Video Camera

Whitepaper

What is Video Camera

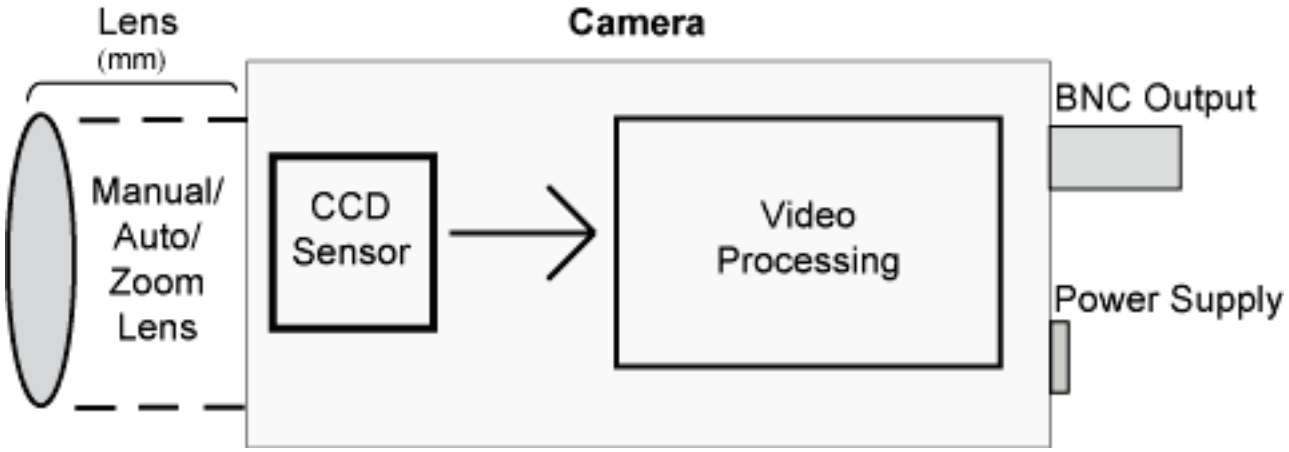
Contents

Chapter 1 Main

1.1 - What is Video Camera?

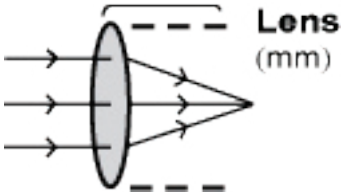
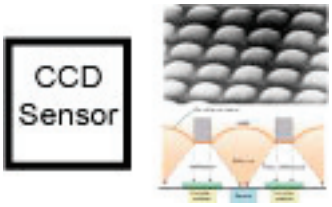
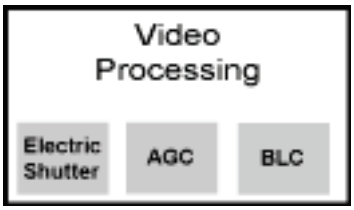
Overview

The starting point for any visual surveillance system must be the camera. The camera creates the picture by capturing image from real environment through its lens and image sensor, of which will be transmitted to the control position, such as control Center, Network DVR or CCTV system. Nowadays, there are may different camera design to suit different complex environment. For instance, Professional Video Camera for mission-critical surveillance purposes, Doom Video Camera for normal small-size retail stores, Convert Video Camera for monitoring in concealment.



Details

Typical Video Camera composed by Lens, Image Sensor, Processing Unit and Output Device.

Lens: Just like photo camera, Lens play important role in all image capturing units in the world. It is used to gather the light from outside world, focalize and transmit them to Image Sensor. Therefore, there are many selection of Lens in the market, 2.8/4/6/8/12/16/25 mm Lens, Fixed/Manual/Auto/Zoom type Lens.	
Image Sensor: After the gathering of light by Lens, those light are needed to create transmission signal to be any use. Image Sensor receive all the light coming in, and product electrical charge for the creation of a "Picture". The most commonly type of Image Sensor is CMOS. They are low in cost, however, produce poor-quality of picture especially dealing with our 3D complex real environment. CCD, is an alternative, produces high-quality	
Processing Unit: It is the main component of a typical Video Camera. It gathers all the pictures generated from Image Sensor, and produce transmittable signal to Output Device. Also, it controls the operation of Electric Shutter, BLC and AGC. [See more at "Functionality" part]	
Output Device: Simple, it outputs all the signals to Center, Network DVR or CCTV System. The commonly using interface is BNC. The 'BNC' plug is for connecting the coaxial video cable. In practical use, Coaxial Cable connects with BNC Output unit and take signals to Recording Unit.	

