Scanners and Reading Devices

- **Data collection** devices obtain data **directly** at the location where the transaction or event takes place
  資料收集裝置可直接從交易或事件發生的地點取得資料
- Used in常應用在
  - Restaurants餐廳
  - Grocery stores商店
  - Factories工廠
  - Warehouses倉庫
  - The outdoors室外

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Figure 7-22


monitor display
laptop display
digital camera display
navigation system display
handheld game device display
smartphone display

OUTPUT

What Is Output?

- **Output** is data that has been processed into a useful form

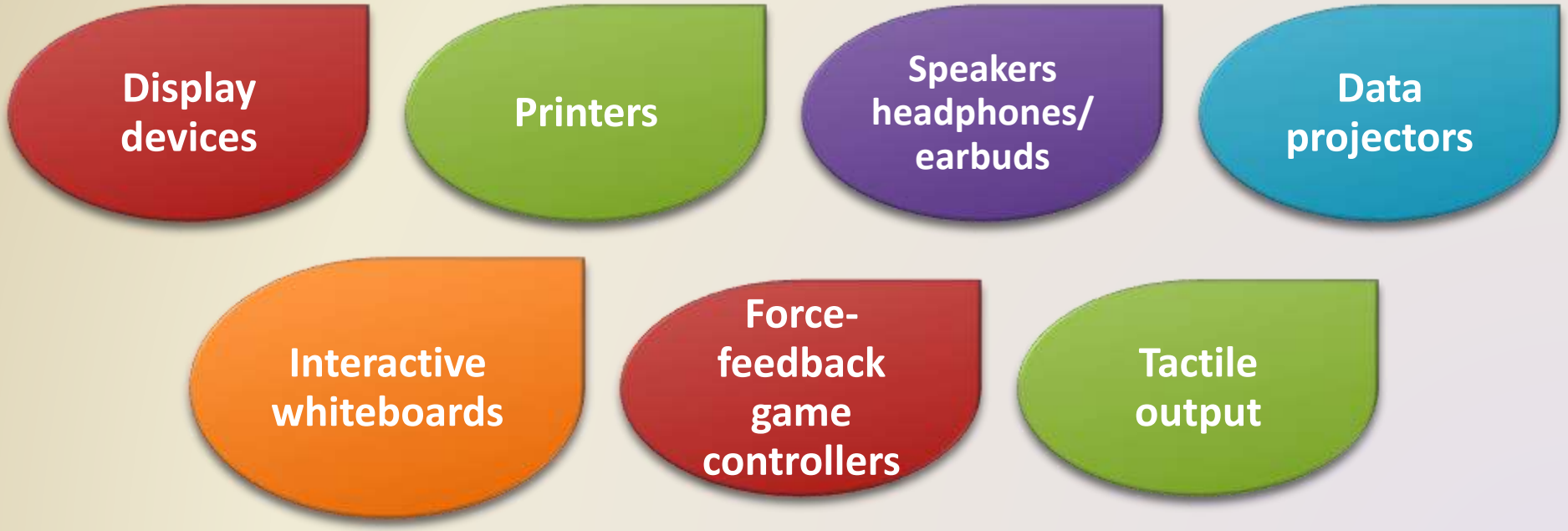
  輸出 指的是資料已經處理成有用的形式
- 輸出形式使用的依軟硬體及使用者的需求而不同
- 輸出的四種基本類：

p340

What Is Output?

- An **output device** is any type of hardware component that conveys information to one or more people

輸出裝置指的是能將資訊傳達給一或多人的硬體元件



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Display Devices

- A **display device** visually conveys text， graphics， and video information
  顯示裝置 是能以視覺方式傳達文字、圖像與視訊資訊的輸出裝置

- A **monitor** is packaged as a separate peripheral
  監視器 被包裝成分開的周邊設備
  - **LCD monitor**
  - Widescreen

Soft copy

Pages 340 - 341

Figure 7-24

Display Technologies

- A ***liquid crystal display*** (**LCD**) sandwiches a liquid compound between two sheets of material that presents **sharp**, **flicker-free** images on a screen when illuminated.
- The light source, called the ***backlight*** , often uses either **CCFL** or ***LED*** technology.
  - CCFL (cold cathode fluorescent lamp)冷陰極管發光
  - *LED* (light-emitting diode)發光二極體

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冷陰極管發光原理

Display Technologies

- A display that uses LED for the **backlight** often is called an ***LED display*** or an **LED LCD display**.
- LED displays **consume less power, last longer, and are thinner, lighter, and brighter** than a display that uses CCFL technology, but they also may be more expensive.
- Screens in laptops and mobile devices often use LED backlight technology.

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Display Technologies

- LCD displays typically produce color using ***active-matrix*** , or ***TFT*** (thin-film transistor), technology, which uses a separate transistor to apply charges to each liquid crystal cell and, thus, displays high-quality color that is viewable from all angles.
- Several types of active matrix displays, or panels, are available, with some providing higher quality than others.

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Display Technologies

- Instead of LCD or traditional LED, some displays use OLED technology.
- ***OLED*** (organic LED) uses organic molecules that are self-illuminating and, thus, do not require a backlight.
- OLED displays consume less power and produce an even brighter, easier-to-read display than LCD or LED displays, but they can have a shorter life span.
- OLEDs also can be fabricated on thin, flexible surfaces.

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行動裝置的顯示技術

- Many mobile computers and devices use either **AMOLED** or **Retina Display technology**.
- **An AMOLED (active-matrix OLED) screen** uses both active-matrix and OLED technologies, combining the benefits of high-quality viewing from all angles with lower power consumption.
- **A Retina Display** developed by Apple, produces vibrant colors and supports viewing from all angles because the LCD technology is built into the screen instead of behind it and contains more pixels per inch of display.

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AMOLED

- **有源矩陣有機發光二極體**或**主動矩陣有機發光二極體**，**Active-matrix organic light-emitting diode**
- 是一種應用於移動設備中的顯示技術。
- 其中OLED(有機發光二極體)描述的是薄膜顯示技術的具體類型-有機電激發光顯示，AM（有源矩陣體**或**主動式矩陣體）指的是背後的像素尋址技術。
- AMOLED為主動矩陣OLED，手機次螢幕及MP3/MP4用面板目前仍然是OLED的主要應用市場，這兩項應用領域主要均採用PMOLED面板，對於AMOLED來說，主要的市場推動力仍是來自於高階手機及較大尺寸應用市場。
- **讓手機畫面更鮮艷的AMOLED螢幕顯示技術**

Retina Display

- **Retina顯示器**
- 是一種由蘋果公司設計和委託製造的顯示器，具備足夠高像素密度而使得人體肉眼無法分辨其中單獨像素點的液晶屏，最初採用該種螢幕的產品iPhone 4由執行長史蒂夫·賈伯斯於WWDC2010發布，其螢幕解析度為960×640（每英寸像素數326ppi）。
- 這種解析度在正常觀看距離下足以使人肉眼無法分辨其中的單獨像素。

Display Devices

- **Liquid crystal display** (**LCD**) uses a liquid compound to present information on a display device
  液晶顯示使用液態的混合物，在顯示裝置上呈現資訊

  - Have a small footprint **具備較小的覆蓋面積**

LCD

主動矩陣驅動

- Active Matrix
- 則以薄膜式電晶體型
  (Thin Film Transistor；TFT)
  為目前主流

被動式矩陣驅動

- Passive Matrix
- 俗稱的單純矩陣驅動
  (Simple Matrix)
- 可分為
  - **扭轉向列型**
    Twisted Nematic，簡稱 TN
  - **超扭轉式向列型**
    Super Twisted Nematic，
    簡稱STN

Active-Matrix Displays

- The table below lists popular types of active-matrix displays.

