DATA IN & DATA OUT

EGCO103 INFORMATION TECHNOLOGY IN THE DAILY LIFE

KANAT POOLSAWASD
DEPARTMENT OF COMPUTER ENGINEERING
MAHIDOL UNIVERSITY
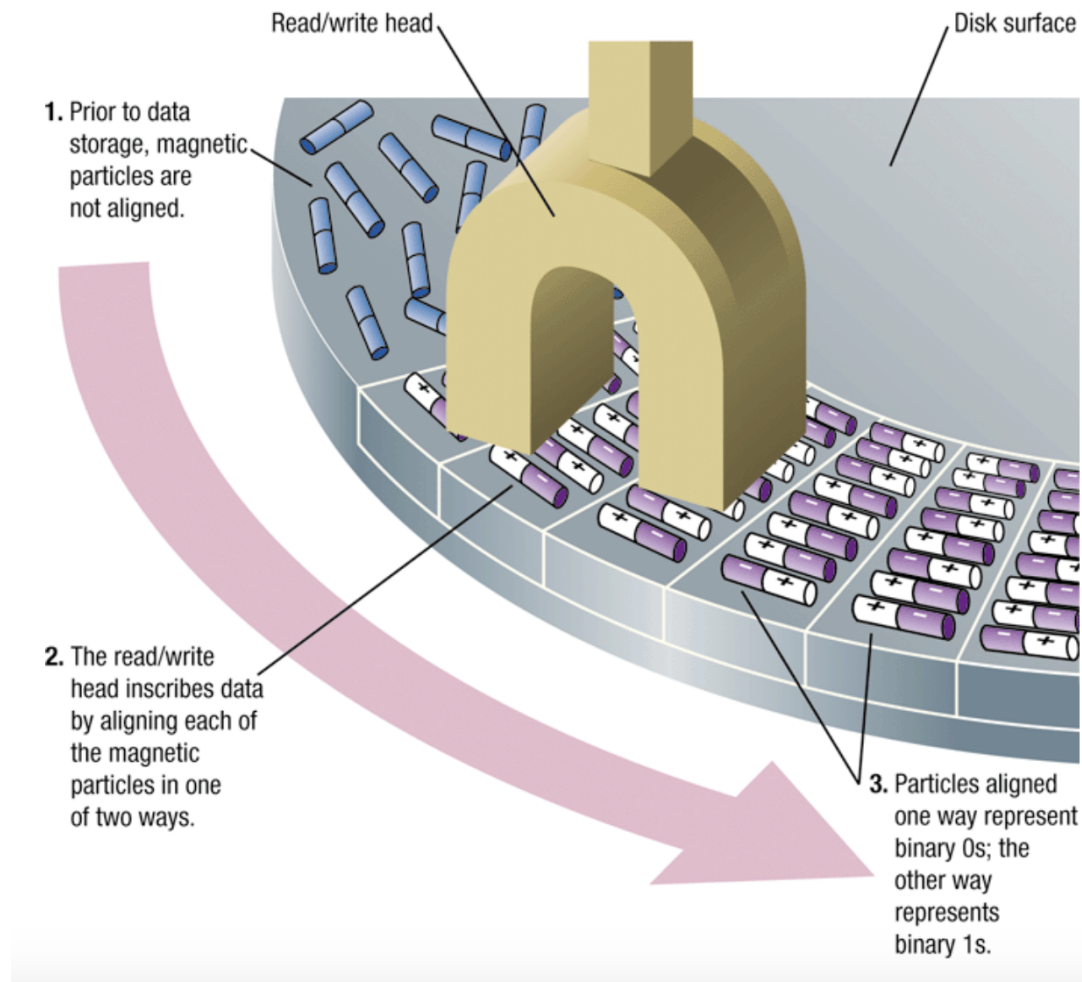
COVERED TOPICS

- Data Storing
- Output Devices
- Input Devices
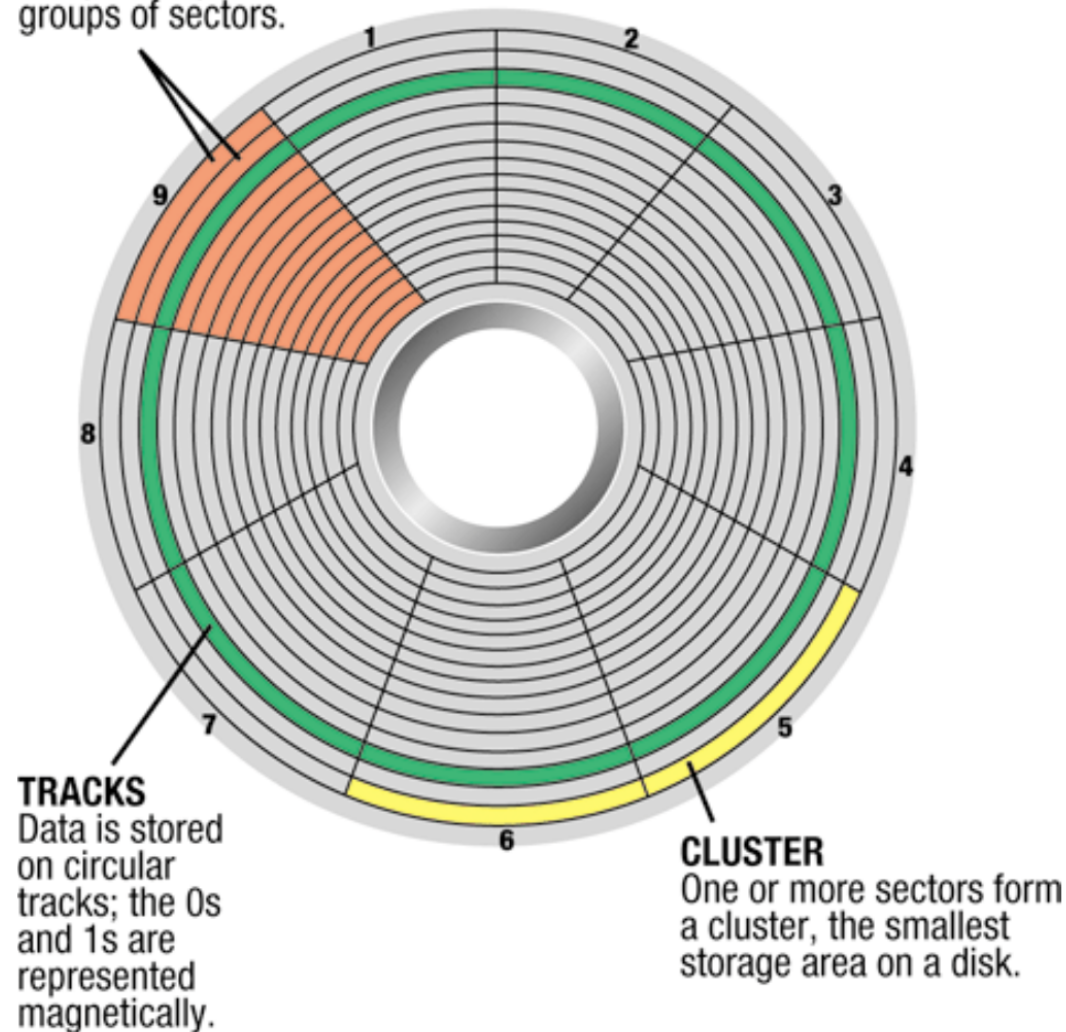- The Cutting Edge

DATA STORING

MAGNETIC DISK SYSTEMS (1)
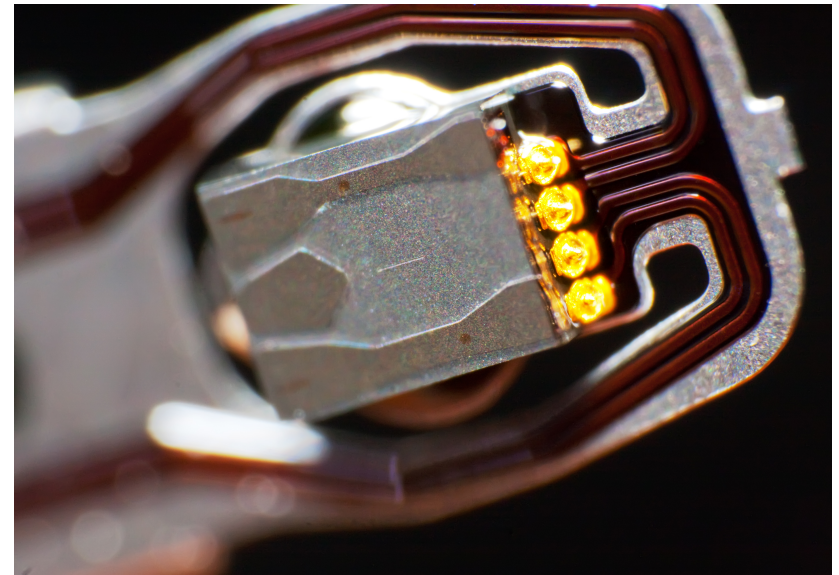

FIGURE 3-3
Storing data on magnetic disks.

Read/write head

Disk surface

1. Prior to data storage, magnetic particles are not aligned.

2. The read/write head inscribes data by aligning each of the magnetic particles in one of two ways.

3. Particles aligned one way represent binary 0s; the other way represents binary 1s.

MAGNETIC DISK SYSTEMS (2)

SECTORS
Each track is divided into pie-shaped groups of sectors.

TRACKS
Data is stored on circular tracks; the 0s and 1s are represented magnetically.