Statistics

Statistics point to major reductions in the amount of crime being committed where there are cameras installed. An article in 'New Scientist' magazine showed that simply installing a system can reduce crime, in the areas covered, by over 95%. As our customers inform us that they are having similar results in all types of business, you will begin to appreciate why Visual Surveillance System is seen by many as the best system for deterrent and detection.

We are sure that you would wish to avoid having to catch those who are perpetrating crime against your organization. Generally, once a Camera system is installed, it will only be fools who attempt to perpetrate offences within its field of view. These are often caught but for the majority it will provide a very high level of deterrence.

1.2 - Typical Deployment

Traditional VCR

Method for recording video on tape with tape-recording equipment is an analog type. Namely, each camera connect to one device (Multiplexer) to split all the cameras image, and then output them on a CRT monitor, and use VHS to record the image on video tape. Operator then uses storage rack to protect tapes from humidity.

HIGH SETUP AND RUNNING COST
As the whole system involved many independent equipments, Multiplexer, TV, several VCRs, immense amount of tapes and expensive storage space that led to high running and operating costs.
LOW VIDEO QUALITY
Tapes would wear or tear over time, image would distort, video integrity is hard to preserve over time due to changing climate and humidity. This is an ever-present problem of analog tapes.
TAPE MANAGEMENT
User may have to review all the tape to find one specific image. And large storage space is required for tapes. Spaces are noticeably expensive in some cities such as Hong Kong. Keeping records for a long period of time, such as one year, is impossible.
LABOR INTENSIVE
Systems need operator to change tape frequently and perform system maintenance, and operator must be at the site to acknowledge emergency.
LIMITATIONS
All the records stored on tapes. Viewer must go to the site and take the tapes to see what was going on. When camera number has to be increased, that also led to the problem of cabling, and troublesome modification of the whole system.

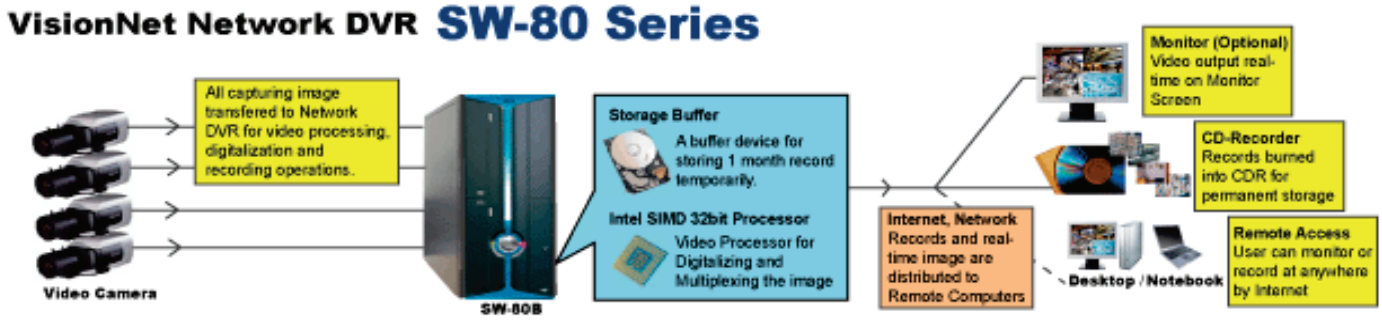
Digitalization

All the problems stated above found no solutions until the boom of digital era. From cameras to digital cameras, from tapes to CD or Hard Disk, from CRT to LCD, surveillance system also gets the same change - VCRs to DVRs (Digital Video Recorder) . From 2002 to 2003, DVRs constitutes up to 75% of new CCTV systems in United States, especially after the terror attacks 9/11. With continuous product improvement come better-functioning products, lower costs, and a steadily growing customer base, products based on digital technology begins to dominate the entire CCTV market.

We now use CD to replace analog tapes, and all the captured images from cameras distribute over the Internet, user can monitor from anywhere at any time.

Network DVR

A Network DVR is a DVR linking CCTV cameras together, and records all signal to Hard Disk, but at the same time, provide remotely access from Internet or computer network to download, replays record, being controlled by remote user but without affecting normal daily operations.



Our DVR is TCP/IP based, that means:

Flexibility and Compatibility:

When every computer connects to the Internet, a unique IP address is allocated to the computer, IP addresses are used to locate computer locations in the world of Internet. When user's computer and the DVR are IP-based, they can communicate with each other and share information or resources.

Digitalization of Recording Technology

As the functionality, usage, quality and costs of VCR-based surveillance system no longer satisfy present surveillance needs and complex environment, that led to the development of DVR, namely digitalized VCRs. Since the introduction, DVRs are replacing traditional VCRs and sales are still increasing with each passing year.

Digital video surveillance is the latest trend and development in the security and surveillance industries. Customers are demanding more advanced surveillance systems for more secured and effective security monitoring. With advanced technologies and high speed data transmission, DVR system makes traditional Video Tape-Based monitoring and recording system obsolete.

