Closed Circuit TV Systems

Human Eye and Light

Spectrum distribution of light, with associated wavelengths
Sources of Light

Typical levels of illumination in indoor

<table>
<thead>
<tr>
<th>Office</th>
<th>Retail Store</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-400 Lux</td>
<td>100-600 Lux</td>
</tr>
</tbody>
</table>

Typical levels of illumination at outdoor

<table>
<thead>
<tr>
<th>Sunny Day (Direct Sunlight)</th>
<th>Sunny Day (Shade)</th>
<th>Overcast Day</th>
<th>Dawn</th>
<th>Dusk</th>
</tr>
</thead>
<tbody>
<tr>
<td>10000-100000 Lux</td>
<td>2000-4000 Lux</td>
<td>100-1000 Lux</td>
<td>0.01 Lux</td>
<td>0.01 Lux</td>
</tr>
</tbody>
</table>

Street Lighting | Full Moon | Quarter Moon | No Moon | Overcast Night |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-10 Lux</td>
<td>0.1 Lux</td>
<td>0.01 Lux</td>
<td>0.001 Lux</td>
<td>0.001 Lux</td>
</tr>
</tbody>
</table>

Optical Elements

Lens assembly

Where,
1- Lens Clip
2- Lens 1
3- Lens spacer
4- Lens 2
5- Lens 3
6- Lens holder
Transmission Media

Instruments Commonly Used in CCTV

- Spectrum analyser
  - A spectrum analyser measures the magnitude of an input signal versus frequency within the full frequency range of the instrument
  - It displays frequency of a signal on the horizontal scale and amplitude of the signal on the vertical scale
Instruments Commonly Used in CCTV

Types of Cameras

- Understanding camera types
  - Board cameras
    - A board camera is a small camera consisting of a lens mounted directly to a circuit board or small group of boards

Board cameras
Types of Cameras

• Bullet camera
  • Bullet cameras use similar technology as that of board cameras but with different configuration
  • Advantages:
    ➢ Low-cost
    ➢ Flexible to any environment

![Bullet camera](image)

Types of Cameras

• Fixed dome camera
  • A fixed dome camera means that the cameras inside the dome enclosure remain at one position
  • Dome cameras are mostly used for indoor applications as the dome can be either smoked or tinted

![Fixed Dome cameras](image)
Types of Cameras

- Pan/Tilt and Zoom (PTZ) domes
  - The PTZ allows camera system operators to rotate and zoom the camera in any direction as required.
  - The camera can be rotated left, right (pan), up, down (tilt).
  - Camera’s view can be easily changed by the operator with the help of the zoom lens.

  ![PTZ domes](image)

- Network cameras
  - These cameras can be connected directly to a computer network (LAN).
  - They have their own nodes or network IP address, and they act as video server on the network.
  - The user can easily monitor the video on any computer equipped with a web browser.

  ![Network camera](image)
**Charge Coupled Device**

- CCD is a semi conductor device that converts light waves into a proportional analogue electrical current
- A wide range of electronic functions can be easily performed by CCD such as
  - Image sensing
  - Signal processing
- Working of CCD
  - In order to generate an image, the CCD must perform the following tasks. They are
    - Charge generation
    - Charge collection
    - Charge transfer
    - Charge measurement

**Introduction to CCTV monitors**

- Traditional CCTV monitors use CRT technology
- CRT technology is being replaced with LCD technology with improved features of
  - Reduced power consumption
  - Higher picture quality

CCTV monitors used for surveillance purpose
Monitors Sizes, Safety and Adjustments

Different monitor sizes used during monitoring

Other Displays

- Working principle

  LCD structure

  LCD display for surveillance
Other Displays

Rear projection monitors usage in CCTV

VCR, VHS and their Limitations

- **VCR**
  - VCRs are also referred as analogue video tape recorders
  - The magnetic recorders used in CCTV, for monitoring purpose can record more than 8 hours
  - There are two types of VCRs in use for CCTV applications, real time VCRs and time lapse VCRs
Video Multiplexers

- Recording in CCTV
  - VCRs are used to record the images from the switchable monitors in CCTV systems

DVR

DVR connections
Ethernet

Telemetry Control
Supporting Equipment for CCTV

Mounting Equipment

(a) Fixed Lattice tower
(b) Tilt-Over Lattice tower

(a) Fixed tabular column
(b) Tilt-Over tabular column
Pan/Tilt Units

Fixed and Motor Driven Pan/tilt systems

Lighting

- Halogen lamps (Tungsten Halogen or Quartz Iodine)
  - They are incandescent lamps with a tungsten filament and are filled with halogen gas such as iodine or bromine added at low pressure.
**Lighting**

(a) Image captured by IR camera during day time
(b) Image captured by IR camera during night time

(a) Sodium street lighting
(b) White light street lighting
Monitor Brackets

- They are used for holding monitors securely when hung from walls or ceilings.
- Brackets are mainly designed for obtaining:
  - Maximum tilt
  - Maximum rotation

Models of brackets used for holding different CRT type monitors

Design Considerations

- Need analysis
- Selecting equipment according to the requirement
- Drawing – CCTV symbols
- Installation
- Camera protection
- IP Ratings
## Drawing – CCTV Symbols

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV camera</td>
<td><img src="image1" alt="Symbol" /></td>
<td>Used on block diagrams and layout diagram. The lens side is to the left.</td>
</tr>
<tr>
<td>Camera protection case</td>
<td><img src="image2" alt="Symbol" /></td>
<td>The window side is to the left.</td>
</tr>
<tr>
<td>TV camera direct mounting method</td>
<td><img src="image3" alt="Symbol" /></td>
<td>Ceiling suspension Wall mounting</td>
</tr>
<tr>
<td>Motorized pan/tilt head</td>
<td><img src="image4" alt="Symbol" /></td>
<td>Erect mounting type Ceiling suspension type</td>
</tr>
<tr>
<td>Signal equipment</td>
<td><img src="image5" alt="Symbol" /></td>
<td>VDA: Video distribution amplifier PDA: Pulse distribution amplifier SG: Sync signal generator</td>
</tr>
</tbody>
</table>

CCTV drawing table

### CCTV installation drawing

![CCTV installation drawing](image6)
Camera Protection

Transparent covering of an enclosure

Dome Camera enclosure

IP Ratings

- Ingress Protection (IP) rating or IP code was developed by the European Committee for Electro Technical Standardization.

- IP rating is based on the International Electrotechnical Commission’s (IEC) standard 60529.

- IP ratings are used to describe the sustainability of an enclosure of the equipment to operate in different environmental conditions.
Commissioning and Maintenance

Test Equipment

- The most useful test signal generator for CCTV applications is one that can produce video and audio test signals.

Test signal generator
Test Equipment

TV Test Charts

ViDi Labs - SD&HD CCTV test chart v.4.2
Test Equipment

- Rotatest have produced a test chart developed by the UK Police Scientific Development Branch (PSDB)
- New UK laws require camera operators to ensure that their equipment produces images well enough for police investigations. They have two charts:
  - Rotakin
  - Rotastat