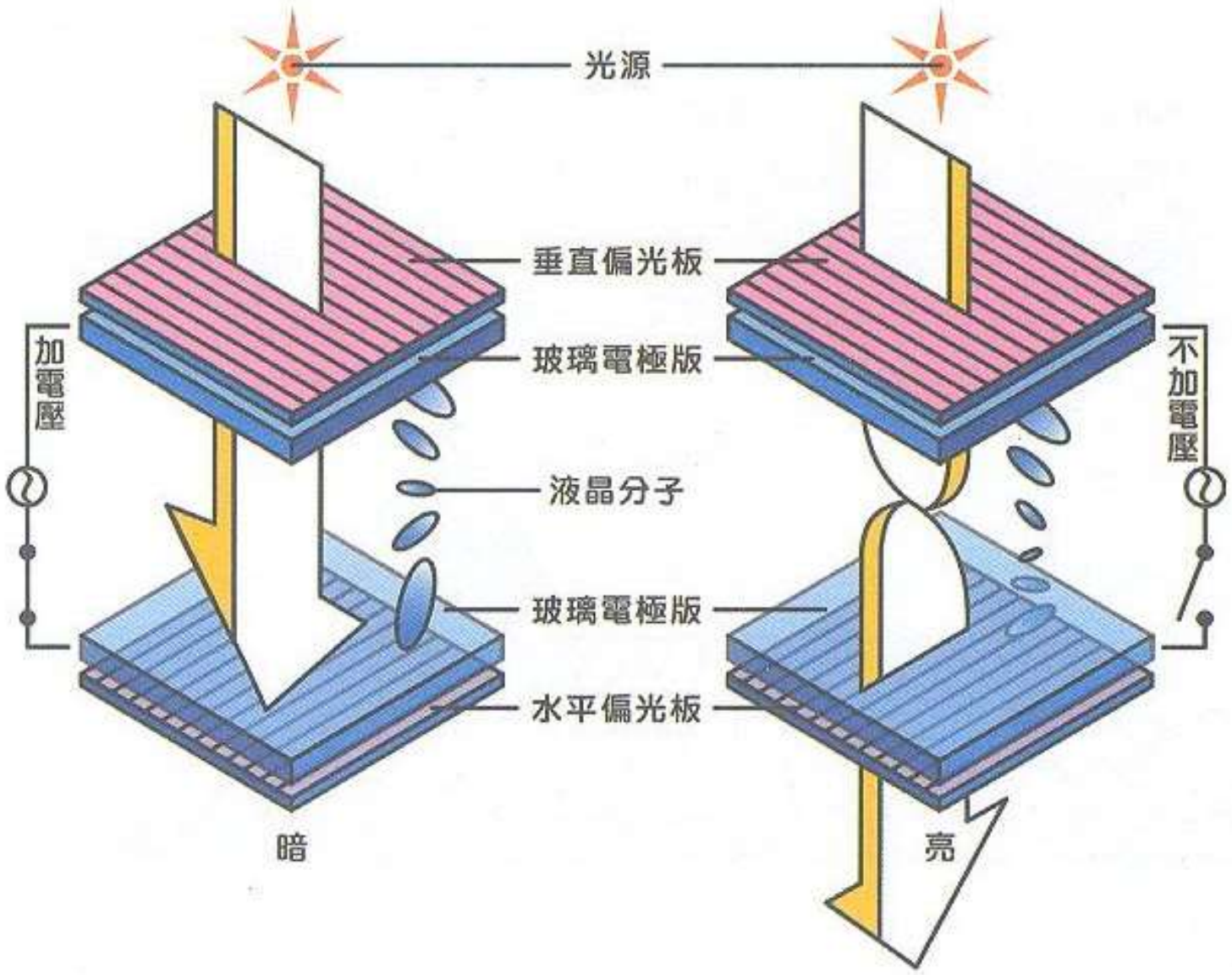
Name	Description
In-plane switching (IPS)	Molecules line up to create color; **improved viewing angle; higher cost**; slowest response times compared to other active-matrix types; sometimes experiences color shifts when viewed from angle
Twisted nematic (TN)	Molecules twist to create color; fast response times; typically lower cost; lower viewing angles, lower brightness, poorer color representation compared to other active-matrix types; oldest technology
Vertical alignment (VA)	Molecules align vertically and then rotate to create color; **improved viewing angles; high maximum brightness; slower response times than TN**

Active-Matrix Displays

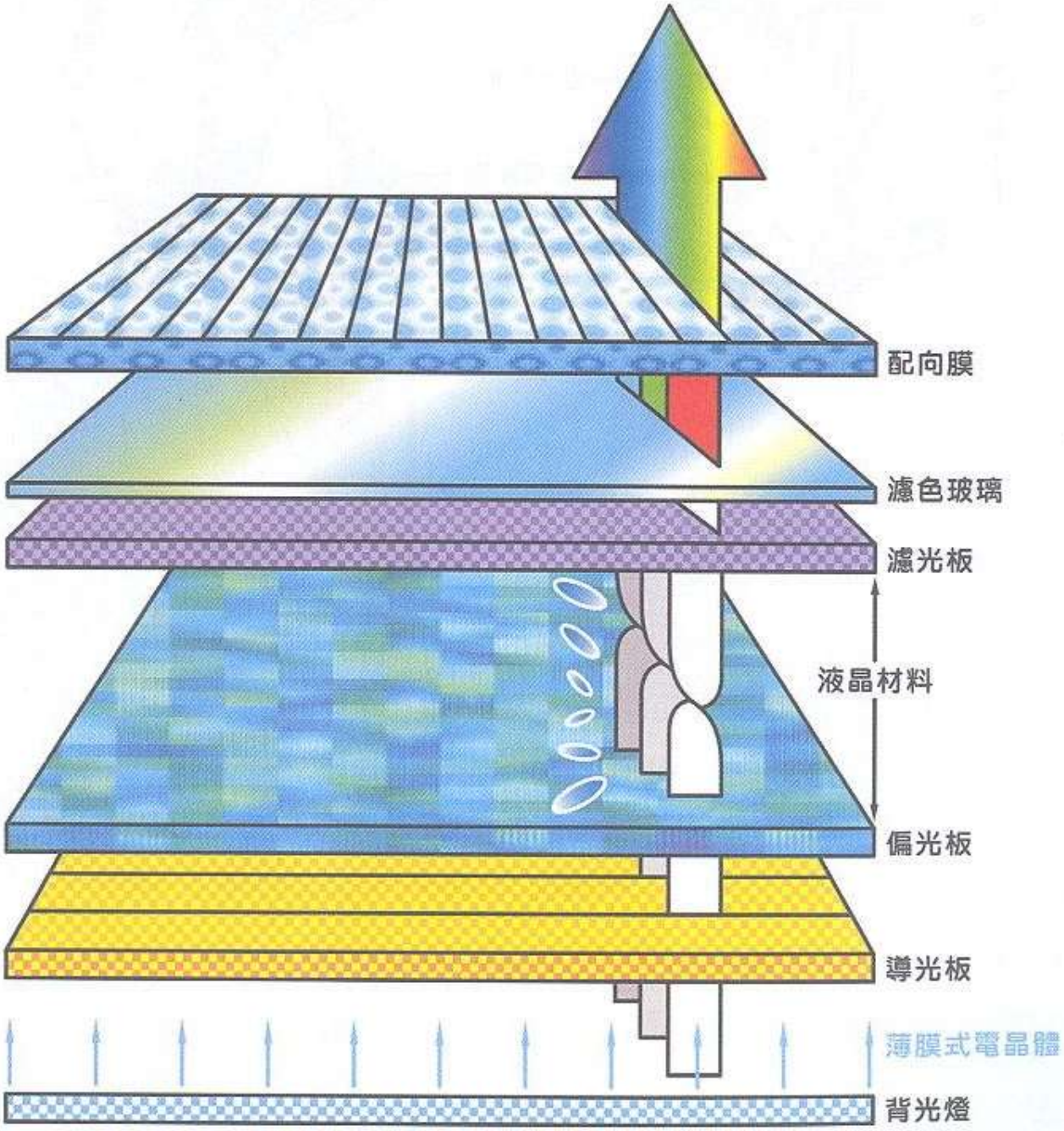
- TFT 家族旗下成員眾多，包含 TN 、 VA 、 IPS 、 Super LCD 、 Super PLS 等，早期的 TFT-LCD 顯示器，中間的液晶排列多是採用 TN（Twisted Nematic）模式，但它最大的缺點就是可視角度較小，因此為了解決此問題，VA液晶（Vertical Alignment liquid crystal）技術應運而生，可擁有更高的對比度及更寬廣的可視角度，也是目前TFT螢幕的基礎。
- IPS（In-Plane-Switching Liquid Crystal）是TFT當中較貴、不良率也較低的一種液晶，由於 IPS 液晶的電極和液晶處於一個平面，所以沒有方向性的技術問題，螢幕可以達到上下、左右 170 度水準的視角。
- 簡單來說， TN 、 VA 、 IPS 的差異主要是在側視、上視、下視等視角下的對比跟色偏的表現不一樣。
- Super LCD 是由 IPS 延續的 FFS（Fringe Field Switching）技術衍生而來，具備陽光直射可視的特性，強調正視對比可達到 800：1 ，水平 160 / 垂直度視角可達到對比大於 100：1 的顯示呈現。
- Super PLS（Plane to Line Switching）是由三星研發的 TFT 面板技術，類似 IPS 功能，不僅螢幕亮度增強 10% ，成本也比較低。