CLUSTER
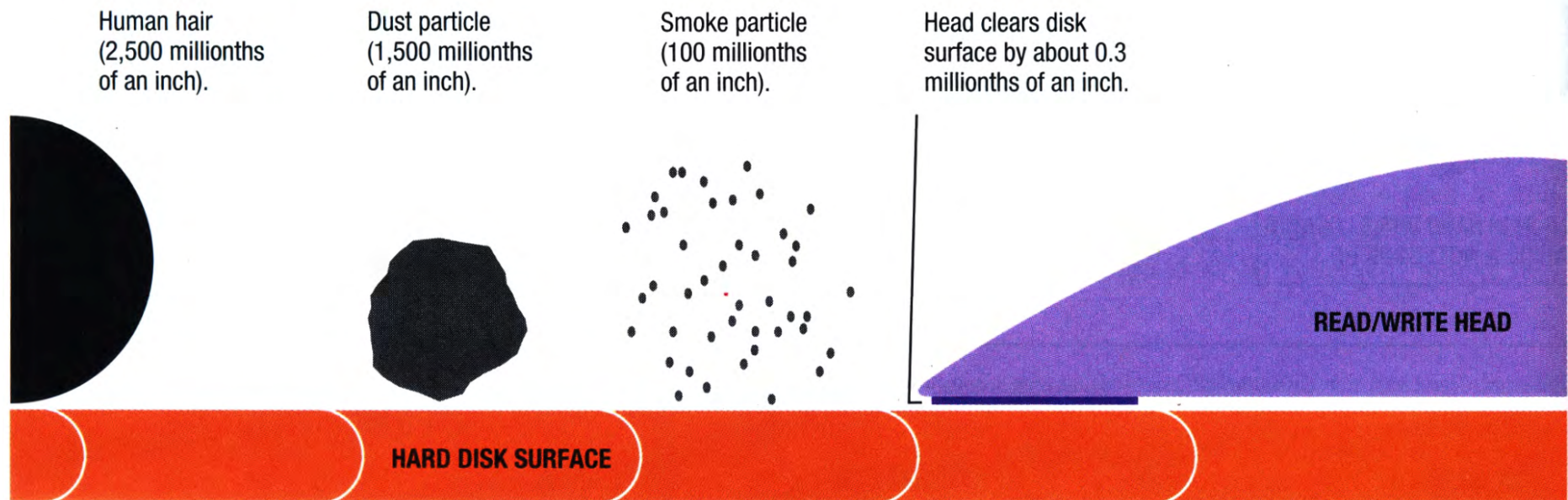One or more sectors form a cluster, the smallest storage area on a disk.
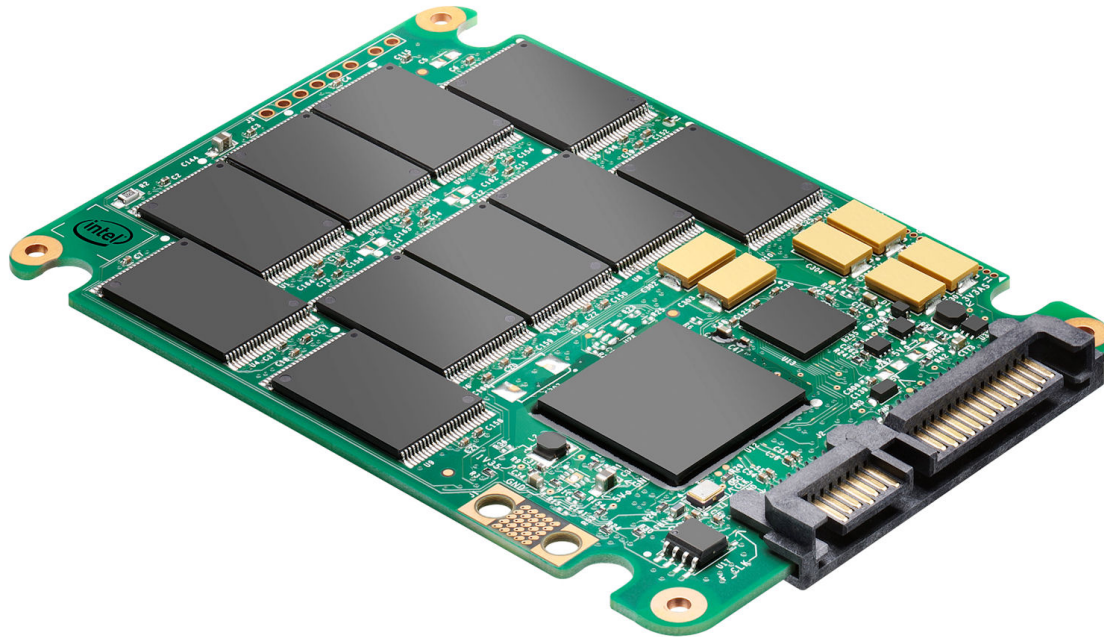
HARD DISK DRIVE (1)

- Read/write head doesn't touch the surface of the disc
  - Head crashes can occur
  - Backing up is important
- Most hard disks are sealed inside the drive
  - Some hard drive systems use hard disk cartridges

Magnetic platter

Read/write head

http://www.khairul-syahir.com

HARD DISK DRIVE (2)

Human hair (2,500 millionths of an inch).

Dust particle (1,500 millionths of an inch).

Smoke particle (100 millionths of an inch).

Head clears disk surface by about 0.3 millionths of an inch.

READ/WRITE HEAD
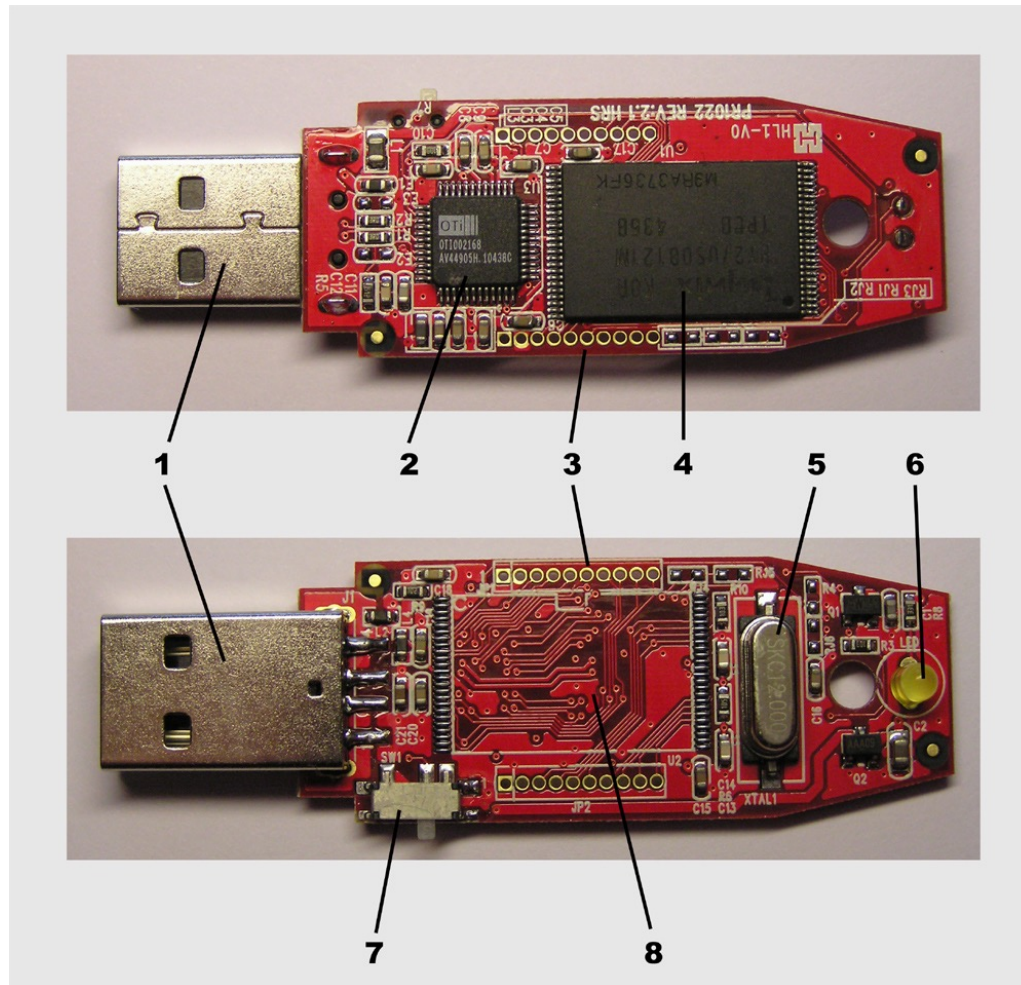
HARD DISK SURFACE

SOLID-STATE DRIVE (SSD)