Details

As all the captured image is digitalized, the storage media were no longer dependent on tapes. Images are stored as computer files on computer Hard disk:

EFFICIENT STORAGE

DVR System uses computer hard disk for data storage. Operator no longer change tapes frequently and hence save a lot of spaces. And the storage time is also significantly longer.

LOW RUNNING AND OPERATING COST

DVR system do not need Multiplexer, separate recorder or large storage space for tapes, this significantly reduce the operating costs.

EASY MANAGEMENT

DVR System uses computer hard disk for data storage. Operator no longer change tapes frequently and hence save a lot of spaces and labor. And the storage time is also significantly longer.

IMAGE PLAYBACK AND DISTRIBUTION

As all records are in digital format, user can easily back them up to CDRW, Floppy, or mobile rack. Also, user can replay records fast or slow forward, backward, frame by frame, zoom in or out, snapshot....etc

INTEGRATION

DVR is developed for replacing analog VCRs, all the standard are almost identical to VCRs. User can easily renew their system to DVR without technical works.

ENHANCED SYSTEM SECURITY

DVR provide multiuser login system, that enables system administrator to control access of other DVR operator, that ensure internal settings not being changed by third party.

Conclusions

However, a Digital Video Recorder (DVR), digitally records the video image so it provides clear image like a picture. It also has a function to record continuously so you don’t have to worry about the frequent change of tapes. With the easy distributed digital format, recorded images, video and audio are easily distributed and viewed at home desktops and notebook. DVR, therefore, is a video recording surveillance system for the next generation and it is growing very rapidly. By contrast, analog CCTV would be obsolete over time as digital technology takes over.

In dealing with small business, especially retail shops, showroom, offices, franchises, chain stores...etc Network DVR Technology is the excellent tool to satisfy their needs, as DVR operator is not essential to smooth daily operation of typical system.

Chapter 2 Applications

2.1 - Advanced Security Surveillance

Since the introduction of DVR surveillance recorder in the early 2000s, applications of DVR system had increased with each passing year. The technology continued to develop, distribute and improve. Nowadays, enterprises, casinos, large retail shops, freight centers, franchises and most government buildings worldwide use DVR surveillance systems to deter crime and aid in criminal investigation.

The technology is developed on computer system, namely Digital Video Recorder DVR, all the captured images, video and audio are stored in computer hardisk, we call it - “Storage Buffer”. This advantage provide much more storage space than VHS so that one system built-in “Storage Buffer” provides adequate storage capacity up to one month. As all the records are stored at “Storage Buffer” temporarily, Day 1 records will be erased automatically for future replacements - Day 31. At the same time, user can use the CD-Recorder in VisionNet Network DVR system to burn important data/record to CDR or CDRW for permanent storage during the month. And as each day record will stay in the DVR system up to one month, that’s why we call it “Buffer”. System user don’t need to worry about changing or forgetting to change tapes in time-lapse recorders. Any old unwanted images can be erased automatically. Using Compact disc technology, records preservation and duplication become more easier and cheaper, and yet quality is superior than tapes.

1. Record 24-hour a day, complete coverage of every days, every weeks.
2. Storage Buffer provides up one month storage capacity.
3. Auto recycling and erasing records from the beginning if capacity is used up.
4. Remote clients can access into Network DVR for records retrieval, replaying, downloading or changing internal settings of the DVR.

Multiple maintenance-free security recording

VisionNet typical Network DVR system supports 3 different recording modes for user to choose:

24-hour a day Continuous Recording

As the storage capacity is much larger than before, system don’t need user to change tapes frequently, don’t need them to keep so many tapes for record storage. Therefore, maintenance-free 24-hour a day recording is possible. System operator don’t need to erase, check, store records because all of them are to be done automatically.

Time-Scheduled Recording

System user can define the recording time period on each day or each week. For instance, ABC Book store set the Network DVR to record only from morning 9:00 to night 10:00 from Monday to Friday, but on Saturday, they set it to record from morning 6:00 to night 11:00.

Motion Detection Recording

As VisonNet Video Camera supports Motion Detection. User can manipulate each camera for detection area and motion sensitivity. When Motion Detection is triggered, recording starts. This function is particularly useful during night time.

Remote Network Security

Network surveillance system is network based, this advanced functionality makes it highly suited to the mission critical applications involved in security surveillance. Armed with the above revolutionary technology, protection of people, property, assets from accident and crime have been greatly enhanced ever than before. Even more, with greatly compatibility with traditional CCTV Cameras, DVR is a very attractive option for those companies wanted to renew their currently using CCTV surveillance system.