VA液晶

- VA液晶（Vertical Alignment liquid crystal）是垂直排列液晶的簡稱。
- 跟TN液晶相比VA液晶有更高的對比度和更寬廣的可視角度，是當今大螢幕液晶電視採用的主流技術。
- 優點對比度較高。
  - 色溫較溫和。
  - 漏光程度較低。
  - 可視角提升到178度，有改善TN版面失色的問題。
- 缺點
  - 雖然有跟IPS一樣的178度可視角，但左右看螢幕會有偏白的情況。
  - 色彩較IPS低。



液晶顯像示意圖



TFT面板顯像流程

OLED

- 有機發光顯示器 (Organic Light Emitting Display)或稱有機發光二極體(Organic Light Emitting Diode) 的縮寫。
- 其發光原理，是在透明陽極與金屬陰極間蒸鍍有機薄膜，注入電子與電洞，並利用其在有機薄膜間複合，將能量轉成可見光。可搭配不同的有機材料，發出不同顏色的光，來達成全彩顯示器的需求。
- 由於OLE D所使用的有機化合物材料會自行發光，因此不像LCD面板後方須要加上背光源，可大幅降低耗電、簡化製程、使面板厚度變薄。

OLED

OLE D依有機材料不同可分為

- 小分子OLED (Small Molecular Organic Light Emitting Diode，簡稱SMOLED)
  - 採用真空蒸鍍法製程
- 高分子OLED (Polymer Organic Light Emitting Diode，簡稱PLED)
  - 採用液態製程，如旋轉塗佈、噴墨列印

OLED

- OLE D產程中將有機層敷塗到基層上的方法
  1. **真空沉積或真空熱蒸發(VTE)**
     位於真空腔體內的有機物分子會被輕微加熱(蒸發)，然後這些分子以薄膜的形式凝聚在溫度較低的基層上，此方法成本高、效率低。
  2. **有機氣相沉積(OVPD)**
     在一個低壓熱壁反應腔內，載氣將蒸發的有機物分子運送到低溫基層上，然後有機物分子會凝聚成薄膜狀，使用載氣能提高效率，並降低OLED的造價。
  3. **噴墨打印**
     利用噴墨技術可將OLED噴灑到基層上，就像打印時墨水被噴灑到紙張上那樣，噴墨技術降低了OLED的生產成本，還能將OLED打印到表面積非常大的薄膜上，用以生產大型顯示器，例如80英吋大屏幕電視或電子看板。

OLED

OLED 依驅動方式可分為：

1. **被動式 OLED (Passive Matrix， PMOLED)**
   - 製作成本及技術門檻較低，卻受制於驅動方式，解析度無法提高，只有被掃描線選擇到的畫素才會被點亮。
2. **主動式 OLED (Active Matrix， AMOLED)**
   - 即是利用薄膜電晶體(Thin Film Transistor ，TFT)，搭配電容儲存訊號，來控制OLED的亮度灰階表現。

OLED

- OLED顯示器實現彩色化的方法主要有三種
  1. **獨立發光材料法**
     以紅綠藍三色為獨立發光材料進行發光，是目前OLED彩色化最常用的方法。
  2. **光色轉換法**
     利用藍光為發光源，經由光色轉換薄膜將藍光分別轉換成紅光或綠藍光進而實現紅綠藍三色光。
  3. **彩色濾光膜法**
     類似LCD，採用白色光源透過類似LCD的彩色濾光片來達到全彩的效果。

OLED

- OLED 具有自發光、超薄特性、高亮度、高發光效率、高對比、微秒級反應時間、超廣視角、低功率消耗、可使用溫度範圍大、可曲撓面板等使用特性，可製作大尺寸、高解析度、高資訊量為主的全彩顯示器

OLED

- OLED相比LCD有許多優勢
  - 超輕、超薄(厚度可低於1mm)、亮度高、可視角度大(可達170度)、不需要背光源，功耗低、回應速度快、清晰度高、發熱量低、抗震性能優異、製造成本低、可彎曲。

OLED - 財經百科- 財經知識庫

新世代顯示器OLED

錸寶科技股份有限公司- OLED介紹

3C小學堂》快速搞懂LCD與OLED面板差異

OLED

Phosphorescent OLED

PHOLEDs

FOLED® flexible OLEDs.

TOLEDs

TRANSPARENT OLEDs

FOLEDs

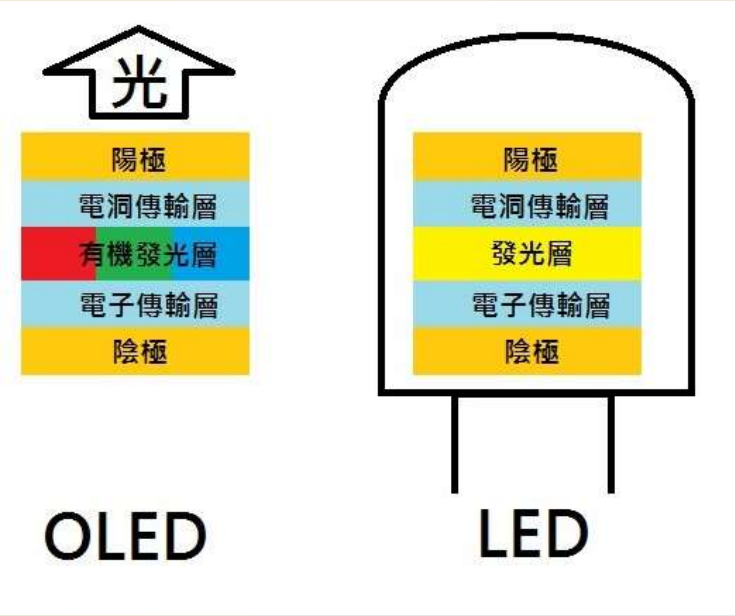
White OLED

WOLEDs

UNIVERSAL DISPLAY CORPORATION

OLED 與 LED

- OLED 與 LED兩個發光的原理很相近，只是使用的材料不一樣
- OLED是使用有機化合物，而LED是使用加入一些元素的半導體材料，然後施加電壓後發光。
- 如右簡易圖解，可以發現兩者之間幾乎只有材料分別。



