History of Photography
History of Photography

Ancient — Camera Obscura – through pinhole

16th - 17th Century — Camera Obscura – improvements by enlarging hole and using telescopic lenses

1837 — Louis Daguerre – creates images on silverplated copper plates

1839 — Alexander Wolcott – added concave mirrors to increase light and was one of America’s first daguerrotype photographers

1861-65 — James Clerk-Maxwell – demonstrates color photography using RGB filters & 3 projectors
Lincoln’s Daguerreotype
History of Photography (continued)

1880 — Mathew Brady – covers American Civil War, first photojournalism

1877 — Eadweard Muybridge – “Do a horse’s four hooves ever leave the ground at once?” Using time-sequenced photographs of Leland Stanford’s horses to settle a bet among rich San Franciscans
THE KODAK CAMERA.

PHOTOGRAPHY REDUCED TO THREE MOTIONS.

1. Pull the Cord. 2. Turn the Key. 3. Press the Button.

And so on for 100 Pictures.

ANYBODY CAN USE IT.

Size of Camera, 3 1/8 x 3 1/2 x 2 1/2 inches.
Weight, 1 lb. 10 oz.
Size of Picture, 3 1/4 in. diameter.

PRICE, €25.00

Price includes hand-sewn sole leather Carrying Case, with shoulder strap and film for 100 exposures. Amateurs can finish their own negatives or send the roll of exposed film to the factory by mail to have them developed and printed. Price for developing, printing and mounting 100 Pictures, including speed 100 films for reloading Camera, €1.00. Speed for reloading only, €0.00.

THE EASTMAN DRY PLATE AND FILM CO., 36 Oxford Street, London, ROCHESTER, N.Y.

Send for descriptive circulars.
Eastman and box. - (from The Story of Kodak, Douglas Collins, 1990, p. 62)
History of Photography (continued)

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1877 — Eadweard Muybridge – “Do a horse’s four hooves ever leave the ground at once?” Using time-sequenced photographs of Leland Stanford’s horses to settle a bet among rich San Franciscans

1880 — George Eastman – sets up Eastman Dry Plate Company in Rochester, NY

1931 — Strobe Photography – Harold Edgerton of MIT
Newton’s Apple, 1970

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<tr>
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<tr>
<td>1934</td>
<td>Mannes &amp; Godowsky – developed full color Kodachrome film</td>
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Color Film Paradigm Shift

From multiple lenses or multiple exposures to multiple layered film

The transition from the optical approach to the chemical approach formed the new basis for color photography

Mannes & Godowsky
1920’s
Protective Layer
Blue-sensitive Emulsion
Yellow Filter
Green-sensitive Emulsion
Interlayer
Red-sensitive Emulsion
Foundation Layer
Acetate Base
Anti-halation Backing

(fig. 1.6, Color Photography, Robert Hirsch, p. 5)
(fig. 17, Color Photography, Robert Hirsch, p. 6)
A low speed, ISO 32 film produces this fine grained image. The right image is a small portion of the whole negative on the left.

A high speed, ISO 400 film produces a coarser grain with less apparent sharpness in the image.
Film Drop-Off
Sites Fading Fast As Digital Cameras Dominate

Katie Hafner. "Film Drop-Off Sites Fading Fast As Digital Cameras Dominate," NYT, 10/9/07
Polaroid Land Camera
CCD Technology

• 1969 George Smith & Willard Boyle invented the CCD image sensor at Bell Labs. They were looking to develop a video phone.

• 1970 They built the world’s first solid state video camera

• 1981 Sony produced the Mavica, the first digital camera

• 1991 Kodak scientist creates the first professional digital camera with a 1.3 Megapixel sensor
CCD Technology
1. After exposure to light, an electronic image accumulates as a pattern of charge in the parallel register.