False Alarm Prevention

False alarms present a big problem to security systems. Video Camera and Network DVR enable alarms to be checked from anywhere before action is taken. When motion is triggered or suspected event happened, a security guard who as been alerted to a break-in, can get a view of the room or building where the break-in has occurred by checking video images immediately in the Network DVR [Network DVR supports Records Playback without affecting normal recording] or other online computer. This way, he knows whether or not it is safe to enter, or any actions have to be taken, such as calling police.

2.2 - Remote Monitoring and Digital Transmission

As VisionNet Network DVR systems are based on existing computer network, users can monitor anything remotely and with mobile at any place by computer notebook, or home desktops through Internet, WAN/ LAN, or even telephone lines, so that authorized viewer can gather information at all key points in real-time. This makes it ideal for monitoring working equipment, scientific experiments, traffic, people, or any places both locally or at a distance. It helps to keep store owners better informed, prevent theft and makes store management easier and more efficient. Such a system is particularly appreciated as knowing that their property can be observed remotely increases peace of mind.

By the help of digital transmission, all the captured images, records stored in Network DVR distribute over the Internet, user can monitor and access from anywhere at any time. In some cases, particularly where network bandwidth is limited, it may be desirable to store video images locally onto a network DVR, and access them by downloading.

2.2 - Network Broadcasting

All the video captured can also be used to broadcast over the Internet, providing viewer or audience with real-time information about sporting competitions, business conference, weather or traffic conditions, or used as a business tool to show promoting products or services to customers.
This function is particularly useful for business promoting event, or building company homepage to introduce products features to customers. The Network DVR automatically transmit every live images, with every hour, minute or even second to remote user through computer network or Internet.

Chapter 3

VisionNet Network DVR compress video prior to record them into “Storage Buffer”. The compression purpose is to save space and enhance network transmission. For instance, SW-80 compress each frame into 2.5kb in size.
There are many Digital Compression Standard in the field of computing. And many mores are still in research and development. Until now, remarkably one include Motion JPEG, MPEG-1, MPEG-2 and MPEG-4.

Motion JPEG:

With motion JPEG, each frame within the video is stored as a complete image in the JPEG format. The still images are displayed at a high frame rate to produce very high-quality video, but at the cost of producing comparatively large file sizes.
Applications: Web cam, mobile.....

MPEG-1:

Moving Picture Encoding Group international standard ISO/IEC 11172.
This standards produce “VCR quality”, giving performance of up to 352x288 pixel, 30fps, max 1.86Mbit/s. As the available resolution is quite limiting, and the size of video is relatively large, one hour recording takes up to 650-700 MB.
Applications: VCD

MPEG-2:

Moving Picture Encoding Group international standard ISO/IEC 13818.
Most widely known standard for DVD, that offers high quality video suitable for installations where TV-quality is needed. This standard provide a resolution of 720x480 pixels at 30fps NTSC or 720x576, 25fps PAL. The bit rate is typically 1-10 Mbit/s. Although this format is excellent for image quality, but the recording size takes up to GB level.
Applications: DVD

MPEG-4:

Moving Picture Encoding Group international standard ISO/IEC 14496.
This standard covers a wide variety of applications ranging from the video displayed in cellular phones, to full feature-length movies shown in a cinema. MPEG 4 is widely used to be the video standard of the future. This format contains many enhancements to any of the early MPEG standards: for example, it offers narrower bandwidth and can mix video with text, graphics and 2-D and 3-D animation layers. High performance hardware and sophisticated techniques are required to produce MPEG-4 video, therefore, many security companies can’t adopt this format in their products. In fact, this format provide image quality comparable to MPEG2, depending on frame rate and resolution, the recording size is excellent for security surveillance recording. One hour of video with 25fps takes 150-200MB.
Applications: VisionNet Network DVR, digital movie.....

Chapter 4 Capturing Image

4.1 - Introduction

Specification of the right Video Camera for a project is not always the easiest of processes. There are many factors that have to be taken into account: technical specifications, the application and its requirements, as well as any physical constraints the site may impose. With ever increasing product ranges available in the marketplace, and technology constantly evolving to optimize performance, reliability and functionality, it is quite a challenge to make an informed decision to meet the requirements for the job whilst remaining within projected budget. Understanding the many variables within Video Camera technology today can only be an advantage in helping you make the right choices.

From here, the rest of this white paper explains the internal features of Video Camera and the working principle of Lens.