INTERNAL AND EXTERNAL HD

- External HD is a hard disk with an external enclosure.
- You can take hard drive from your broken notebook. Buy an external enclosure (Get the right size) => Your new external HD.
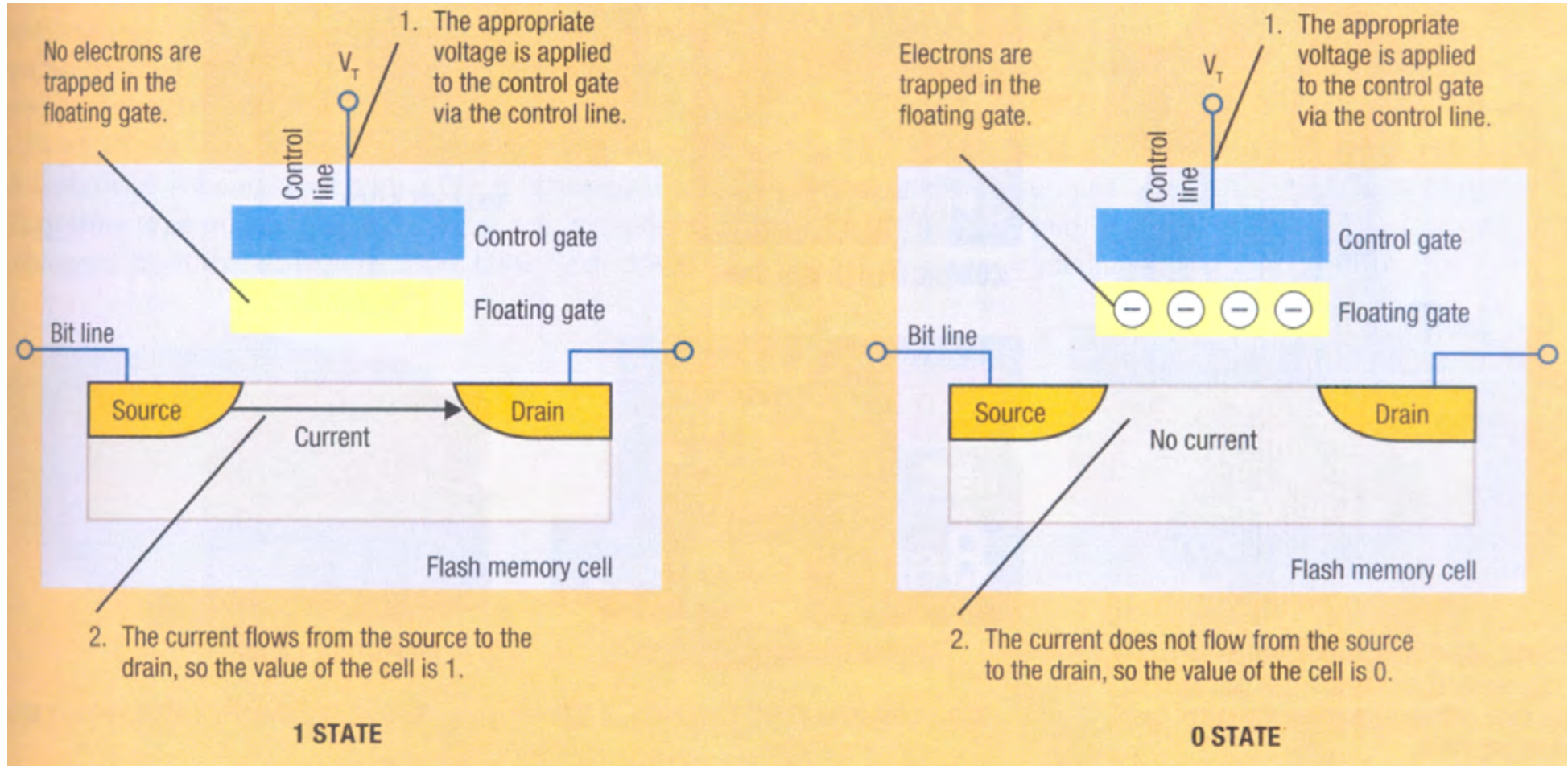
MAKING EXTERNAL HD
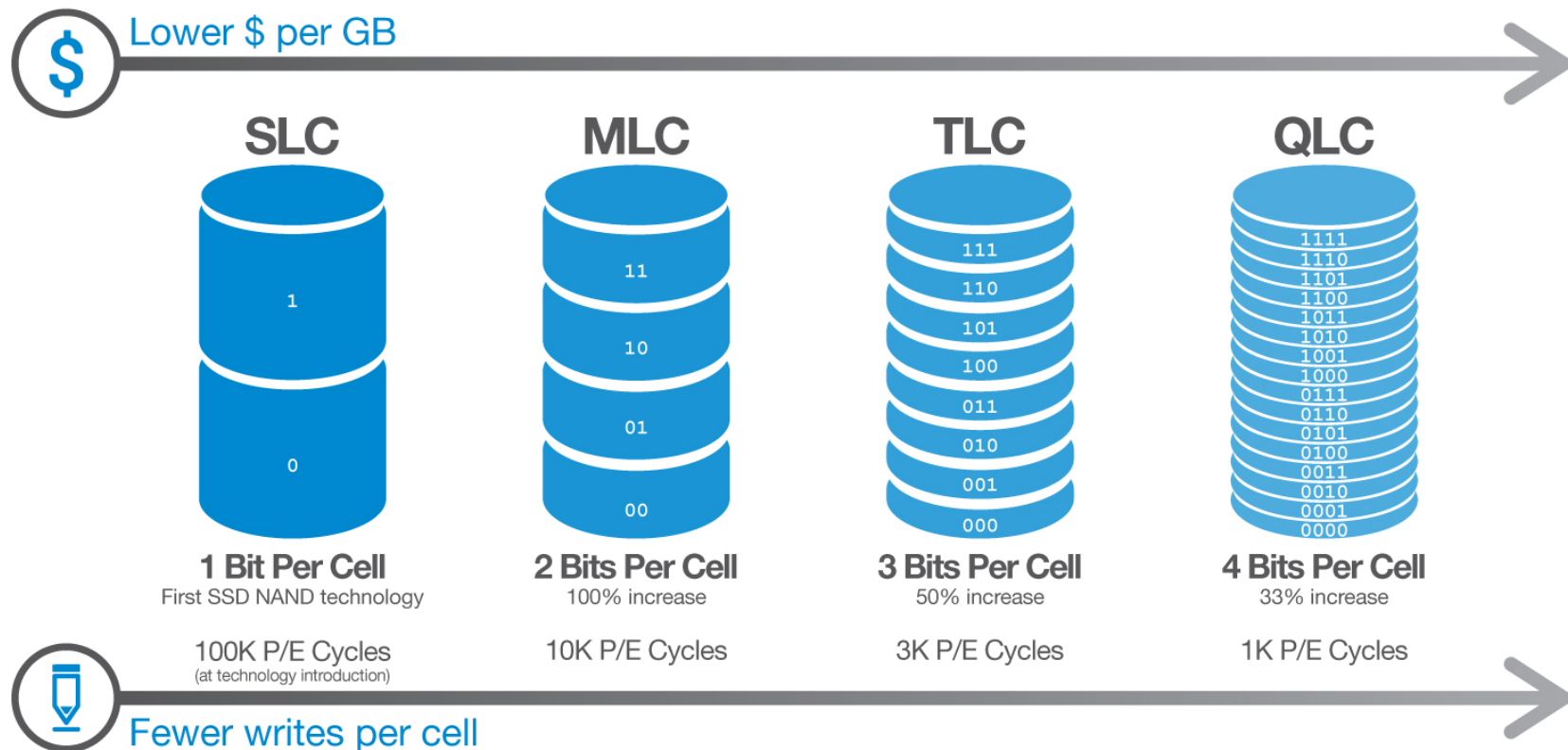
THUMB DRIVE / FLASH DRIVE

NAND MEMORY CELL

No electrons are trapped in the floating gate.

1. The appropriate voltage is applied to the control gate via the control line.

Control line

V_T

Control gate

Floating gate

Bit line

Source

Current

Drain

Flash memory cell

2. The current flows from the source to the drain, so the value of the cell is 1.

1 STATE

Electrons are trapped in the floating gate.

1. The appropriate voltage is applied to the control gate via the control line.

Control line

V_T

Control gate

Floating gate

Bit line

Source

No current

Drain

Flash memory cell

2. The current does not flow from the source to the drain, so the value of the cell is 0.

0 STATE

TYPE OF SSD (1)

QLC = More Density Per NAND Cell

$ — Lower $ per GB ➜

SLC	MLC	TLC	QLC
1	11	111	1111
		110	1110
	10	101	1101
		100	1100
0	01	011	1011
		010	1010
	00	001	1001
		000	1000
			0111
			0110
			0101
			0100
			0011
			0010
			0001
			0000

1 Bit Per Cell	**2 Bits Per Cell**	**3 Bits Per Cell**	**4 Bits Per Cell**
First SSD NAND technology	100% increase	50% increase	33% increase
100K P/E Cycles (at technology introduction)	10K P/E Cycles	3K P/E Cycles	1K P/E Cycles

✎ Fewer writes per cell ➜

Micron

TYPE OF SSD (2)

	SLC	MLC	TLC	HDD	RAM
P/E cycles	100k	10k	5k	*	*
Bits per cell	1	2	3	*	*
Seek latency (μs)	*	*	*	9000	*
Read latency (μs)	25	50	100	2000-7000	0.04-0.1
Write latency (μs)	250	900	1500	2000-7000	0.04-0.1
Erase latency (μs)	1500	3000	5000	*	*
Notes	* metric is not applicable for that type of memory				
Sources	P/E cycles [20] SLC/MLC latencies [1] TLC latencies [23] Hard disk drive latencies [18, 19, 25] RAM latencies [30, 52] L1 and L2 cache latencies [52]				

FLASH MEMORY CARD

SD Card

Card Reader
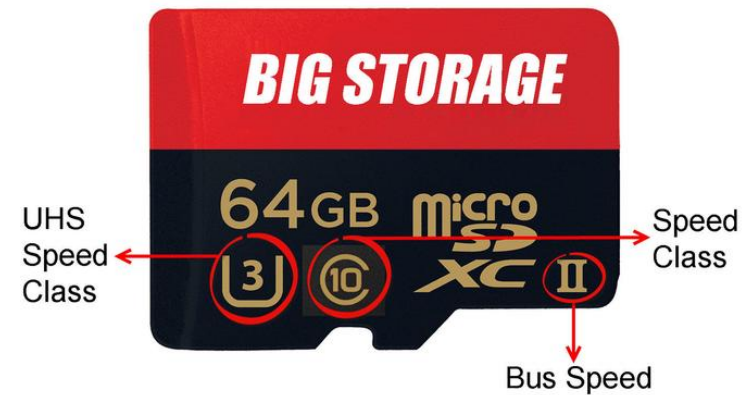
Micro SD Card

CF Card

OPTICAL DISC

- CD, DVD and BLUERAY
- Use laser beam to write and read information
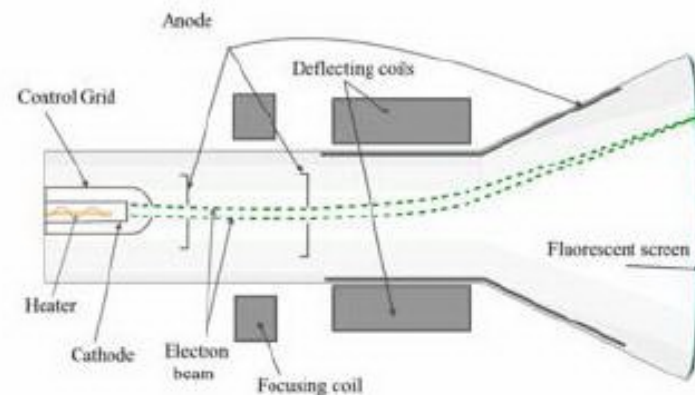
OPTICAL DISC SYSTEMS (1)

TRACK
A single grooved track spirals from the center of the disc outward; recorded data is stored in the groove.

SECTOR
The track is divided into multiple sectors for data organization.

LAND

PIT

WRITING DATA
When data is written to the disc, a laser beam creates pits, represented by dark, nonreflective areas on the disc.

READING DATA
A low intensity laser beam reads the disc. A transition between the pits and lands is interpreted as a 1; a set period of time between transitions is interpreted as a 0.

OPTICAL DISC SYSTEMS (2)

OUTPUT DEVICES
(DATA OUT)

CATHODE RAY TUBE (CRT)
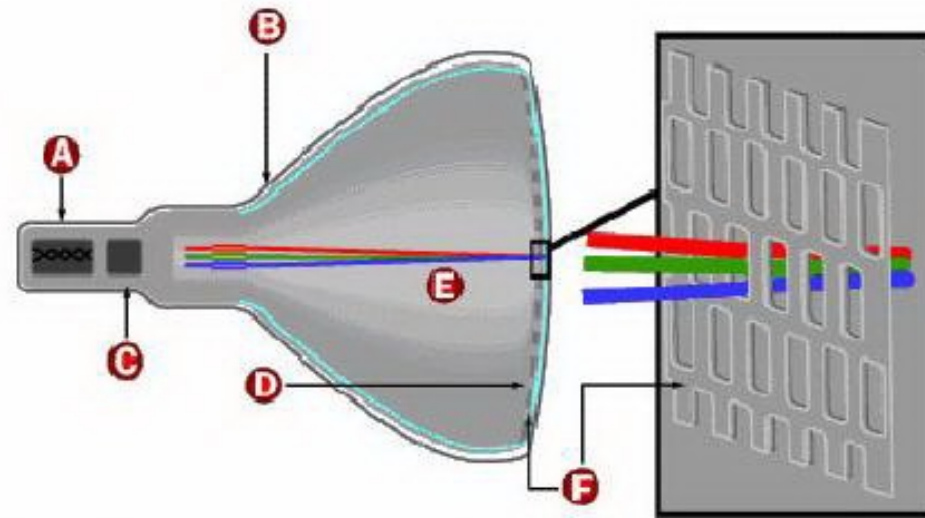
A Cathode
B Conductive coating
C Anode