OLED怎麼發光的？簡單原理介紹 你一定要懂

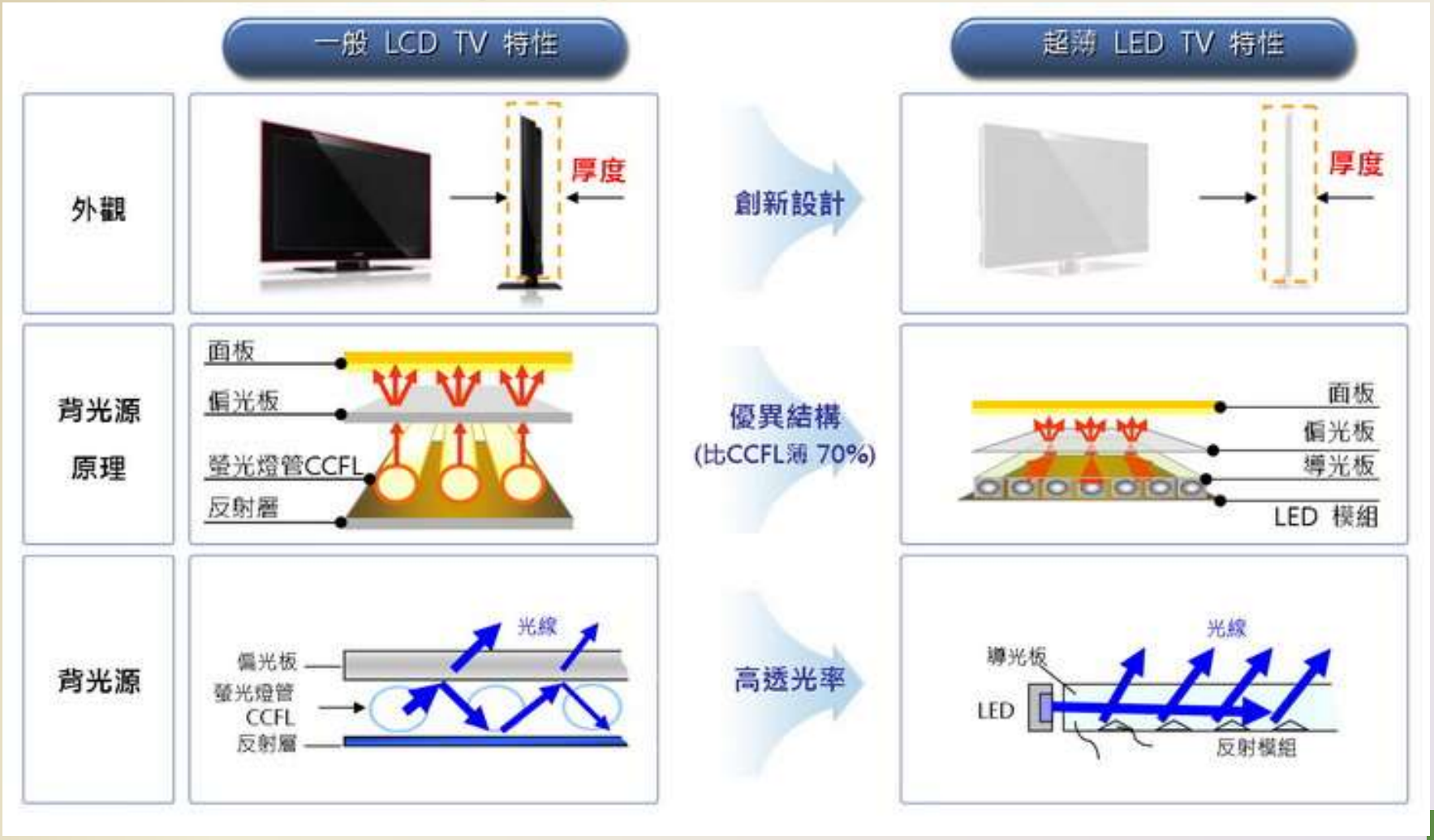
OLED 與 LED

- OLED與LED架構上非常相似，至於為什麼他會發光呢?
- 市面上最常見的照明設備水銀日光燈，是依靠電子與水銀碰撞後產生紫外線，而紫外線碰到燈管的螢光材料就轉換成我們可以看到的光。這樣的方式，我們稱他為"激光"(Luminescence)，像是日光燈是以紫外光照射螢光材料後發光，我們稱呼他為"光激光"(PhotoLuminescence)，也就是利用我們看不見的光來激發材料發出我們想要的光。
- 而另外一種激光方式，我們稱呼他為"電激光"(ElectroLuminescence)，顧名思義就是利用電壓來激發材料後發光，而OLED就是利用這樣的方式發光，而這樣的材料我們稱他為EL，也就是電激光的簡稱。因為有機EL會較無機EL容易發出色彩，所需要的電壓也比較小，所以有機的EL材料會比較容易應用在消費型產品上，所以"有機發光二極體"(Organic Light-Emitting Diode, OLED)就因此而產生。

OLED怎麼發光的？簡單原理介紹 你一定要懂

LED LCD

- 是**使用發光二極體（LED）作為背光源**的液晶顯示電視



Display Devices

- The **quality of an LCD monitor** or LCD screen depends primarily on:
  LCD監視器或LCD螢幕的品質，主要由以下性質來決定：

Resolution
解析度

Response time
回應時間

Brightness
亮度

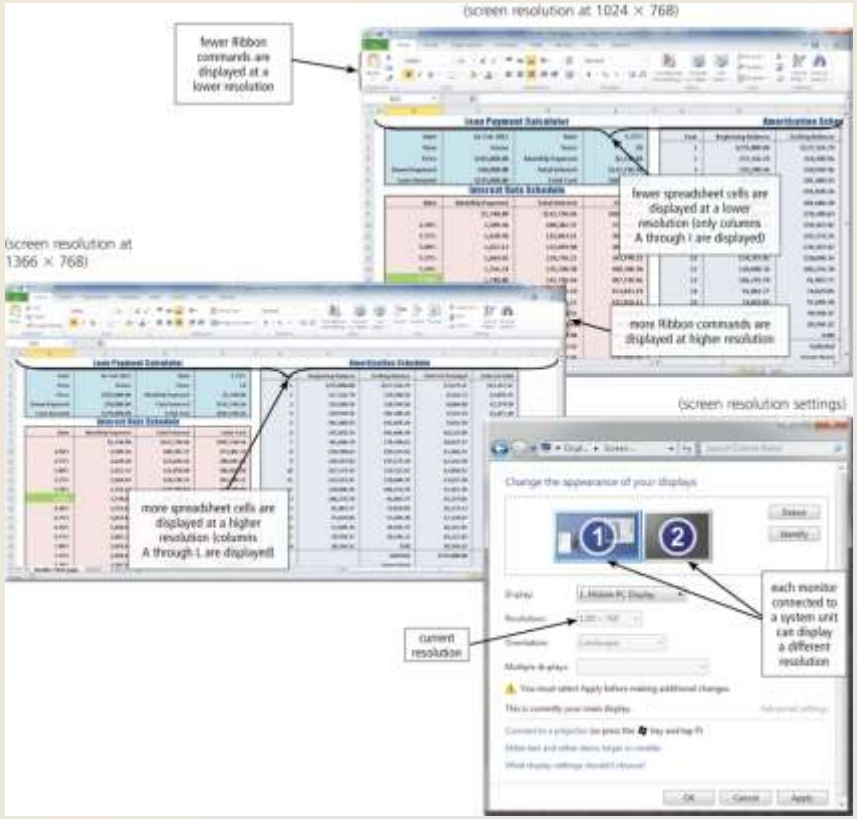
Dot pitch
點距

Contrast ratio
對比

P342

Display Devices

- **Resolution** is the number of horizontal and vertical pixels in a display device
  - A higher resolution uses a greater number of pixels
- 一般LCD螢幕都有**原生解析度**(Native Resolution)的特性，就是特定解析度下，才有最佳的畫質表現。



- ✓ **解析度**是顯示裝置中水平與垂直像素的數量
- ✓ 解析度愈高，使用的像素數量愈多，影像就愈平滑、明亮且清晰

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Resolution and Aspect Ratio Explained

Response time

- **Response time** of a display refers to the time in milliseconds (ms)毫秒 that it takes to turn a pixel on or off.
- Response times of displays range from 2 to 16 ms.

  The lower the number, the faster the response time.

