



CHAPTER 4

COMPONENT OF THE CCTV SYSTEM

4.1 Video Camera

The video camera is used to capture images, convert it into electrical signals, and send it down through the coaxial cable to the monitor. Currently, there are several types of surveillance video camera in the market; i.e. High-resolution Coloured Video Camera or the Black and White Video Camera. The High-resolution coloured video camera is more expensive than the normal black and white video camera. High-resolution coloured video camera requires more pixels, but produces clearer pictures, thus affecting the data transmission speed. The colour camera's picture is clearer and the size of the data is relatively bigger than the non-coloured camera. High-resolution colour video camera is ideal for visualisation of tourist spots, weather information, and traffic control. On the other hand, black and white video camera would normally be used for security purposes. In order for the transmission rates to be faster, these large amounts of video surveillance system, has to use smaller data size.



High-resolution colour video camera



Black and white video camera

Figure 4.1 Video camera

Video camera can be wired or wireless, with wired camera being physically connected at two end points. On the other hand wireless camera can placed in any way without being physically connected

4.1.1 Wired Camera

A wired camera consists of a cable that connects the camera to a TV, VCR or computer. The video signal is passed from the camera via the cable to the TV, VCR or computer where users can view the picture. Most wired cameras need coaxial cables to connect the camera to the TV, VCR or computer.

- CCTV camera – CCTV camera is widely used in the traditional CCTV system. The camera is linked to the multiplex, TV, VCR or video capture card via the coaxial cable.
- Network camera – Network camera is a new technology in the CCTV system. It runs on the network environment by using twisted pair cables. It directly links the network camera to the hub, and does not require multiplex, video capture card or VCR. Network cameras is easier to install



and can be used for remote video monitoring. But, it is more costly than CCTV camera and can only work in a network environment.

The network camera has its own IP address that must be set up before the installation can be implemented. The network camera is connected to the Hub / Switching Hub via twisted pair cables and the remote computer has to run the application software in order to access the camera. Using network camera is simple and flexible. The network camera can be connected directly to the network through hub without linking to the PC. It allows all the computers within the network to access it. Hence, network camera is able to support the data transmission from 10 M bits to 100 M bits. Figure 4.3 shows the structure of the network camera that operates using computer network.



Figure 4.2 Network camera

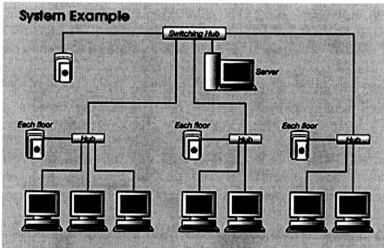


Figure 4.3 Structure of Network Camera

Network camera does not require multiplex or video capture card and the installation of the network camera is not limited. It therefore requires large bandwidth, in order to ensure continuous data transmission. Therefore, 100 M bits switching hub is recommended. The application software of the network camera provides the functions for remote monitoring and video recording. All the data can be recorded and saved onto the computer hard disk for future references. The computer on the network can choose to save the data or just monitor it. In other words, it allows for multiple computer or terminal in different places to operate / monitor the situation at the same time. The network camera that is normally used in the office environment consists of network support. The disadvantage of



network camera is that the data transmission speed relies on the size of bandwidth of the network.

- Web camera / PC camera – Web camera / PC camera is widely used as a home surveillance system. It is simple, cheaper and able to support high colour resolution. Web camera / PC camera does not require multiplex, video capture card or VCR. However it does require a computer with a large hard disk and memory size to support it. The PC camera is linked to the computer through USB cables. It allows fast data transmission and image recording onto the hard disk. Web camera / PC camera can be used for remote monitoring system. However it can only support a small size surveillance system.

4.1.2 Wireless camera

A wireless camera does not require any coaxial cable to connect the camera to the TV, VCR or computer. The video signal is transmitted directly through the air to the TV, VCR, computer, or to the receiver. Most wireless video cameras operate on the amateur radio frequency. Wireless cameras obtain their power supply by using either batteries, or by direct plugging into regular wall outlets.

The advantage of the wireless video camera is its ease of setup. The use of physical cables has been eliminated therefore allowing for faster transmission. The disadvantage however, lies in its susceptibility to interference problems as



the video signal is no longer on a dedicated run but rather on a shared frequency. This can lead to signal problems where the video quality somewhat diminishes at times.

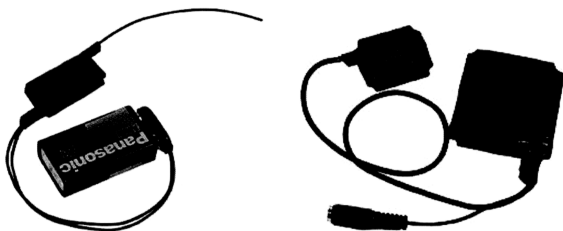


Figure 4.4 Wireless camera

4.2 Video recorder

Video recorder is used for recording the events captured by the CCTV camera.