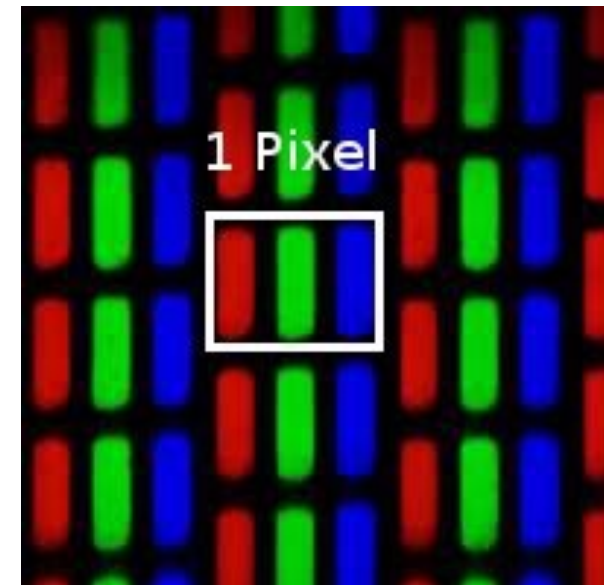**D** Phosphor-coated screen
E Electron beams
F Shadow mask

PLASMA
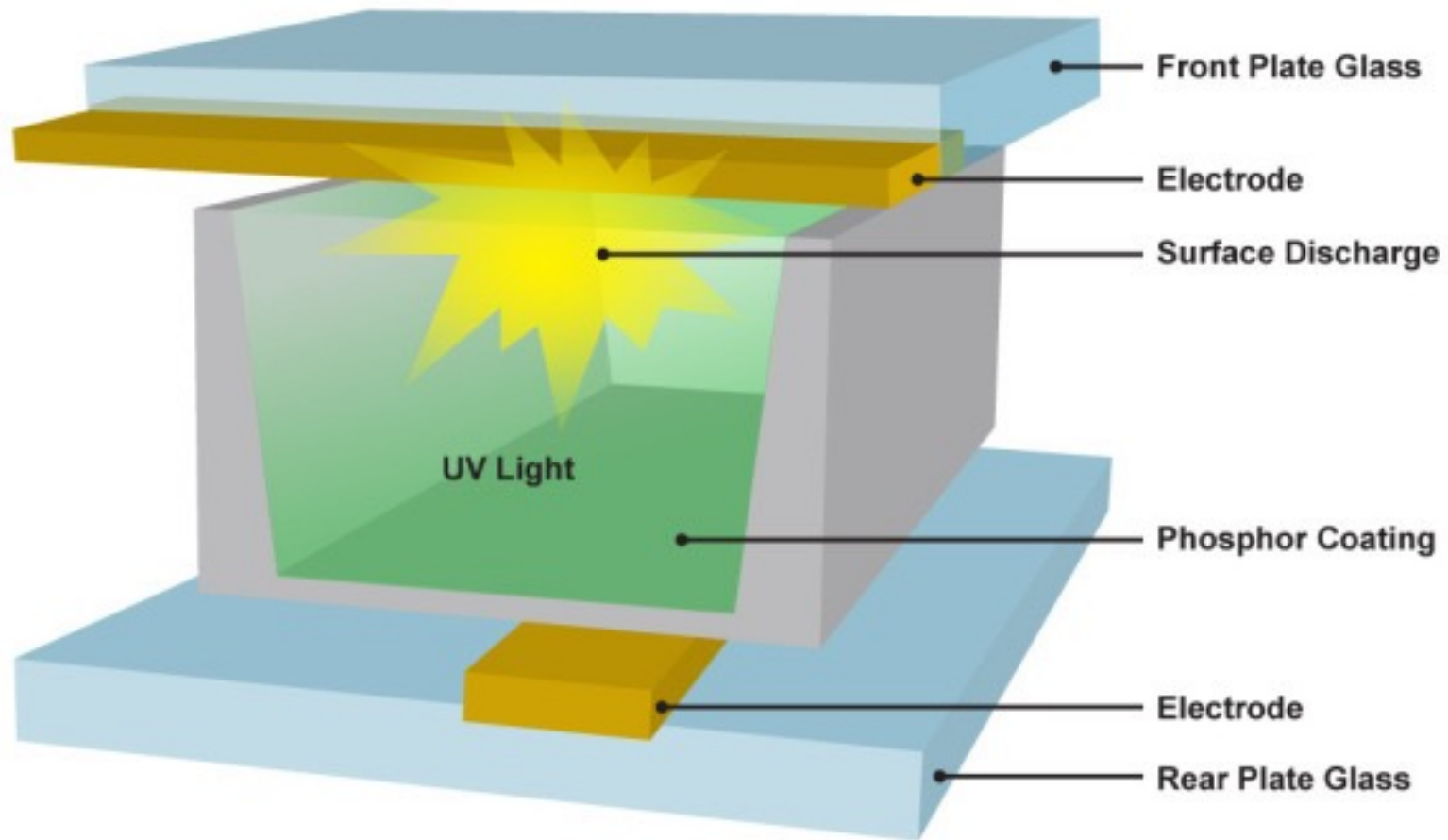
LIQUID-CRYSTAL DISPLAY (LCD)
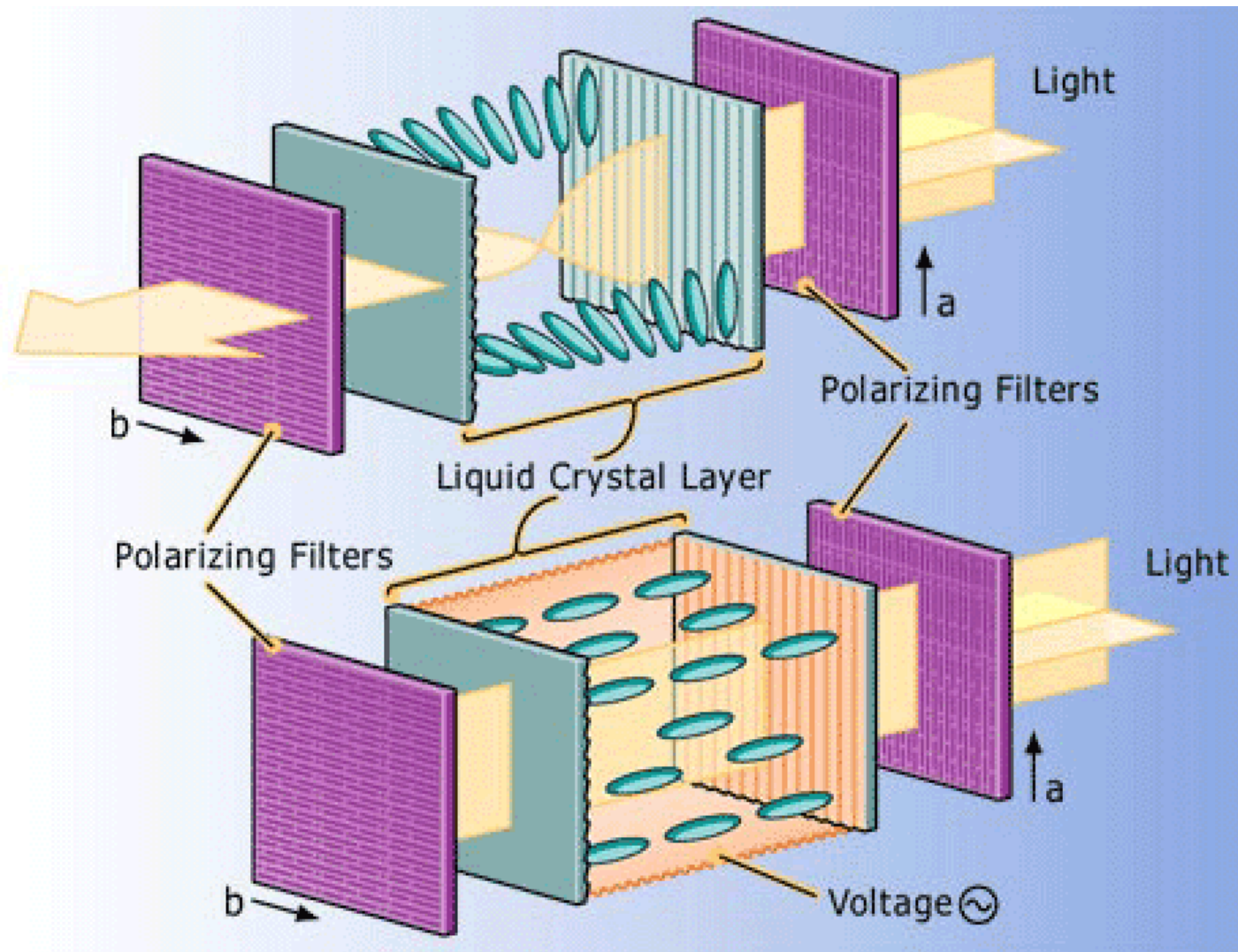
LIGHT-EMITTING DIODE (LED)

Epoxy lens/case
Wire bond
Reflective cavity
Semiconductor die
Anvil } Leadframe
Post
Flat spot
+ Anode
− Cathode

1 Pixel

IPS VS AMOLED

3D DISPLAY

Screen
Lenticular lens
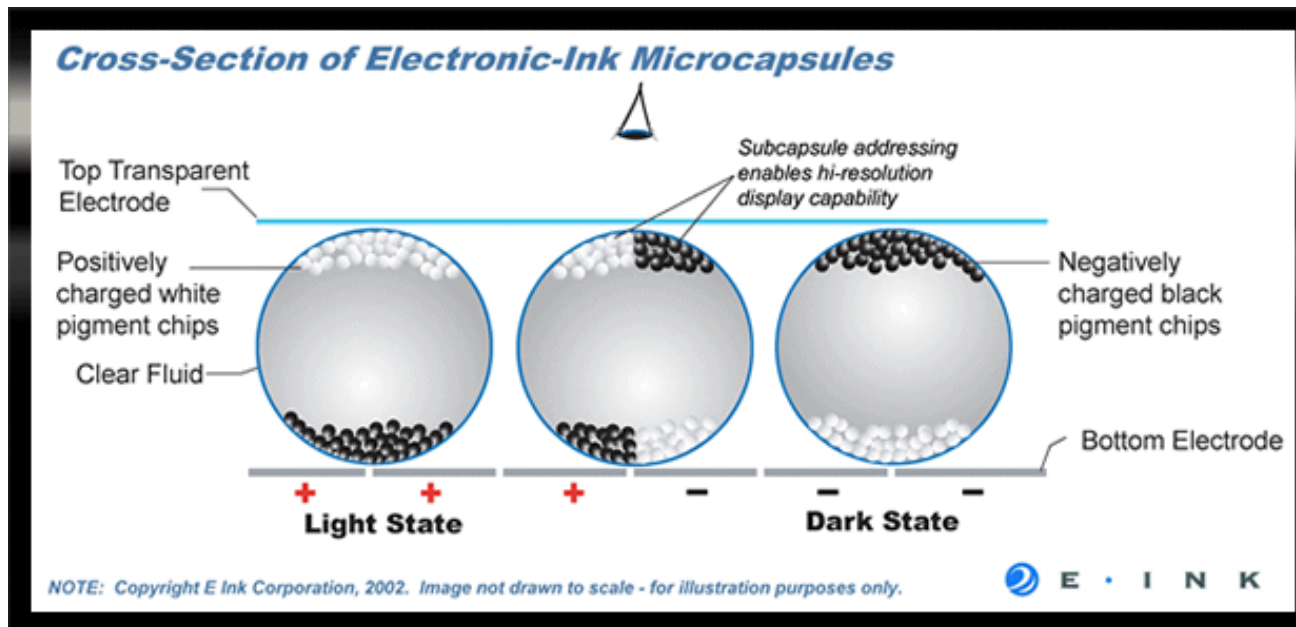Left eye
Right eye