1秒=1000毫秒(ms)

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Brightness

- Brightness of a display is measured in **nits**.尼特,亮度單位
- **A nit** is a unit of visible light intensity equal to **one candela** (formerly called candlepower) **per square meter**.
  (1nit=1cd/m2，1尼特=1新燭光/米2)
- The candela is the standard unit of luminous intensity.
- Displays today range from **250 to 550 nits**.
- **The higher the nits, the brighter the images.**

液晶螢幕的亮度單位為 cd/m2 ，就是每單位平方公尺的燭光亮度(candela)。
通常要求在客廳環境，顯示器的亮度最好能夠達到 500c d/m2 以上。
螢幕亮度是可以調整的，用戶可以根據使用情境調節成視覺最舒服的亮度，所以高亮度標示的機種，就代表使用者可以調節的亮度彈性更大。

光強度 luminous intensity
光度即光源明亮度，是測量其他光學物理量的基本國際單位，單位為**燭光(candela, cd)** 。
光源在某一方向立體角內之光通量大小。
一般而言，光源會向不同方向以不同之強度放射出其光通量。
在特定方向所放出之可見光輻射強度稱為光強度。

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Dot pitch

- The **distance** in millimeters **between pixels** on a display.
- sometimes called **pixel pitch**
- Text created with a smaller dot pitch is easier to read.
- Advertisements normally specify a display's **dot pitch or pixel pitch**.
  - Average dot pitch on a display should be **0.30 mm or lower**.
  - **The lower the number, the sharper the image.**

millimeter，符號mm 公釐，毫米

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Contrast ratio 對比率

- The difference in light intensity between the **brightest white** and **darkest black** that can be produced on a display.
- Contrast ratios today range from **500:1 to 2000:1**. **Higher contrast ratios represent colors better.**

Contrast ratio explained

ViewSonic

- 對比率(Contrast Ratio)在液晶顯示器(LCD Monitor)產品中所扮演的角色及功能
- 對比的計算方式是以全白的亮度值除以全黑的亮度值所得的數值。
- 其數值表現將影響畫面色彩飽和度及層次感表現的主要因素，對比度越高，畫質越好，且擁有較佳的立體感。

何謂對比率(Contrast Ratio)技術支援- ViewSonic

亮度與閃爍(Brightness & Flicker)

破解螢幕動態對比的迷思，動態、原生差在哪？

Contrast ratio 對比率

- 人類眼睛的視覺會隨著物體與背景之間亮度的差異而有不同的感受，這種亮度的差異稱為「對比(Contrast)」。
- 對比的定義為畫面中亮區域(BMax)與暗區域(Bmin)的亮度差異除以亮區域(BMax)與暗區域(Bmin)的亮度平均值：

$$\text{對比}(C)=\frac{\text{亮區域的亮度}(B_{Max})-\text{暗區域的亮度}(B_{\min})}{1/2[\text{亮區域的亮度}(B_{Max})+\text{暗區域的亮度}(B_{\min})]}$$

- 對顯示器的應用來說，更常用來衡量對比性質好壞的方式是使用「**照度比(Contrast ratio)**」，照度比的定義為畫面中亮區域(BMax)與暗區域(Bmin)的亮度比值：

$$\text{照度比}(C_R)=\frac{\text{亮區域的亮度}(B_{Max})}{\text{暗區域的亮度}(B_{\min})}$$

Video Standards

- The table below lists popular video standards

Name	Aspect Ratio	Typical Resolution
FHD (Full HD)	16:9	1920 × 1080
FUHD (Full Ultra HD)	16:9	7680 × 4320
HD (High Definition)	16:9 or ~16:10	1360 or 1366 × 768
QHD (Quad HD)	16:9	2560 × 1400
QUHD (Quad Ultra HD)	16:9	15360 × 8640
QWXGA (Quad Wide XGA)	16:9	2048 × 1152
SVGA (Super Video Graphics Array)	**4:3**	**800 × 600**
SXGA (Super XGA)	5:4	1280 × 1024
UHD (Ultra HD)	16:9	3840 × 2160
UHD+ (Ultra HD Plus)	16:9	5120 × 2880
UXGA (Ultra XGA)	**4:3**	**1600 × 1200**
WQXGA (Wide Quad XGA)	16:10	2560 × 1600
WSVGA (Wide Super VGA)	~17:10	1024 × 600
WUXGA (Widescreen Ultra XGA)	16:10	1920 × 1200
WXGA (Wide XGA)	16:10 or 16:9	1280 × 800 or 1366 × 768
XGA (Extended Graphics Array)	**4:3**	**1024 × 768**

Video Standards

- Which of the following video standards does not have a 16:9 aspect ratio?

A. FHD
B. QWXGA
C. SVGA
D. UHD

Graphics Chips, Ports,

- The **graphics processing unit (GPU)** controls the manipulation and display of graphics on a display device圖像處理單元(GPU) 的用途是控制顯示裝置上圖形的處理和顯示
- LCD monitors use a **digital signal** and should plug into
  - a **DVI port,**
  - an **HDMI port**
  - a **Display Port**

  LCD監視器使用數位訊號，
  而且應該連接到DVI連接埠、
  HDMI連接埠或Display Port

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Graphics Chips, Ports,

- A **DVI (Digital Video Interface)** enables **digital signals** to transmit directly to a monitor.
- **An HDMI (High-Definition Media Interface) port** combines **DVI** with **HDTV** (high-definition television and video).
  - Some ultrathin laptops have mini-HDMI ports that require the use of an adapter when connecting to a standard-size HDMI display.
- **A Display Port is an alternative to DVI that also supports HDMI.**

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HDMI

- HDMI的英文全稱是“High Definition Multimedia”，中文的意思是**高清晰度多媒體介面**。
- HDMI介面可以提供高達**5Gbps**的資料傳輸帶寬，可以**傳送無壓縮的音頻信號及高解析度視頻信號**。
- 應用HDMI的好處是只需要**一條HDMI線，便可以同時傳送影音信號**。
  - HDMI技術不僅能提供**清晰的畫質**，而且由於**音頻/視頻採用同一電纜**，大大簡化了家庭影院系統的安裝。

何謂 HDMI 介面？

DTVs and Smart TVs

- Home users sometimes use a **digital television (DTV)** as a display
- **HDTV** is the most advanced form of digital television
- A **Smart TV** is an Internet-enabled HDTV

Page 343
Figure 7-25

Display Devices

- Televisions also are a good output device
  - Require a converter if you are connecting your computer to an analog television
- **Digital television (DTV)** offers a crisper, higher-quality output
  數位電視 (DTV) 提供更清晰的高品質輸出
- **Digital television** signals provide two major advantages over analog signals
  - Digital signals produce a **higher-quality pictures**.
  - Many programs can be **broadcast on a single**.

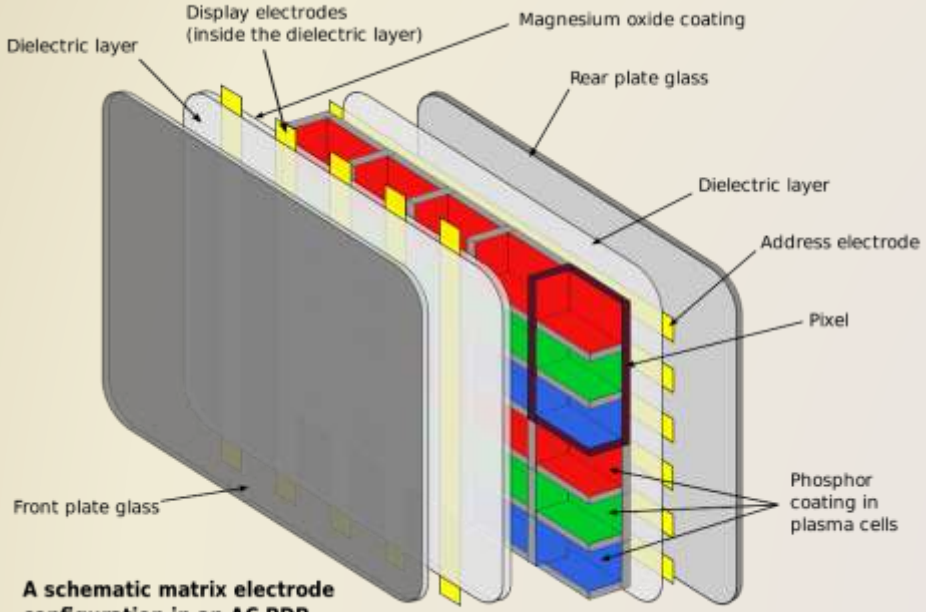
Display Devices

- **HDTV** is the most advanced form of digital television working with
  - **digital broadcast signals**
  - transmitting **digital sound**
  - supporting **wide screens**
  - providing **high resolutions**
- To receive the HDTV signals via **OTA** (over-the-air) broadcasts
  需要VHF/UHF天線
- 經由人造衛星需要HDTV相容的接收器/調整器
- 若經由有線電視則需要與HDTV相容的視頻轉換器