4.2 - CCD Camera Sensor

VisionNet Video Camera consist of CCD image sensor as it produces high quality image, especially in 3D environment. The CCD is comprised of about 500,000 light sensitive cells called picture elements (pixels) which convert the light falling onto its surface into an electrical signal. The performance of the camera affects by 3 factors:

1. Image Sensor
2. Lens
3. Illumination

However, Video Camera Image Quality are more dependent upon the quality of the CCD than any of the other camera components. Currently, the popular formats are:

1/2” Half-inch	High performance for high sensitivity and low noise
1/3” Third-inch	Most popular and ideal but high cost
1/4” Quarter-inch	A recent development, produce excellent image with low cost

Benefits of CCD Technology

Long Life	Produced with a design life of up to 10 years
Shock Resistant	Much more rugged than older tube technology
Size and Weight	Have enabled the miniaturization of cameras
Spectral Response	Responsive in the near infra red area

4.3 - B/W and Color Camera

Basically, Video Camera divides into two main categories: B/W and Color Camera.
Broadly speaking, all video camera sensors are B/W, color is obtained by inserting red, green and blue filters in front. As in reality, those color filters differ some part of incoming light that results less light going to the image sensor successfully. This is why color cameras have less resolution than B/W cameras. Also due to the filters, color cameras are not sensitive to infrared light. Therefore all the discussion on camera sensitivity and suitability for infrared illumination is confined to B/W cameras. This is except for the Dual Mode cameras now becoming available which potentially offer the best of both worlds - VPC-400N.
B/W cameras can offer Infra Red (IR) sensitivity allowing their use with covert IR illumination possible. This can be particularly useful where planning permission makes extra lighting impractical or the security requirement is such that intruders should not be alerted to the existence of CCTV surveillance.
However, in most cases, color cameras are still the best choice as it produces crystal and clear image for what is happening or what exactly is moving in the targeted site. In the incident of crime, color camera can distinguish whether the suspect person is wearing blue jacket or grey jacket, while B/W camera produce the same color whatsoever.

4.4 - Light Illumination

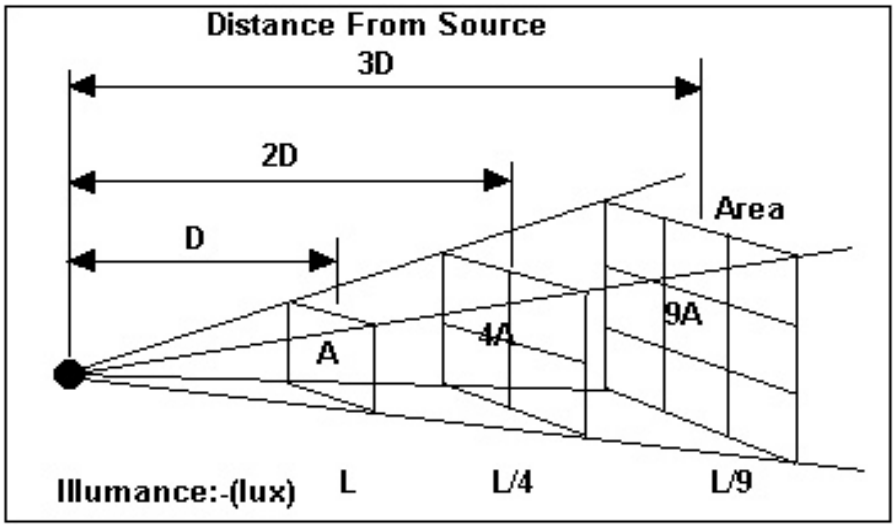
In the world of Video Camera, light is vital to produce any image. The type of lighting used, and the correct positioning, are vital to maximum security. Everyday White or Daily light is actually a mixture of colors of different frequencies. Video Camera is more receptive to certain color combinations than others. The best results are usually obtained by matching the spectral response of the camera to the light illuminating the scene. The amount of light reflected from an object determines how bright it appears.

During the designation of a security deployment, lighting takes the first account of choosing the right camera. Amount of Light is measured by Lux. One unit of Lux can be represented by the amount of light generated from a burning candle.

Only natural light provides absolutely even illumination, although it is of course affected by clouds and shadows. All forms of artificial light suffer from the fact that as the distance increases from the light source so the illuminance reduces. This is due to the inverse square law of illumination where the illuminance falls to a quarter of its value if the distance is doubled..

Inverse Square Law Of Illumination

As the luminous flux travels away from the light source the area over which it spreads increases, therefore the illuminance (lux) must decrease. The relationship is expressed by the inverse square law and illustrated below:



Inverse Square Law Of Illumination

The relationship between illuminance and it's effect at a distance is given by:

$$E = \frac{I}{d^2}$$

This factor is particularly important in considering the light available for a camera. For instance a light source providing a level of 30 lux at 20 Metres will provide 7.5 lux at 40 Metres and only 3.3 lux at 60 Metres. The other effect of this is that the wide range of light levels can cause problems with automatic iris lenses. Unless set up correctly, the foreground light will cause the iris to close and lose definition in the distance. The reverse is if the iris is set to the distant light level in which case there will be a lot of flare in the foreground.