Screen
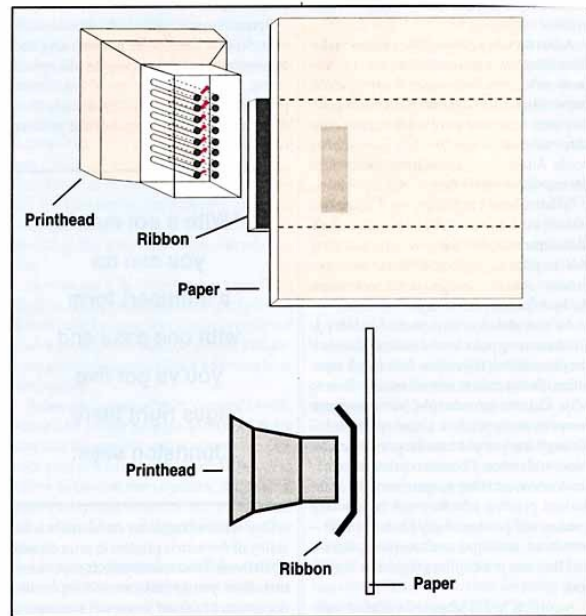Parallax barrier
Left eye
Right eye
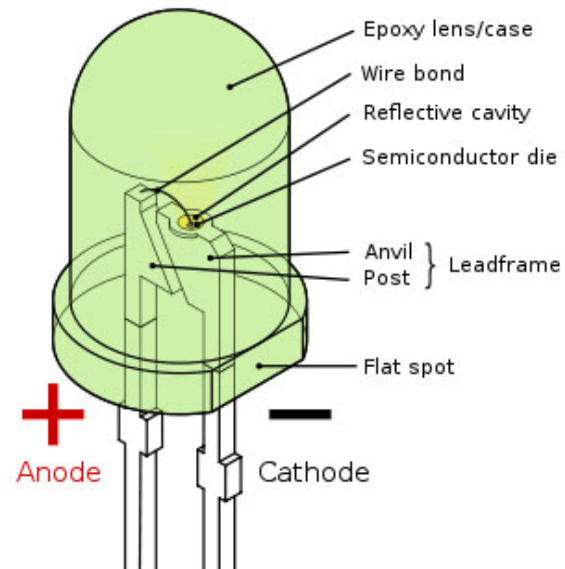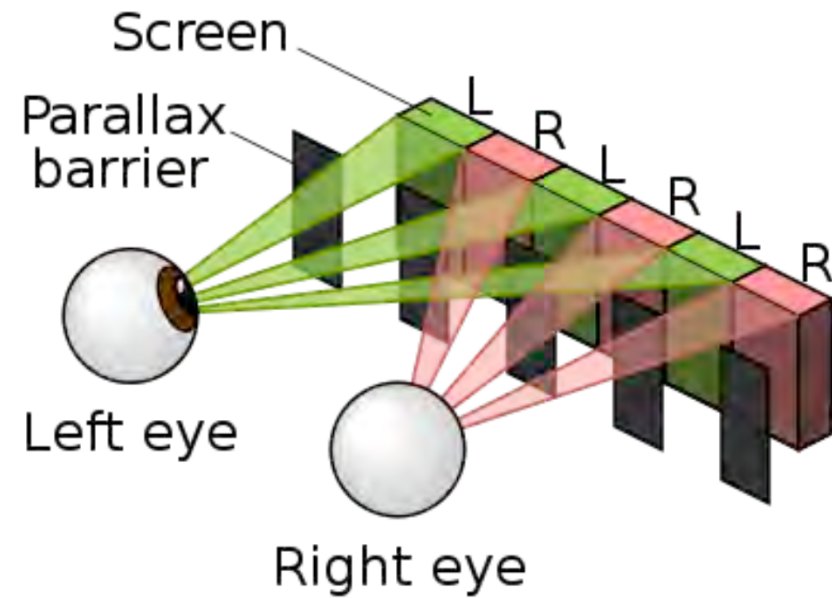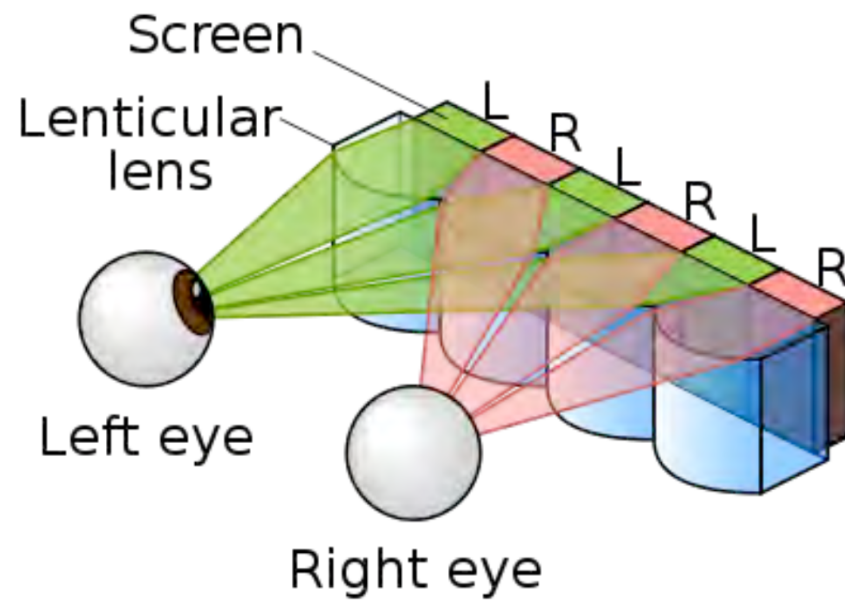
E-INK

PRINTER

- Three types of printer
  - Dot-Matrix (Mono)
  - Inkjet (Color)
  - Laser (Mono/Color)

HOW PRINTER WORKS ? (1)

Dot-Matrix
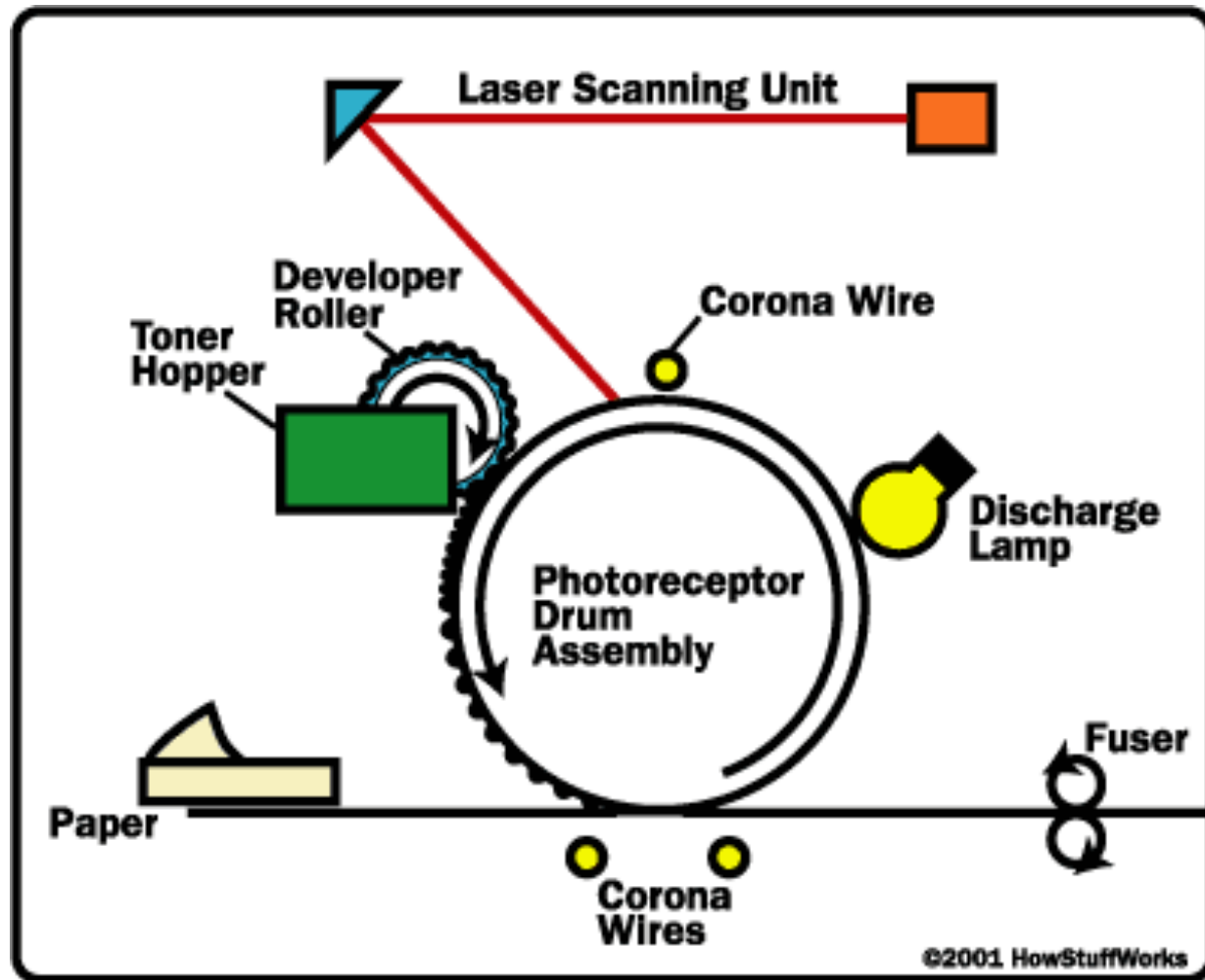
HOW PRINTER WORKS ? (2)

Principle of the ink-jet printer

paper

paper feed

control circuitry

ink cartridges

ribbon cable

printhead stepper motor

stabilizer bar

printed image

belt

printhead assembly (moves back and forth)

paper feed stepper motor

paper advance rollers

paper exit

1. heating element / tube containing ink / nozzle inside printhead

2. Heating element heats up, forming a bubble in the ink.

3. Growing bubble forces ink from tube.

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Inkjet

HOW PRINTER WORKS ? (3)

Laser Printer

3D PRINTING

INPUT DEVICES
(DATA IN)

THE FIRST MOUSE

- Doug Engelbart invented the computer mouse in the early 1960s in his research lab at Stanford Research Institute (now SRI International). The first prototype was built in 1964

TRACKBALL

- A trackball is a pointing device consisting of a ball held by a socket containing sensors to detect a rotation of the ball about two axes— like an upside-down mouse with an exposed protruding ball.
- The user rolls the ball with the thumb, fingers, or the palm of the hand to move a pointer.