2. Charge is shifted up the parallel register one row. The first row is shifted into the serial register.

3. The first pixel is serially shifted into the output node.

4. The charge at the output node is collected for signal processing.

5. The charge from the next pixel is shifted to the output node.

6. The charge at the output node is collected for signal processing.

7. After all pixels in the serial register are processed, the next row is shifted into the serial register.
Requirements For Pervasive Digital Photography

- High resolution, low cost image acquisition devices
- Sufficient computer processing power and memory systems for digital manipulation
- Image enhancement software with easy-to-use interfaces
- High density, low-cost local storage systems
Requirements For Pervasive Digital Photography

- Cheap LCD displays for previewing

- Bandwidth! Bandwidth! Bandwidth!
  - High network bandwidth (wired) for distant transmission
  - Fast throughput (e.g. Firewire) for local transmission
  - Wireless bandwidth (local) for ease of use

- High quality, low cost digital printers
CMOS Technology

- Complementary metal oxide semiconductor

- Cheaper manufacturing technology than CCD’s
  - Follows the semiconductor industry cost curves
<table>
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<tr>
<th>CCD</th>
<th>CMOS</th>
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<tr>
<td>• Approaching practical limits</td>
<td>• Basically unlimited resolution</td>
</tr>
<tr>
<td>• Relatively expensive</td>
<td>• Cheap manufacturing cost</td>
</tr>
<tr>
<td>• Requires assembly of chips for control, off-loading and storage</td>
<td>• Can have full integration</td>
</tr>
<tr>
<td></td>
<td>• Mass production today</td>
</tr>
<tr>
<td></td>
<td>• Improving at rapid rates</td>
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Charge-Coupled Device
Kodak DCS420

$14,000 approximately – June 1994
Bayer pattern

Incoming light
Filter layer
Sensor array
Resulting pattern

Cost of CMOS image sensors ~ $1

Wikipedia
Foveon

• Founded by Dr. Carver Mead (1997)
• Uses CMOS technology (not CCD)

• Specifications and Performance
  – Resolution 16.8 Mpxels
  – 7 active transistors behind each pixel
  – Less interference, better focusing
  – More precise exposure times
  – Smarter pixels
Foveon Camera 16.8 Megapixels
New Chip Technology

Richard Merrill, Foveon’s senior scientist, beside a print of a cowboy taken using the company’s new chip technology.

The fine detail of an eyebrow, above, showing hairs without breaking up into dots, or pixels.

Pictured is the Foveon II Digital Portrait Camera shown with laptop and frame configuration.
FIG. 5
(PRIOR ART)
## Cost of Digital Cameras (2005-2012)

<table>
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<td>Powershot S50</td>
<td>EOS 1Ds</td>
<td>Powershot G7</td>
<td>Powershot G9</td>
<td>Powershot G10</td>
<td>Powershot G10</td>
<td>Powershot G12</td>
<td>Powershot S100</td>
<td>Powershot A810</td>
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<td>Sony (Cybershot)</td>
<td>DSC-F717</td>
<td>Not SLR</td>
<td>DSC-T50</td>
<td>DSC-N2</td>
<td>DSC-W170/R</td>
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<td>• Megapixels</td>
<td>5Mp</td>
<td>8Mp</td>
<td>7.1 Mp</td>
<td>10.1 Mp</td>
<td>10.1 Mp</td>
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<td>12.1 Mp</td>
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<td>Kodak Z710</td>
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<td>Kodak M1063</td>
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<td>14Mp</td>
<td>7.1 Mp</td>
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<td>Coolpix S550</td>
<td>Coolpix S630</td>
<td>Coolpix S630</td>
<td>Coolpix S630</td>
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Digital Cameras

Sony CyberShot
- 20 MegaPixels
- $80

Nikon Digital SLR
- 24 MegaPixels
- $600

2014
iPhone5 camera

8MP iSight camera
Advanced optics, a custom lens, and an 8-megapixel sensor capture high-quality photos, even in panorama. And you can record 1080p HD video with improved stabilization.
Nokia Lumia 1020 – 41 MPixels
Fly’s Eye
AWARE-2

http://mosaic.disp.duke.edu:90/aware/image_list/image_list/public
AWARE-2

http://www.kickstarter.com/projects/aqueti/carolina-zoomin
AWARE-2 online demo

Professor Pedro Sander
• **GigaPan: Corcovado 67GP (first stitch)**
Photo Stitching Panoramas
Photo Stitching Panoramas

• Registration
  – Matching features

• Calibration
  – Exposure
  – Lens corrections

• Blending
Creating Full View Panoramic Image Mosaics and Environment Maps

3D rotation registration of four images taken with a hand-held camera

Sergey Brin with Google Glass
End