4.5 - Sensitivity

Color cameras generally perform less well in low light than B/W cameras, all other things being equal. Sensitivity is usually measured by reference to minimum illumination lux level at which a camera can produce an image. The lux valuation, although usually referred to as a metric unit of measurement of light, is very often applied subjectively to the ability of a camera to produce images.

For instance: VPC-400N Video Camera produce image with minimum illumination of 0.03 at F1.2 Lux.
*Actual amount of Lux falls into the image sensor differs considerably from the factors of Lens and Illumination.

F-Number
The f-number of a lens is the ratio of the focal length to the effective object lens diameter. It is a mechanical ratio and does not infer the efficiency of a lens. It does affect the amount of light energy passed to the sensor and will play a significant part in the resulting picture. In simple terms the smaller the f-number the more light is passed to the sensor, therefore f1.2 is better than f1.8. The percentage of light passed by different apertures is listed below. This shows the percentage of light falling on the lens that is passed to the sensor.

F number	f1.0	f1.2	f1.4	f1.7	f2.0	f2.8	f4.0	f5.6
% passed	20%	14.4%	10%	7.07%	5%	2.5%	1.25%	0.625%

	LUX*	DESCRIPTION
	50,000	British summer sunshine
	5,000	Overcast sky
	500	Well lit office
	300	Minimum for easy reading
	50	Passageway/outside working area
	15	Good main road lighting
	10	Sunset
	5	Typical side road lighting
	2	Minimum security risk lighting
	1	Twilight
	0.3	Clear full moon
	0.1	Typical moonlight/cloudy sky
	0.001	Typical starlight
	0.0001	Poor starlight

*Metric unit of measurement of light.

Chapter 5 Functionality and Specification

5.1 - Motion Detection

This function is used in conjunction with VisionNet Network DVR. The motion detection function is designed to automatically detect any activities within a selected detection areas, and to start recording of that camera when activity is detected inside the detection area.

5.2 - Excellent Image Quality

Resolution is the ability of a camera to discriminate fine detail in a scene. The resolution of a camera is usually expressed in terms of horizontal TV lines (TVL). Cameras specifications quote resolution based on the number of horizontal elements that can be captured by the camera and, confusingly, this relates directly to the number of vertical lines that can be discerned. Imagine a camera with a resolution of 570TVL being able to display a signal horizontal lines as 570 individual segments. The higher the number of segments, the more fine detail can be resolved in the image. Obviously the number of horizontal lines displayed vertically (i.e. the vertical resolution) in a given system is fixed according to the standard in use (625 lines in PAL/CCIR; 525lines in NTSC; etc)

Cameras are often described as medium and high resolution. This typically equates to medium resolution of 330 TVL and a high resolution of 480TVL for color cameras; and a medium resolution of 380TVL and a high resolution of 570TVL for B/W cameras. If it is important to be able to resolve fine details in an application, especially in sensitive area, choose a camera with an appropriate resolution.

In the world of Network DVR, TVL image is translated to digital resolution. Namely, (Pixels x Pixels). Typical VisionNet Video Camera supports image capturing resolution up to 512x582 in PAL mode and 420TVL clarity. The generated image is digitalized by Network DVR, The achieved image quality surpasses traditional analog CCTV Camera in the product line of VisionNet Technology.

However, as the larger the image resolution, the larger data will be generated for storage. When it comes to image transmission, it also requires more bandwidth. In practical use, users are able to select different recording resolution in deal with different situation.

5.3 - High Image Capturing Speed

Smoothness of Digital Video is represented by Frame rate. All the video is composed of a series of Frame (Picture) linking and playing together to form a video. Human eye can see up to 25 Frames per second. VisionNet Video Camera generate maximum 25 Frame in one second. As a result, generated video produces 25Frame/sec, we call it “Real-Time” records. When the record is replaying, viewer can see every movement momentarily, just like real-life.

However, just like the principle of Image Quality, the larger the Frame rate, the larger data will be generated for storage considerably. When it comes to image transmission, it also requires more bandwidth. In VCR-based system, using one tape to record 24-hour mode, the Frame rate is less than 1fps, when it comes to VisionNet typical Network DVR system, capacity of “Storage Buffer” is adequate for one month recording in 12.5fps.

5.4 - AGC (Automatic Gain Control)

Video Cameos contain a video amplifier which applies gain to the video signal as required (up to a maximum of 28dB). The circuit is designed to compensate for fluctuations in scene illumination which would cause the video output level to be too low. If the video level is adequate, the circuit will not apply any gain to the signal. As the video level drops (e.g. the scene illumination level falls), more and more gain is applied by the AGC circuit to the video signal. The camera only applies as much as gain as is necessary to bring the video signal up to a reasonable level (typically 1V peak to peak).