GRAPHIC TABLETS

TOUCH SCREEN

- Detail History:
  - http://billbuxton.com/multitouchOverview.html
- Two type of touch screen
  - Resistive
    - Pressing down creates short circuit/change in resistance.
    - Not quite responsive
    - Cheap.
  - Capacitive
    - iPhone screen
    - Use change in capacitance.

SCANNER

BARCODE AND QR CODE

42000 06200

Traditional Barcode

VS

QR Code

QR-Code

DataMatrix

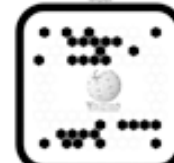Cool-Data-Matrix

Aztec

UPCODE™
000133

Trillcode

Quickmark

Shotcode

mCode

Beetagg

ANATOMY OF QR CODE (1)

- **Position Markers:** Identifying the boundaries of the QR Code.
- **Format Information:** Stores information like the error correction level and masking information
- **Alignment Markers:** Allows viewing the code at different angles.
- **Timing Code:** Determining the size of the code.
- **Version Information:** Determining type of code.
- **Dead Space:** Separates the data from its surroundings.
- **Data:** Stores the information

ANATOMY OF QR CODE (2)

Position Markers

Format Information

Alignment Markers

Timing Code

Version Information
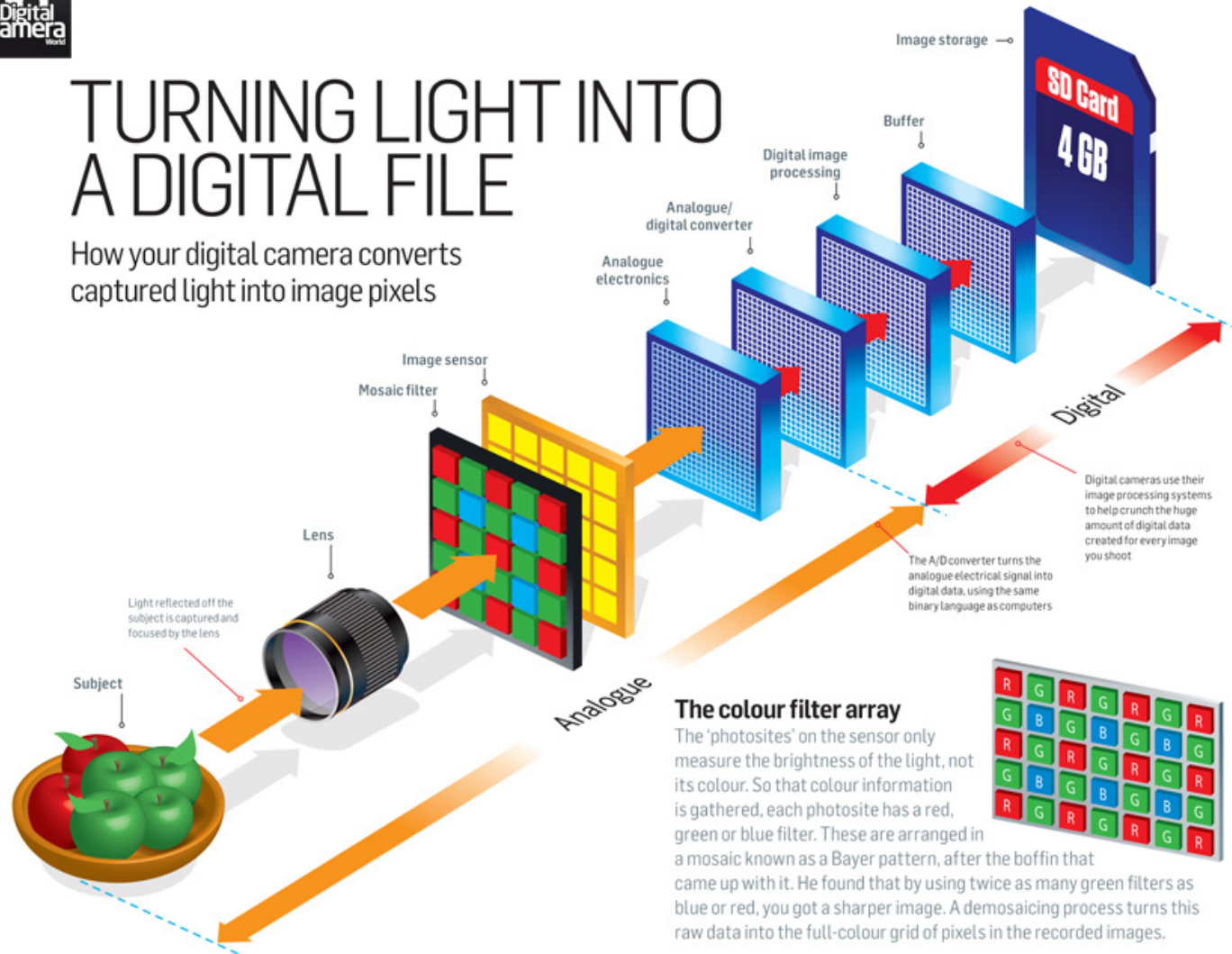
Dead Space

Data
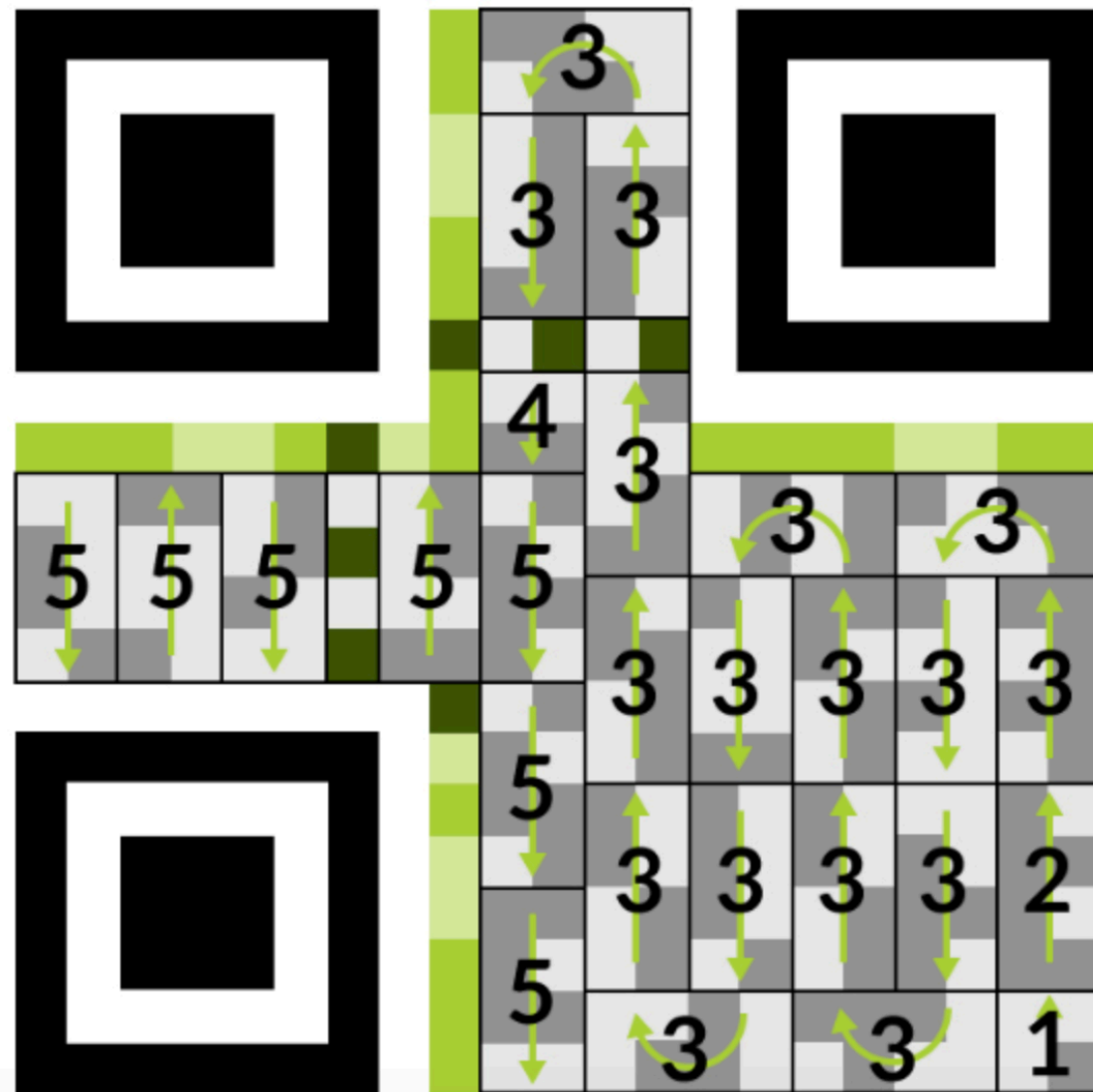
CAMERA (1)

