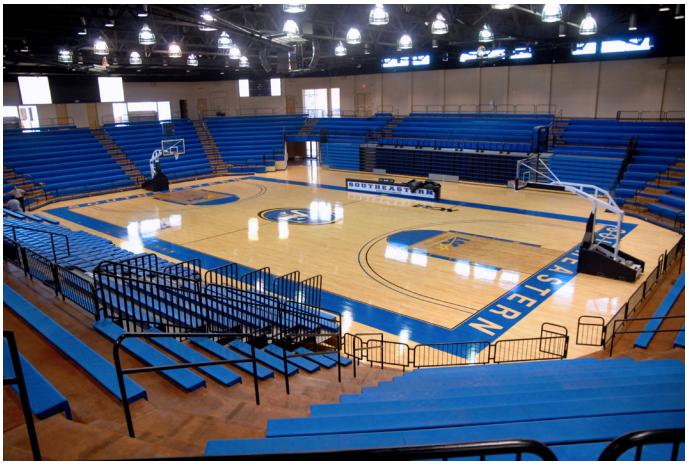
Reliability is not only about durability, but also about repeatability of presets. Most PTZ cameras can store presets. It is important, however, to know how many P/T presets and lens positions Z/F can be stored in the camera head, so that a remote camera controller can be replaced without losing the stored presets.

Inputs & outputs should be appropriate for broadcast environments, allowing Genlock, HDSDI, composite and sync and Ethernet connections.

Ethernet (Internet) is important because it not only makes the system easy to install and integrate into a facility network, but also provides a web-interface for control, status monitoring, and video monitoring over the network. This important feature allows control of the PTZ camera(s) without a remote controller. The Telemetrics RoboEye camera has increased reliability thanks two Ethernet connections with an internal Ethernet-switch for network redundancy.

To ensure you choose a truly reliable camera, you need to ask if it is upgradable over a network. Firmware updates need to be accessible through the web.

Not all applications of PTZ cameras are equal. Often PTZ cameras are used for sports that require fast servo motions or sometimes in legislative applications when slower smooth motions are desired. Having remote firmware update capability, e.g., to change the servo settings, becomes very useful when the PTZ camera system is a servo-motor system. Servo motor systems usually accommodate these kinds of changes. This is true of Telemetrics' RoboEye.



Fast Servo Motion Required

Slow/Smooth Servo Motion

As automation becomes more prevalent, certain capabilities become critical, for example support for a remote computer controlled motion protocol.

This whitepaper concludes with the summary to the right of the most important factors to consider when searching for a high reliability remotely controllable high end performance Broadcast Robotic Camera.

Imager Sensor Pixels	2.2 megapixels
Optical Zoom and Digital Extender	30x Zoom, F1.6 to F22, f = 4.4-132mm
Video Signal Resolutions	1080/59.94p, 1080/50p, 1080/59.94i, 1080/50i, 720/59.94p, 720/50p
NTSC / PAL SD	625i/50 (PAL) and 525i/59.94hz (NTSC) Simultaneously with active HD output
Image invert Horizontally	Left / Right (mirror)
Image invert Vertically	On or Off with Auto Flip
Minimum Illumination	0.6lx (F1.4, 50IRE +31.5dB, 1/60 sec)
Signal to Noise Ratio	More than 50 dB
Video Delay	1 Frame (progressive) 50/60P 1 Field (Interlaced) 50/60i
Lens Operation Modes	Auto and/or Manual Zoom, Iris and Focus
Manual Video Control	Gain, Red Blue Gain, White Balance, Gamma, Shutter, Master Black
Synchronization (Genlock)	Internal or External Bi-level (BBS) or Tralee (3SY)
Pan Range and Speed	+ 180º to -180º variable speed range .01 to 90º/sec
Tilt Range and Speed	270º of travel / Dynamic range of .01 - 90º/Sec
In-Camera Preset Positions	1,000 Presets on Camera
Virtual Set Interface	Accurate Feedback Provided for Virtual Set Synchronization
Stand Alone Synchronized Motion	Simultaneous convergence of Pan/Till/ Zoom/Focus (PTZF)
Programmable PTZF Motion Path	Fully Programmable PTZF (option)
Web Server	JPEG Monitor, Remote viewing; size VGA/ QVGA, control
Ethernet (IP) Data	Ethernet In (RJ45), Out (RJ45) or Backup Ethernet or Auxiliary device
Serial Data I/O	RS-232, RS-422
SDI Output	1080/60P/50P HD
HDMI Output	1080/60P/50P
Fiber Interface	Yes
Overall PTZ Quietness	Better than NC 35 (ultra quiet)
Environmental	IP65 Rated (fully weatherproof)
Operating Temperature	-4ºF to +115ºF (-20ºC to +46ºC)

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Camera Control Systems

6 Leighton Place, Mahwah, New Jersey, U.S.A. 07430 • phone: 201.848.9818 • fax: 201.848.9819 • telemetricsinc.com