It should be understood that the AGC circuit cannot work miracles and some light must be present within the scene. Note that as a consequence of amplifying a poor signal, the noise present in the signal is also amplified. Therefore a poorly lit scene with a lot of gain applied to it will appear noisy or grainy. This is usually accepted in deference to the alternative of having no picture at all. Obviously, the ideal solution is to provide adequate illumination for the scene wherever possible.

It is recommended that the AGC feature is left permanently switched on since it will have no effect as long as the scene illumination is adequate. When setting lens levels, switch the AGC off. This way you can be sure that the picture you are seeing is not due to the effects of the AGC circuit. After the lens level has been set up, switch the AGC back on.

5.5 - BLC (Back Light Compensation)

Backlight compensation is a most important feature for image optimization. Situations frequently arise where the brightness light in the scene is coming from behind the subject of interest. Imagine a camera monitoring a doorway. In this example, the light outside the door is much brighter than the ambient light in the room where the camera is located. The camera's exposure system sets itself according to the average light level in the scene. However as someone opens the door the exposure system reacts to the increased light level and as a result, anybody entering the room appear "dark". The backlight compensation feature can help to overcome this problem.

Normally, the exposure circuit within the camera takes an average reading from the illumination present in the entire scene and uses this to adjust the electronic iris (or the lens iris in the case if a motorized lens). Ideally, the camera would calculate the exposure based on the light level in the part of the scene that is of interest to the viewer. The backlight compensation feature uses a "window" to set the exposure. Everything outside the window is ignored by the exposure system.

5.6 - Electronic Shutter

In some lighting conditions, particularly fluorescent, the image can be seen to flicker. This is usually caused by the interaction of the shutter with the A.C. frequency of the lighting. The Fickerless setting changes the shutter speed of the camera to a value that will not cause flicker (1/120s for PAL system cameras; 1/100s for NTSC). The disadvantage to fixing the shutter speed in this way is that the sensitivity of the camera will be reduced. This is because the electronic iris feature has effectively been turned off and it will no longer control the optimum exposure setting for the available light conditions.
Shutter Speeds

The electronic shutter available on Video cameras is analogous to the shutter in a conventional 35mm camera. The shutter speed is usually selected using a bank of dip switches located on the side of the camera.
A faster shutter speed can arrest the motion of a fast moving object rendering it sharp. Fast shutter speeds allow less light to fall on the CCD and can darken the image. If fast shutter speeds are required, ensure that there is adequate lighting. Selecting a shutter speed manually will override features such as the electronic iris and flickerless settings.

5.7 - White Balance

The white balance feature compensates for the temperature color ‘casts’ that different light sources can cause. Color casts can make white appear with a slight hue under different light sources (e.g. tungsten and fluorescent). To see the effects caused by different lighting conditions, point a camera set to auto color mode out of a window. Allow the camera ten seconds or so to balance to the outside lighting, then point the camera indoors at a room scene lit with artificial lighting. Any white areas in the scene will show a definite color tint, After a dew seconds you will see the camera compensate and the white areas will be rendered correctly. The camera cannot do this unless the color mode is set to auto color balance. It will only correctly reproduce white for the specific lighting type it is set for. Video Camera set the three fixed color modes on their cameras to compensate for indoor (tungsten), outdoor (daylight) and fluorescent lighting types.

Because no signal lighting has a fixed color temperature, accurate rendering of white cannot be guaranteed. Color compensation should only be used if the scene being viewed contains a number of different lighting types and this causes the auto white balance circuit to ‘hurt’ as it tries to balance itself. For cameras fitted with this feature. VisionNet recommends that it is always set it Auto.

5.8 - Signal to Noise Ratio

As seems obvious this is the ratio of the level of the video signal to the amount of noise present. Noise in a video is seen as snow or graininess, resulting in a poorly defined image on the monitor or video recording. The unit for expressing s/n ratio is decibels (dB), but do not be too worried because it can be expressed as a ratio. The following table shows the equivalent ratio for values given in dB.

dB	Ratio
100	100,000:1
60	1,000:1
50	316:1
40	100:1
30	32:1
20	10:1
10	3:1

It can be seen that a s/n ratio of 40Db is equivalent to a ratio of 100:1, that is the signal is 100 times the noise level. Conversely the noise is one hundredth of the signal. Note that at a s/n ratio of 20Db, the noise is 10% of the signal and would produce an unacceptable picture. The following table provides a guide as what quality to expect from various s/n ratios.

S/N ratio dB	**S/N ratio : 1**	**Picture quality**
60 dB	1,000	Excellent, no noise apparent
50 dB	316	Good, a small amount of noise but picture quality good.
40 dB	100	Reasonable, fine grain or snow in the picture, fine detail lost.
30 dB	32	Poor picture with a great deal of noise.
20 dB	10	Unusable picture.