- There are many types of camera
  - Digital Camera (Still Camera)
    - DSLR (Digital Single-Lens Reflex)
    - Digital Compact Camera
  - Video Camera
    - CCTV (Closed-Circuit Television)
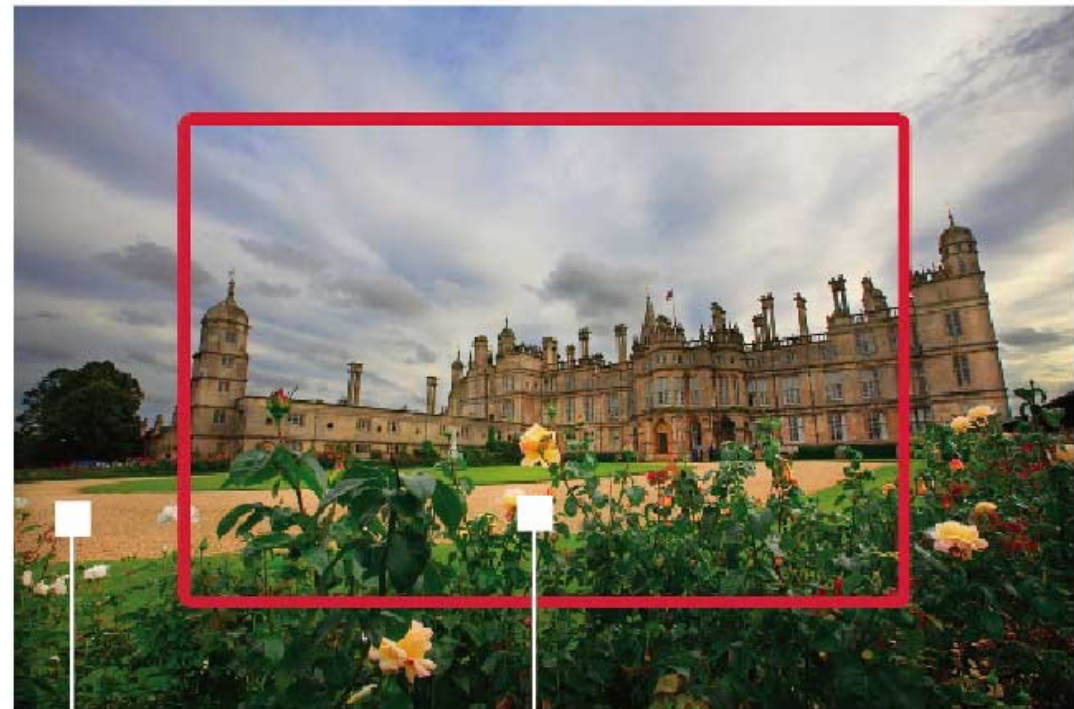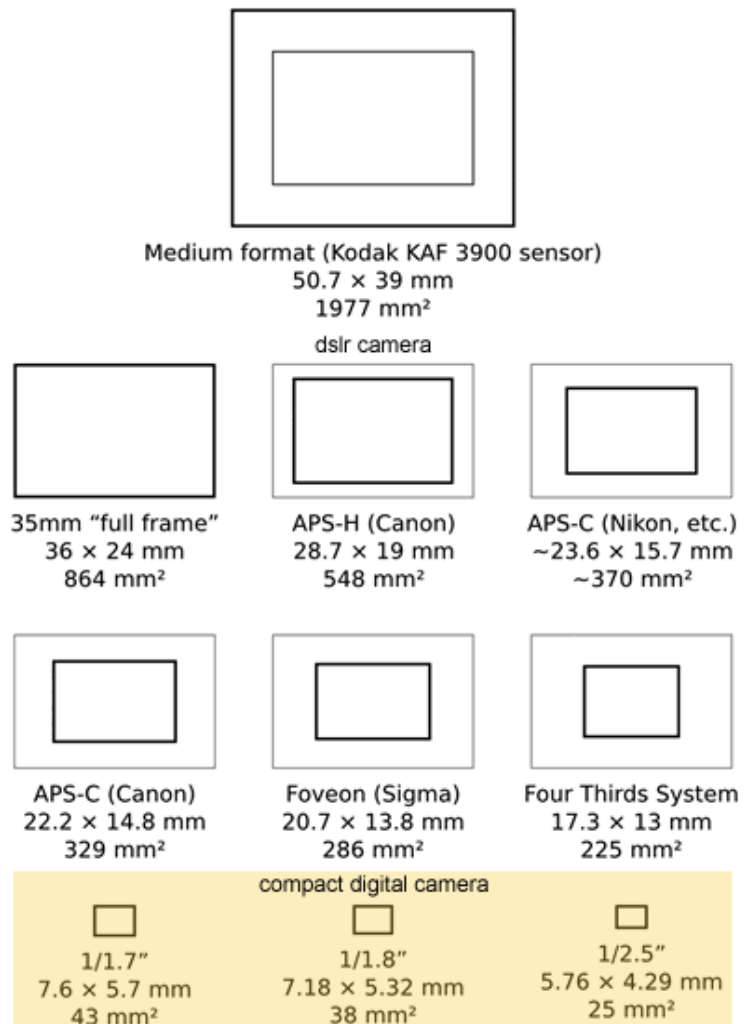   - Web Camera
  - Phone Camera, and etc.

CAMERA (2)

TURNING LIGHT INTO A DIGITAL FILE

How your digital camera converts captured light into image pixels

The colour filter array

The 'photosites' on the sensor only measure the brightness of the light, not its colour. So that colour information is gathered, each photosite has a red, green or blue filter. These are arranged in a mosaic known as a Bayer pattern, after the boffin that came up with it. He found that by using twice as many green filters as blue or red, you got a sharper image. A demosaicing process turns this raw data into the full-colour grid of pixels in the recorded images.

Digital cameras use their image processing systems to help crunch the huge amount of digital data created for every image you shoot

The A/D converter turns the analogue electrical signal into digital data, using the same binary language as computers

Light reflected off the subject is captured and focused by the lens

www.digitalcameraworld.com

C A M E R A (3)

Medium format (Kodak KAF 3900 sensor)
50.7 × 39 mm
1977 mm²

dslr camera

35mm "full frame"
36 × 24 mm
864 mm²

APS-H (Canon)
28.7 × 19 mm
548 mm²

APS-C (Nikon, etc.)
~23.6 × 15.7 mm
~370 mm²

APS-C (Canon)
22.2 × 14.8 mm
329 mm²

Foveon (Sigma)
20.7 × 13.8 mm
286 mm²

Four Thirds System
17.3 × 13 mm
225 mm²

compact digital camera

1/1.7"
7.6 × 5.7 mm
43 mm²

1/1.8"
7.18 × 5.32 mm
38 mm²

1/2.5"
5.76 × 4.29 mm
25 mm²

Full-frame sensor
The same view that you would get with a 35mm film camera, a full-frame sensor gives you a much wider view of your subject.

APS sized sensor
Most D-SLRS have a much smaller sensor than the 5D. The red box shows exactly how much less area is covered using the same lens.
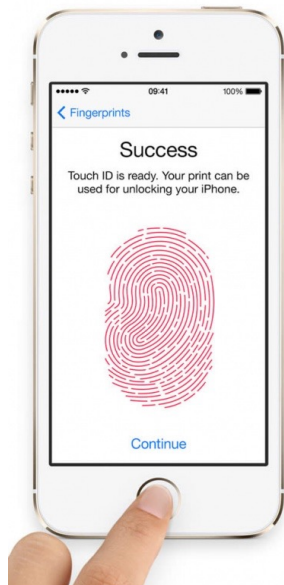
CAMERA (4)

FULL FRAME VS. APS-C (1)

