



Ingo Gunther's WorldProcessor globe design now shown on the Giant Geo Cosmos OLED display at the Museum of Emerging Science and Innovation in Tokyo, Japan.

69

Information Visualization MOOC

Unit 7: Dynamics & Deployment

Deployment

- Image Resolution
- Display Ratio
- Data Formats
- Image Generation/Capture Options
- Image Display Options
- The Ultimate Display

Image Resolution

Pixel, or picture element, is the smallest area that a device can read or write.

Voxel, or volume element, is the smallest volume that a device can read or write.

Dots per inch (DPI) is the number of dots/pixels in a one-inch line.

Resolution is measured in DPI. Common values are

- 72 DPI for the Web
- 300 DPI for prints
- 1200 DPI for scanners

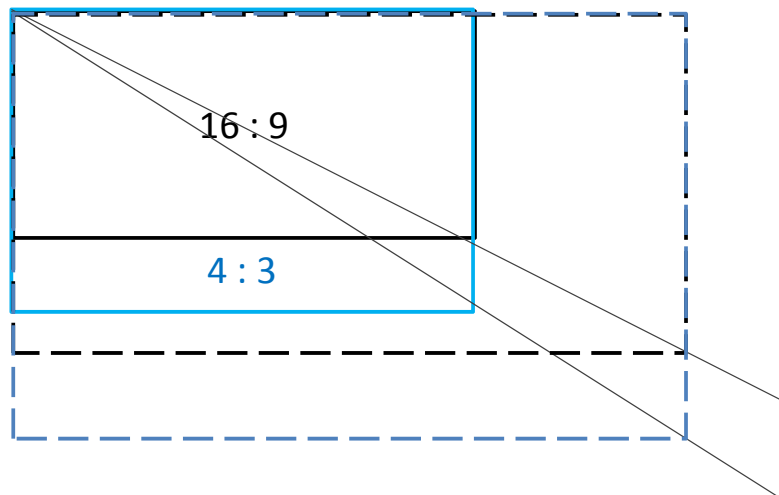
The higher the DPI, the higher the resolution and the file size.

Mega Pixels (MP) equal 1,000,000 pixels.

71

Display Ratio

The quantitative relation between the width and height of a display.



Letter (8.25" x 11")	4 : 3
Movies	4 : 3 or 16 : 9
TV	4 : 3 or 16 : 9
Most displays	4 : 3 or 16 : 9
Laptop screens	4 : 3 or 16 : 9
YouTube	16 : 9

72

Examples

Camera

2981 x 1677 = **5MP**, 16:9 ratio

Letter size paper + 300 DPI laser printer

8.5 x 11 inch at 300 DPI, **8.5 MP**

iPad3

2048 x 1536 pixels on 5.8 x 7.76 inch, 264 DPI

iPhone4S

960 x 640 pixels, 326 DPI

TV Screens

- VGA: 640 x 480, 4:3 ratio
- PAL/SECAM: 768 x 576, 4:3 ratio
- HD 720: 1280 x 720, 16:9 ratio

73

Example: 5MP Camera Photo

Aspect ratio: 16:9

Resolution: 2981 x 1677=5,000,000 pixels or 5 MP

File size

<i>Bits</i>	<i>Color scale</i>	<i>Size</i>	
8-bit	grayscale	4.77 MB	
8-bit	RGB color	14.3 MB	
16-bit	RGB color	28.6 MB	- more common
32-bit	RGB color	57.2 MB	

Down sampled to 72 DPI Web resolution reduces the file size by a factor of four.

Can be **printed** in

300 DPI at a size of 9.9 x 5.6 inches (25.2 x 14.2 cm)

Can be **displayed** on HD Screen in full resolution:

2.5 HD screens (each with a resolution of 1920 x 1080 = 2,073,600)

74

Data Formats

Vector

Stored as geometric description that can be rendered at any size.

- Postscript .ps
- Scalable Vector Graphics .svg
- MS Power Point .ppt



Raster

Stored as grid of pixels.