Chapter 6 Choosing the Right Lens

The most common thing that can impair the performance of a Video Camera is an incorrect or poorly chosen lens. Lens choice depends upon several factors such as the physical position of the camera, the available scene illumination and the type of view of the scene that is required.

6.1 - Specification of Lens

Focal Length
The focal length of a lens determines its field of view at a given distance. A wide angle lens as its name suggests has a wide field of view at a given distance. This means that it can capture a wide area of the scene in both the horizontal and vertical planes. A longer focal length lens can capture a distant image with magnification. Because of this, objects in the scene will appear far away and show little detail. Broadly speaking, the focal length of a lens falls into two categories: fixed or variable.

Focal Length and Angle of the Field of View
Lens with a shorter focal length monitor a nearer object more clear than that with longer focal length. In contrast, lens with longer focal length can take a more distinct image than that with shorter focal length. However, the angle of the Field of View is greater with a short focal length and will show a wider picture. The angle of the Field of View is smaller with a long focal length and will show a narrower picture. Here are the example of lens with different focal length.

Depth of View
The depth of field refers to the area within the field of view which is in focus. A large depth of field means that a large percentage of the field of view is in focus, from objects close to the lens often to infinity. A shallow depth of field has only a small section of the field of view in focus. The depth of field is influenced by several factors. A wide angle lens generally has a larger depth of field than a longer focal length lens.

Camera Lens Illustration

Fixed Focal Length
A lens having a fixed focal length is often the least expensive. Since the focal length is fixed, so is the field or angle of view. This means that accurate calculations will have to be performed in order to correctly select a lens for a given application. A change in the requirements of the application will often result in a changing of lens.

Variable Focal Length
Although more expensive, these lenses are easier to use, set up and change. It is much simpler to obtain the correct view of a scene when it is possible to vary the focal length [and therefore the angle of view] of the lens. Variable focal length lenses should not be confused with zoom lenses which have a much larger adjustment range.

6.2 - Lens Mount

The larger format cameras such as 1" and 2/3" have used the C-mount type lens system to physically couple the lens to the camera. With the advent of smaller CCDs such as 1/2" and 1/3", the CCTV industry has adopted the CS-mount. However, the unique back-focusing mechanism on Video Cameras allows both types of lens mount to be used. This is because the CCD assembly can be physically moved backwards and forwards in relation to the back of the lens. If this were not the case, the flange of a C-mount lens would mechanically interfere with the CCD causing damage. CS-mount lenses are often less expensive and, in general terms, for a given focal length, a CS-mount lens is physically smaller than an equivalent C-mount lens.

6.3 - Lens Iris

The amount of light that falls on the surface of the CCD sensor needs to be within certain limits for optimum performance. Too much light and the image is overexposed or washed out. Too little, and the resulting image is dark losing details in the shadow areas of the scene. The lens iris us used to control the amount of light falling on the sensor. This iris consists of a number of thin metal plates arranged in such a way that they produce a circular opening at their center. This opening, called the iris or aperture, can be made smaller or larger usually in fixed increments called f-stops.

6.4 - Lens Selection

Fixed Iris
Fixed iris lenses cannot be adjusted for different lighting conditions. These lenses are most situated to indoor conditions where the lighting level will remain constant. However, the Electronic Iris and Automatic Gain Control features of Video Camera can make this lens much more flexible in use.

Manual Iris
The iris on a manual iris lens is usually set up when the camera is installed to suit the prevailing lighting conditions. These lenses cannot react to changes in scene illumination and are best suited to indoor applications where the ambient light will remain constant. The Electronic Iris and Automatic Gain Control features of Video Cameras can allow this type of lens to be used in a wider range of application areas.

Automatic Iris
For external conditions, and where the scene illumination is constantly changing, a lens with some sort of automatically adjustable iris is preferred. The iris aperture is controlled by the camera and is constantly changed to maintain the optimum light level to the CCD.

Zoom Lenses
Zoom lenses is the from of variable focal length lenses and offer the greatest functionality. They can be continuously adjusted throughout their range, usually remotely, to vary the focal length and field of view. Note that because the depth of field is also dependent upon the focal length of the lens, it will continuously vary throughout the zoom range being at its greatest when the lens is zoomed fully out [wide angle]. Remotely controlled zoom lenses are often used by the operator to closely examine critical areas of the scene.

Infrared Lenses
In some cases, Video Cameras have to be used in a very dark conditions. Operations of Video Camera are based on light, however, we can install infrared light that can illuminate the areas. Image produced by Infrared is B/W. And human eyes cannot see Infrared light, as a result, the area illuminated by infrared remains darkness to human.