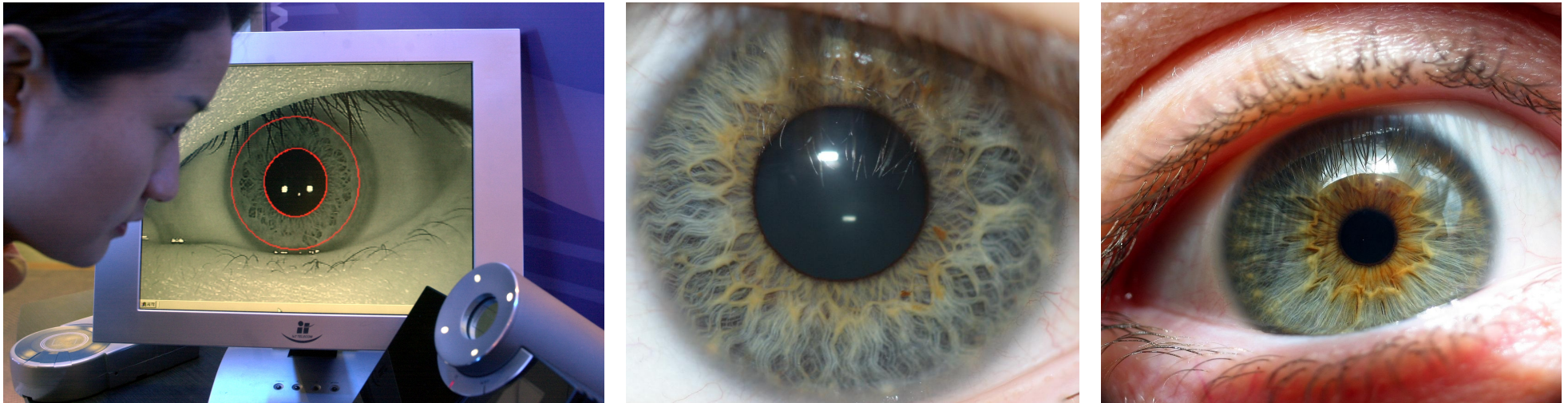Nikon D600 vs D5200 | Nikon 50mm F1.4G

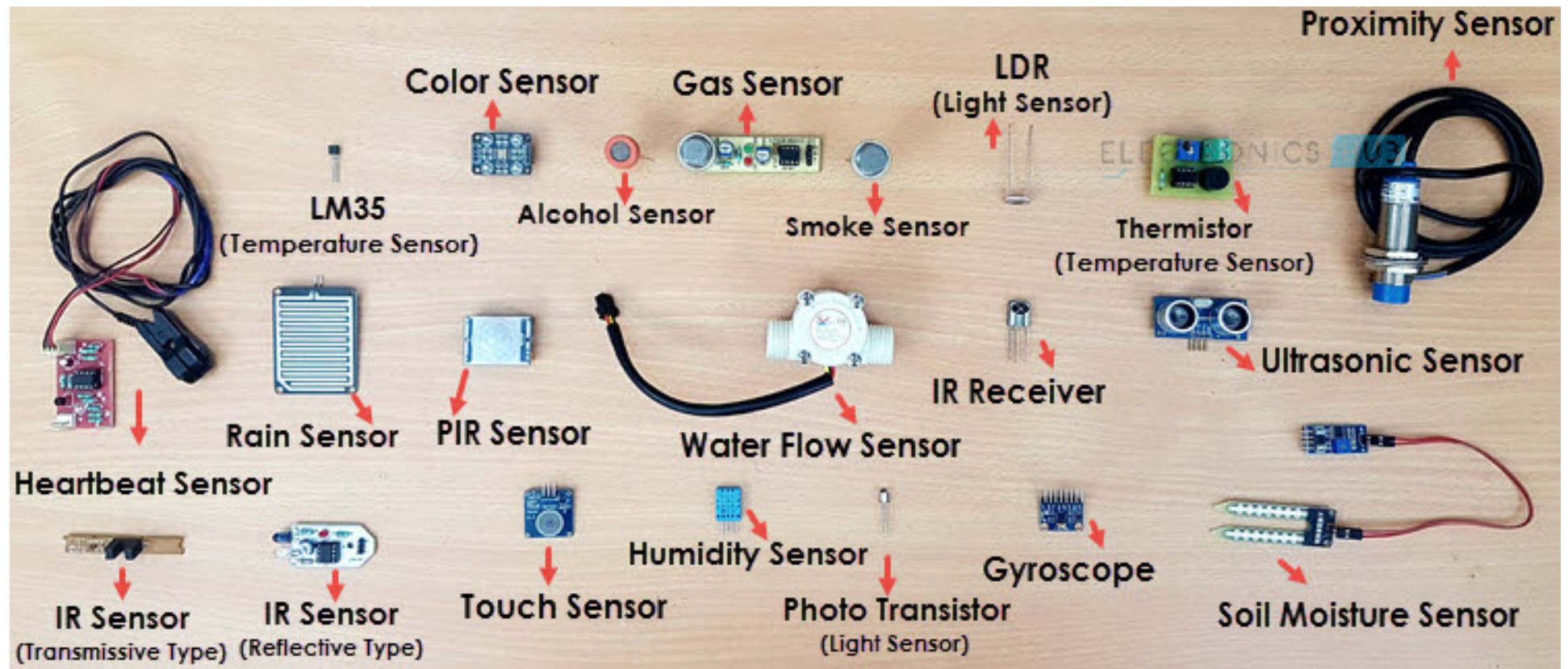# BIOMETRICS SCANNER (1)
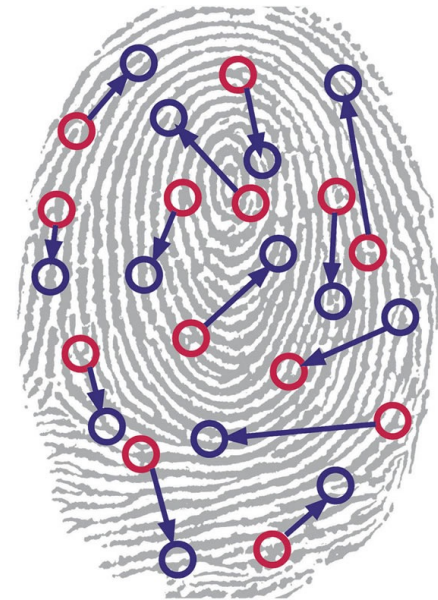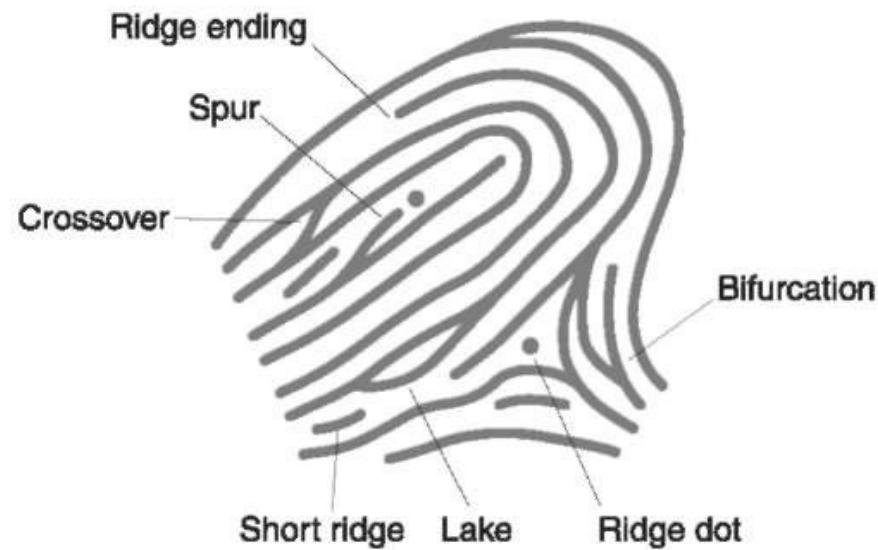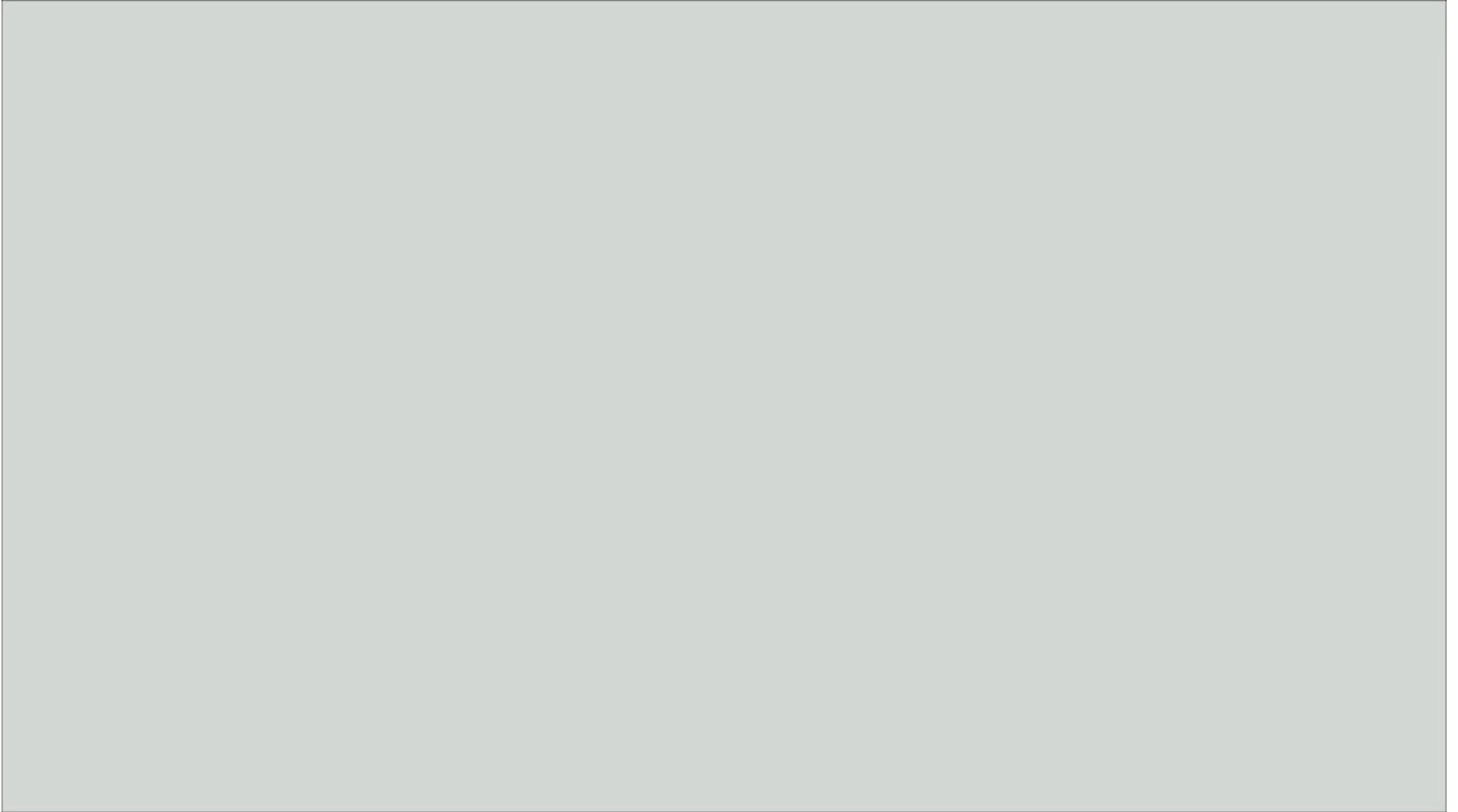

Fingerprint Scanner

BIOMETRICS SCANNER (2)

Retina (Eye) Scanner

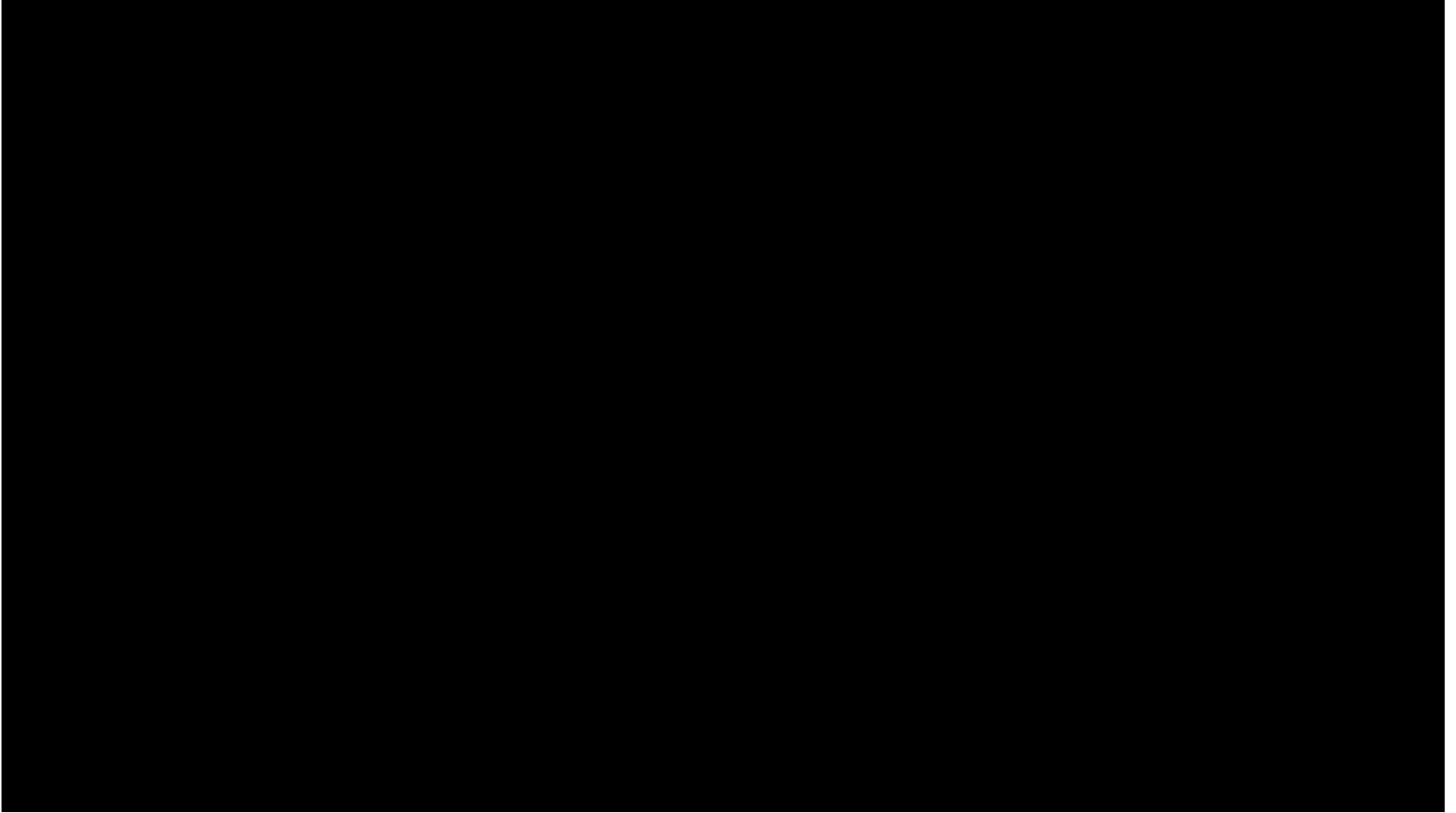# DIFFERENT TYPES OF SENSORS

THE CUTTING EDGE

LEAP MOTION

MICROSOFT KINECT

MYO

ASSIGNMENT 2

- จากอุปกรณ์ **"รับและแสดงผล"** ข้อมูลรูปแบบต่าง ๆ ไม่ได้มีแค่ Keyboard และ Mouse เท่านั้น แต่ยังมีอุปกรณ์อื่น ๆ อีกมากมาย รวมถึงในตัวอย่างที่เราได้เรียนรู้ในวันนี้ เช่น LeapMotion, Microsoft Kinect, Myo และ 3D Printer
- ให้แต่ละกลุ่มกลับไปลองหาแนวคิดว่าจะเอาอุปกรณ์ต่างๆ เหล่านี้ (นอกเหนือจาก 3 อันนี้ก็ได้) ไปประยุกต์ใช้ทำอะไรได้บ้าง

HATSUNE MIKU (HOLOGRAMS)