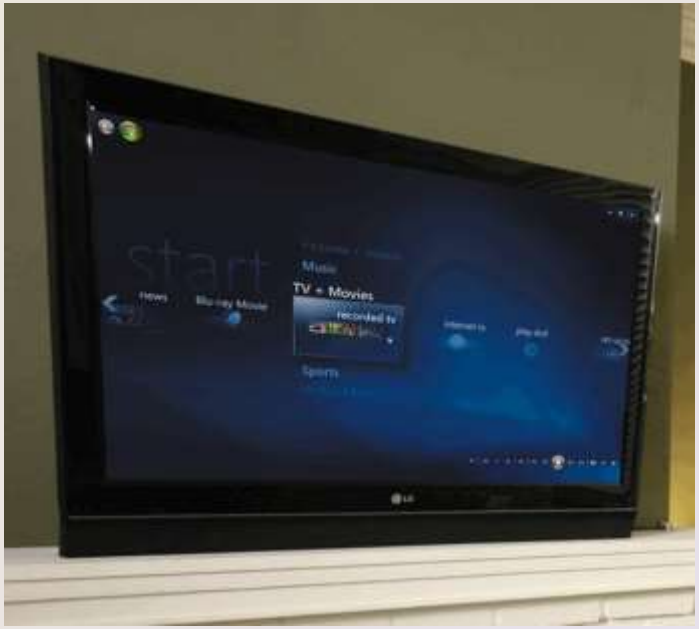
Display Devices

- DTVs often use LCD, LED, or plasma technology.
- **Plasma monitors** are display devices that **use gas plasma technology,** which sandwiches a layer of gas between two glass plates.

電漿監視器 是一種使用氣體電漿技術的顯示裝置



A schematic matrix electrode configuration in an AC PDP



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電漿顯示器

- Plasma monitor電漿顯示器
  - 如同**日光燈管的照明原理**，是利用在真空玻璃管中注入**惰性氣體**或水銀氣體，當施加電壓時，腔內會產生電漿放電，使得氣體產生等離子效應與電漿效應，並且放出**紫外線來激發RGB三原色**，並利用激發時間的長短來產生不同的亮度，再將三種原色混會產生各種顏色以形成彩色畫面
  - 不同於其他顯示的方式在於它的紅藍綠RGB三原色的發光體不是經由電子槍掃描或背光的明暗(如LCD或投影機)所產生的光，而是每個個體獨立發光的，所以大大的減少所佔的空間。
  - 利用兩片材料間裝置電漿作為顯示的平面顯示器可提供比LCD更大的螢幕的尺寸及呈現品質，但是價格也比較貴。

Printers

- A printer produces text and graphics on a physical medium
  - Printed information is called a hard copy， or printout
  - Landscape or portrait orientation
    直式與橫式

直式
Landscape

橫式portrait

Printers

- To meet the range of printing needs from home users to enterprise users, many different types and styles of printers exist with varying speeds, capabilities, and printing methods.

Pages 345

Printers

1. What is my budget?
2. How fast must my printer print?
3. Do I need a color printer?
4. What is the cost per page for printing?
5. Do I need multiple copies of documents?
6. Will I print graphics?
7. Do I want to print photos?
8. Do I want to print directly from a memory card?
9. What types of paper does the printer use?
10. What sizes of paper does the printer accept?
11. Do I want to print on both sides of the paper?
12. How much paper can the printer tray hold?
13. Will the printer work with my computer and software?
14. How much do supplies such as ink, toner, and paper cost?
15. Can the printer print on envelopes?
16. How many envelopes can the printer print at a time?
17. How much do I print now, and how much will I be printing in a year or two?
18. Will the printer be connected to a network?
19. Do I want wireless printing capability?

1. 預算有多少？
2. 印表機的列印速度需要多快？
3. 需要彩色印表機嗎？
4. 列印每一頁的成本是多少？
5. 需要列印多份副本嗎？
6. 需要列印圖像嗎？
7. 需要列印相片嗎？
8. 需要能直接從記憶卡列印嗎？
9. 印表機要使用哪一種材質的紙張？
10. 印表機可接受哪些尺寸的紙張？
11. 需要雙面列印嗎？
12. 印表機的紙匣能放多少張紙？
13. 印表機能與電腦和軟體相容嗎？
14. 墨水、碳粉和紙張等消耗品的成本是多少？
15. 印表機能在信封上列印嗎？
16. 印表機一次能列印多少信封？
17. 目前的列印需求量，以及一兩年後的列印需求量各是多少？
18. 印表機需要與網路連接嗎？
19. 需要無線列印的功能嗎？

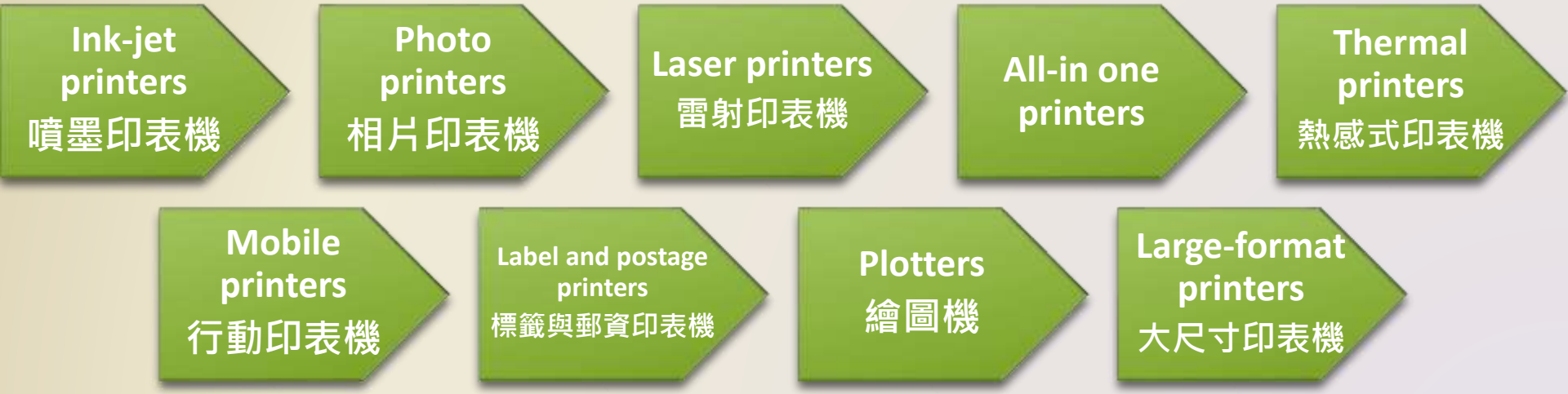
Questions to consider before purchasing a printer.

Pages 345
Figure 7-26

Printers

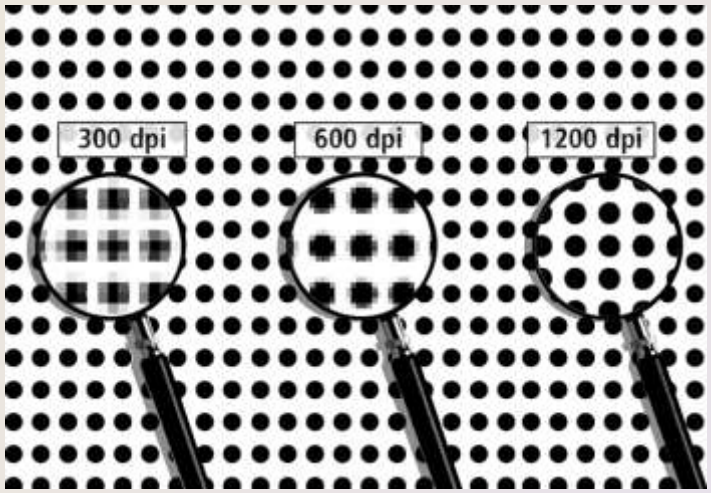
- A **nonimpact printer** forms characters and graphics on a piece of paper without actually striking the paper

  非撞擊式印表機沒有實際撞擊紙張即可在紙上形成文字與圖形



Printers

- An **ink-jet printer** forms characters and graphics by spraying tiny drops of liquid ink onto a piece of paper
  - Color or black-and-white
  - **Speed** is measured by the number **of pages per minute (ppm)** it can print
  - The **resolution** of a printer(印表機解析度)
    - Sharpness and clarity
    - Measured by number of dots **per inch (dpi)** printer can output
      以印表機能夠輸出的每英吋
      點數予以測量
    - Printers with a higher dpi (dots per inch) produce a higher quality output



More about ink-jeck Printer

Ink Cartridges

- The printhead mechanism in an ink-jet printer contains ink-filled cartridges.
  噴墨印表機的列印頭結構中，含有填充墨水的墨水匣
- Each cartridge has fifty to several hundred small ink holes, or nozzles.
  每個墨水匣有50到數百個微小的墨水洞或噴嘴。

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下圖顯示每滴墨水出現在紙張的過程，墨水藉由通過不同組噴嘴組合，在紙張上形成文字或影像。

How an Ink-Jet Printer Works

Step 1
A small resistor heats the ink, causing the ink to boil and form a vapor bubble.