There are two types of video recorder: VCR and DVR



Figure 4.5 Videocassette recorder



VHS Tape

Video Cassette Recorder (VCR) – The VCR is one of the most important components in the surveillance system. VCR is used to record events using standard VHS tapes. Some of VCR features are event-recording, time and date searching, time and date generator and real time recording.

Digital video recorder (DVR) – DVR functions similarly to the VCR. However, the DVR records the events using internal or removable hard disk rather than standard VHS tape. An advantage, which it has over VCR, is that it does not require waiting time for the rewind or forward function.

There are two types of video recorder:

- Time Lapse recorder

Time Lapse recorder records and views the events like viewing a slide show whereby there are frames which are skipped / missed. Time Lapse recording only records the events when motion is detected.



□ Real time recorder

Real Time views and records the events smoothly and continuously. Real time viewing and recording provides richness of event flow, therefore is more costly and often requires a more advanced form of equipment.

4.3 Multiplexer

Multiplexer is used to integrate two or more video cameras, the functions of multiplexer is just like a network hub, combining the signals from different video cameras and sending it to a VCR. Multiplexing allows up to 16 video camera signals to be transmitted to a VCR at same time. There are two types of multiplexer, Simplex multiplexer or duplex multiplexer. Simplex multiplexer allows for single data transmission. It is only able to display a particular picture at a time. Duplex multiplexer allows for multiple data transmission and displays multiscreens or pictures at a time. "http://www.ncjrs.org/school/ex2_16.html"



4.4 Video Capture Card

In order to install a video capture card on the computer, a PCI slot is required. The video capture card receives the video stream from the coaxial cable. There are usually 4-port capture cards, or multiples of four. The capture cards take four or more video signals and deliver them to the computer as a single multiplexed signal, by making use of the PCI interfaces.

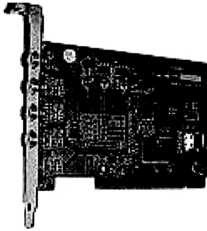


Figure 4.6 Video Capture Card

The video capture card on-board processor transforms the video frames into the formats that the computer can understand (e.g. MPEG), then the operating system and software packages take over all the others tasks.

4.5 Transmission Media

The transmission media can be categorized into two major classes: conducted and radiated. Conducted media transfers signal from sender to receiver through



conductors such as wires or cables. This includes telephone wires, twisted pair wires, coaxial cables and fibre optic cables. Radiated media, which is also known as wireless media, use radio waves of different frequencies or infrared light to broadcast through air or space. This included broadcast radio, microwave, satellite and infrared light.

4.5.1 Conducted Media

Wire is the earliest type of data transmission media and is the most common form of transmission media. Wires is highly available and at lower cost. The disadvantage however, includes its susceptibility to signal distortion or error; and the relatively low transmission rate when used for long distance transmission. Examples of conducted media used for CCTV are:

- Twisted pair cable

Twisted pair is one of the most common media used in LANs, twisted pair wires commonly operate at the speed of 10 to 100 million bits per second (Mbps). Twisted pair cable is specially used for network camera.

- Coaxial cable (Coax cable)

Coaxial cable is commonly used in CCTV camera. Coaxial cables consist of one or two central data transmission wires covered by an insulating



layer, a shielding layer, and an outer jacket. Coaxial cables provide high degree of immunity to externally caused signal distortion and the theoretical data bit rate transfer is more than 400 Mbps. In LAN of less than a half-mile, signal loss or attenuation is not a concern. The advantage of using coaxial cable is the higher level of data transmission rates, immunity to noise or signal distortion and reasonable cost over short distances.



Figure 4.7 Coaxial cable



□ Universal serial bus (USB)

USB cables are becoming more and more common; they also make it possible for manufactures to produce equipment that can be made for the computer. USB cable and connections, which allow much faster data transfer rate, will soon replace the traditional serial cable and port. Today, most web camera / pc camera is being manufactured with USB port.

4.5.2 Radiated media

Radiated media, which is also known as wireless media, use radio waves of different frequencies or infrared light to broadcast through air or space.

Most wireless CCTV cameras today operate on the radio frequency. The advantage of wireless camera systems is, that cabling does not have to be run underground, through the air, or behind walls and ceilings. Therefore, the chance of tampering is much less. However, it requires a receiver to operate it. Data transmission can be affected by environmental conditions and it has limited data transmission rate. The transmission ranges are limited to about 300 feet.



Private line	300,1200,2400,4800,9600,19200,38400,56000 64000, 80000
Switched line	300,1200,2400,4800,9600,19200,38400
Leased line	2400,4800,9600,19200,56000,64000
T1, T2, T3, T4	1.5M, 6.3M, 46M, 281M
Unshielded twisted pair	1M, 10M, 16M, 100M
Shielded twisted pair	1M, 10M, 16M, 100M
Coaxial cable	1M, 2M, 10M, 50M, 100M (over 400M potential)
Fiber optics	Over 2 Gbps
Microwave	To 45M
Broadcast radio	9600
Spread spectrum radio	2M
Infrared light	1M, 4M
Satellite	To 50M

Table 4.0 Media and their common transmission speeds (Stamper 1994)