- .jpg
- .tiff
- .gif
- .bmp
- .png



75

Image Generation/Capture Options

Image generation

- Render into file: Size and resolution only restricted by file/disk size

Image capture

- Screen capture: 72 DPI, pixel size and ratio depend on screen
- Camera
- Scanner



Super-high-resolution images: Combine multiple images—e.g., Photopic Sky Survey is a **5,000 MP** photograph of the entire night sky stitched together from 37,440 exposures. Requires 1000 times more space to print or display than a 5 MP image.

<http://skysurvey.org>

76

Image Display Options

Static

- 2D printout—e.g., on paper
- 3D printouts

Interactive

- 2D digital displays: Hand-held devices, desktop and laptops, large displays
- 3D digital displays—e.g., CAVE

Super-high-resolution displays: Combine multiple displays

Combination

- Illuminated Diagram display: printout with projected data overlays

See examples on subsequent slides.

77

2D Printouts—e.g., on Paper

- Are cheap—no computer hardware/software/expertise costs
- Offer high resolution—a map the size of a 4 x 6 foot (1.2 x 1.8m) dining table in 300 DPI print quality can display more than 310 MP
- Fast—no boot up time
- Easy to transport and deploy—no outlet needed
- Can be easily explored and annotated (e.g., using a pen) by a single viewer or by a team
- Durable—archival paper prints stored in a dry, dark room are likely to be readable in 500 years

78

3D Printout

- Can be created manually or using computers
- using plastics, resins, or metals
- Different resolutions
- Single or multi-color



From <http://norikoambe.com>

79

2D Digital Displays

- **Computer, laptop, tablet, and phone displays** come in different sizes, resolutions, interactivity, and prices. In 2012, high resolution displays might reach **10 MP**.
- **Super-High-Resolution Displays** compile multiple displays into a tiled display wall, the walls of a room (CAVE), on the surface of a globe, etc.

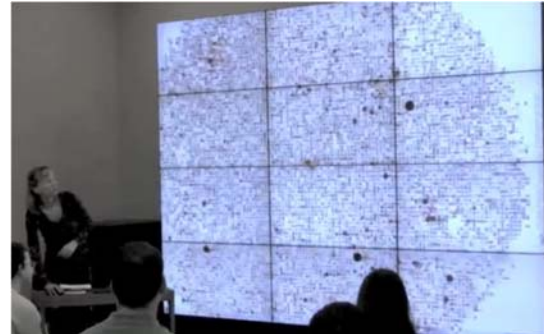


From <http://pti.iu.edu/avl>

80

Super High Resolution Displays

- Davos Studio Room uses 5 x 16 = 80 modules, each with 128 x 128 pixels—i.e., 2048 x 640 = 1.3 MP on 7,90 x 2,56m wall, <http://www.youtube.com/watch?v=7MUaR24tYJ8>
- IU's IQ-Wall uses 12 high-resolution monitors with a total of 12.5 MP
- North Carolina State U Libraries' Immersion Theater serves 6824 x 2240=15.2 MP, <http://youtu.be/YgfaiqtXws>



81



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82

Combination: Illuminated Diagram display



Science maps in “Expedition Zukunft” science train (12 coaches, 300 m long) visiting 62 cities in 7 months. Opening was on April 23rd, 2009, and attended by German Chancellor Merkel.

<http://www.expedition-zukunft.de>

83



Figure 1: An illuminated Diagram at SIGGRAPH 02

84

The Ultimate Display

Would effectively match human visual perception:

- Resolution equals visual acuity of the human eye
- Wide viewing angle that also stimulates peripheral vision
- High brightness and color brilliance
- High update rate
- Supports stereoscopy

But differs from Sutherland's vision in which a computer "can control the existence of matter."

Sutherland, Ivan E. 1965. "The Ultimate Display." In *Proceedings of IFIP Congress*, 506-508.

85

Relevant Software

- <http://Zoom.it> (formerly Seadragon), see Unit 7: Hands-on
- <http://gigapan.org>
- <http://www.openzoom.org> open source toolkit for the Adobe Flash Platform.

support the sharing interactive exploration (zoom and pan) of large images.

Please post your favorite deployment hardware or software to Twitter, Flickr using tags "ivmooc" and "#deployment."



86