Step 2
The vapor bubble forces the ink through the nozzle.

Step 3
Ink drops onto the paper.

Step 4
As the vapor bubble collapses, fresh ink is drawn into the firing chamber.

Printers

A **photo printer** produces lab-quality pictures
相片印表機是一種彩色印表機，可產生照相館沖洗品質的相片

Many use ink-jet technology

PictBridge allows you to print photos directly from a digital camera
可讓你直接從數位相機列印相片

Print from a memory card

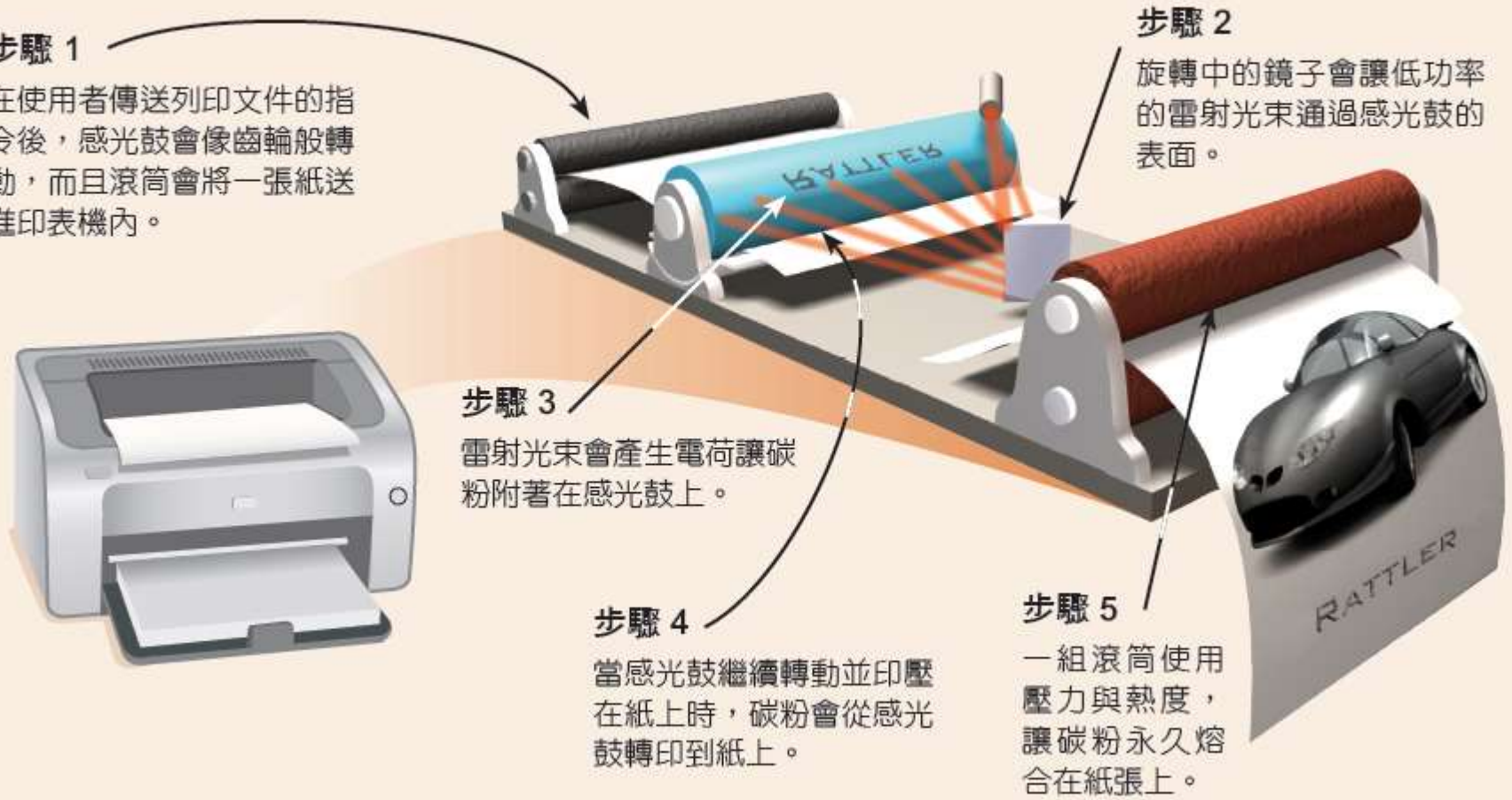

只能列印 4 × 6 尺寸
可列印 4 × 6、5 × 7、8 × 10、8 1/2 × 11 等尺寸

Printers

- Laser printer
  - High-speed
  - High-quality
- Laser printers are available in both black-and-white and color models.

Page 348
Figure 7-30

黑白雷射印表機的作業原理



How a Black-and-White Laser Printer Works

Step 1
After the user sends an instruction to print a document, the drum rotates as gears and rollers feed a sheet of paper into the printer.

Step 2
A rotating mirror deflects a low-powered laser beam across the surface of a drum.

Step 3
The laser beam creates a charge that causes toner to stick to the drum.

Step 4
As the drum continues to rotate and press against the paper, the toner transfers from the drum to the paper.

Step 5
A set of rollers uses heat and pressure to fuse the toner permanently to the paper.

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Printers

- An **all-in-one printer** is a single device that prints, scans, copies, and in some cases, faxes
  - Sometimes called a **multifunction printer**

    多功能事務機 是一種可同時提供印表機、掃描器、影印機，也許還 加上傳真機等多種功能的單一裝置，有時稱作多合一裝置

Page 349
Figure 7-32

Printers

- A **3-D printer** uses a process called **additive manufacturing** to create an object by adding material to a three-dimensional object, one horizontal layer at a time

3D印表機材料 - 3D列印機

3D印表機的7大成型技術，材質與固化方式

MIC研究報告-3D列印材料發展現況與趨勢

Page 349
Figure 7-33

Printers

- A **thermal printer** generates images by pushing electrically heated pins against the heat-sensitive paper
  熱感式印表機是移動電熱式的針頭接觸感熱紙而產生影像

Thermal wax-transfer printer
熱蠟轉印式印表機

Dye-sublimation printer
熱昇華印表機

Page 349
Figure 7-33

Dye-sublimation printer熱昇華印表機

- sometimes called a ***digital photo printer***
- uses heat to transfer colored dye to specially coated paper.
- Photography studios, medical labs, security identification systems, and other professional applications requiring high image quality use dye-sublimation printers that can cost thousands of dollars.

Dye-sublimation printer

- 也可稱為染料擴散式列印，是將油墨加熱汽化（亦稱昇華），讓氣體狀態的染料附著在特殊紙張（類似相紙）上。
- 是高品質的彩色列印方式之一，效果近光學之照片。
- 但耗材貴、速度慢，非一般使用者可消費的。
- 由於高列印成本，及高彩色品質的輸出，有些廠商即將熱轉印技術與熱昇華技術合併於同一台列印機之中，可兼顧不同需求。

Printers

- A **mobile printer** is a small, lightweight, battery-powered printer that allows a mobile user to print from a mobile device

行動印表機是一種體積小、輕巧且使用電池的印表機。
行動使用者在外時可從筆記型電腦、智慧型手機或其他行動裝置列印文件

Page 350
Figure 7-35

Printers

- A **label printer** is a small printer that prints on an adhesive-type material that can be placed on a variety of items
  標籤印表機是一種專門列印在貼紙材質上的小型印表機
- A postage printer郵資印表機prints postage stamps
- Postage also can be printed on other types of printers
  郵資印表機是一種特殊類型的標籤印表機，專門用來列印郵票

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Figure 7-36

Printers

- **Plotters** are used to produce high-quality drawings

  繪圖機 是用來列印高品質繪圖的精密印表機

- **Large-format printers** create photo-realistic quality color prints

  大尺寸印表機是使用噴墨式印表機技術，可產生相片品質的彩色列印，但尺寸大很多

Page 350
Figure 7-37

Printers

- **Impact printers** form characters and graphics on a piece of paper by striking a mechanism against an inked ribbon that physically contacts the paper

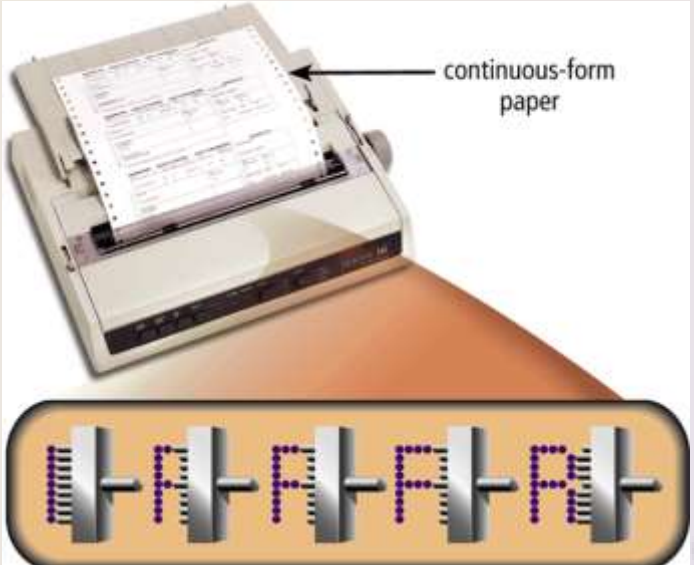
  撞擊式印表機是以機械裝置對準與紙張接觸的墨水色帶撞擊，而產生字元與圖形

撞擊式印表機
- Dot-matrix printer 點陣式印表機
- Line printer 行列式印表機

Page 351
Figure 7-38

Printers

- A dot-matrix printer produces printed images when tiny wire pins on a print head mechanism strike an inked ribbon
  點陣式印表機 是利用列印頭機械裝置上的極小金屬撞針，撞擊色帶而產生列印影像
- The speed of a dot-matrix printer is measured by the number of characters per second (cps) it can print.
- The speed of most dot-matrix printers ranges from 375 to 1550 characters per second (cps), depending on the desired print quality.



Page 351 Figure 7-38
Chapter 7 Free Resources P38

Impact Printers

- A **line printer** prints an entire line at a time
  行列式印表機是種一次可列印一整行的高速撞擊式印表機
- The speed of a line printer is measured by the number of lines per minute (lpm) it can print.
- Some line printers print as many as 3,000 lpm. Servers or networked applications, such as manufacturing, distribution, or shipping, often use line printers.
- These printers typically use 11 × 17-inch continuous-form paper.

Speakers

- Many users attach surround sound **speakers** or speaker systems to their computers, game consoles, and mobile devices to generate higher-quality sounds

Page 351
Figure 7-39

Speakers

- Most surround sound computer speaker systems include one or two center speakers and two or more ***satellite speakers*** that are positioned so that sound emits from all directions.衛星音箱/環繞喇叭
- Speakers typically have tone and volume controls, allowing users to adjust settings.
- To boost the low bass sounds, surround sound speaker systems also include a ***subwoofer*** .重低音

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Figure 7-39

The first number refers to the number of speakers, and the second number refers to the number of subwoofers.

A 2.1 speaker system contains two speakers and one subwoofer.

A 5.1 speaker system has five speakers

4 satellite speakers, 1 center speaker

1 subwoofer.

A 7.2 speaker system has seven speakers

4 satellite speakers, 2 side speakers, 1 center speaker

2 subwoofers.

WHAT DO THE NUMBERS MEAN IN SURROUND SOUND CONFIGURATIONS?

Other Output Devices

- **Headphones** are speakers that cover or are placed outside of the ear耳罩式耳機
- **Earbuds** (also called earphones) rest inside the ear canal耳塞式耳機

Page 352
Figure 7-40

Other Output Devices

- A **data projector** is a device that takes the text and images displaying on a computer or mobile device screen and projects them on a larger screen

  資料投影機是將電腦螢幕上顯示的文字和影像，投影到大螢幕上

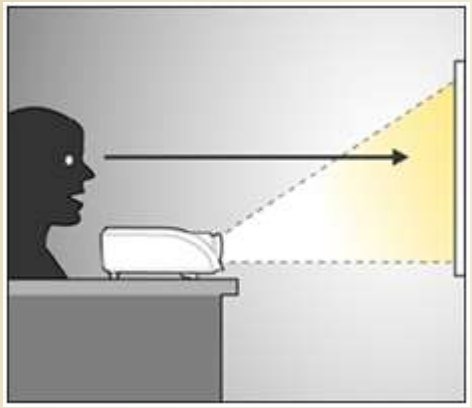
Page 352
Figure 7-41

Other Output Devices

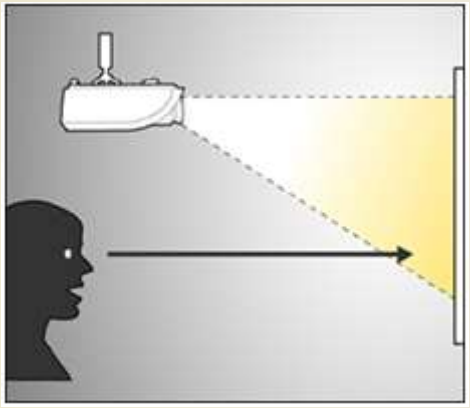
- What is the difference between a front projection system and a rear projection system?
  - In a front projection system, the light source and the audience are on the same side of the viewing screen. On the contrary, for a rear projection system, the light source and the audience are on opposite sides of the viewing screen.

Other Output Devices

Front projection

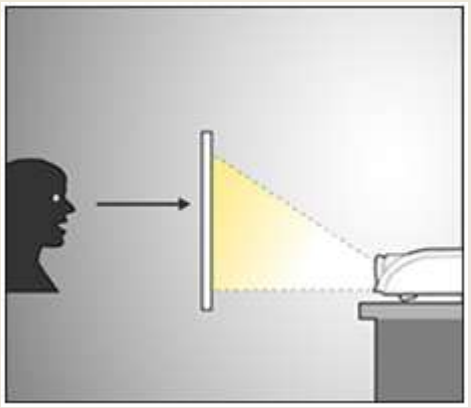


Normal front projection.

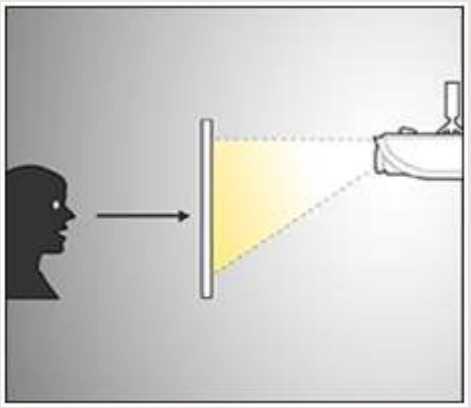


Suspended front projection.

Rear projection



Normal rear projection.



Suspended back projection.

Other Output Devices

LCD projector

- 是利用液晶顯示技術直接連接到電腦螢幕，而且使用自己的光源將電腦螢幕上顯示的資訊顯示出來
- 影像品質較低

Digital light processing Projector

- 數位光源處理投影機
- 使用微小的鏡子來反射光源 ，產生清晰、明亮、有色彩的影像，即便在很亮的房間仍然可以對焦且清楚看到投影

3LCD vs DLP

3LCD vs DLP Projectors

Other Output Devices

- An **interactive whiteboard** is a touch-sensitive device, resembling a dry-erase board, that displays the image on a connected computer screen

  互動式白板是一種類似一般白板的觸控感應裝置，上面顯示與它連接的電腦螢幕上的畫面

Page 353
Figure 7-42