Webcam

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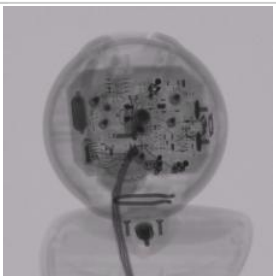
A **webcam** is a video camera that feeds or streams its image in real time to or through a computer to computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and email as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera (which connects using Ethernet or Wi-Fi), a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

The term 'webcam' (a clipped compound) may also be used in its original sense of a video camera connected to the Web continuously for an indefinite time, rather than for a particular session, generally supplying a view for anyone who visits its web page over the Internet. Some of them, for example, those used as online traffic cameras, are expensive, rugged professional video cameras.

Typical low-cost webcam used with many personal computers



Animated set of X-ray images of a webcam. Images acquired using industrial CT scanning.

Contents

Characteristics

Webcams are known for their low manufacturing cost and flexibility,[1] making them the lowest cost form of videotelephony. Despite the low cost, the resolution offered at present (2015) is rather impressive, with low end webcams offering resolutions of 320x240, medium webcams offering 640x480 resolution, and high-end webcams offering 1280x720 (aka 720p) or even 1920x1080 (aka 1080p) resolution.[2][3][4]

They have also become a source of security and privacy issues, as some built-in webcams can be remotely activated via spyware.

Uses

The most popular use of webcams is the establishment of video links, permitting computers to act as videophones or videoconference stations. Other popular uses include security surveillance, computer vision, video broadcasting, and for recording social videos.

The video streams provided by webcams can be used for a number of purposes, each using appropriate software:

Health care

Most of the modern webcams allow to capture arterial pulse rate (http://sourceforge.net/projects/pulsecapture/) by means of simple algorithmic trick. Researchers claim that accuracy of such measurements about plus minus 5 bpm.

Video monitoring

Webcams may be installed at places such as childcare centres, offices, shops and private areas to monitor security and general activity.

Commerce

Webcams have been used for Augmented Reality experiences online. One such function has the webcam act as a 'magic mirror' to allow an online shopper to view a virtual item on themselves. The Webcam Social Shopper is one example of software that utilizes the webcam in this manner.[5]

Videocalling and videoconferencing

Webcam can be added to instant messaging, text chat services such as AOL Instant Messenger, and VoIP services such as Skype, one-to-one live video communication over the Internet has now reached millions of mainstream PC users worldwide. Improved video quality has helped webcams encroach on traditional video conferencing systems. New features such as automatic lighting controls, real-time enhancements (retouching, wrinkle smoothing and vertical stretch), automatic face tracking and autofocus, assist users by providing substantial ease-of-use, further increasing the popularity of webcams.

Webcam features and performance can vary by program, computer operating system, and also by the computer's processor capabilities. Video calling support has also been added to several popular instant messaging programs.

Video security

Webcams can be used as security cameras. Software is available to allow PC-connected cameras to watch for movement and sound,[6] recording both when they are detected. These recordings can then be saved to the computer, e-mailed, or uploaded to the Internet. In one well-publicised case,[7] a computer e-mailed images of the burglar during the theft of the computer, enabling the owner to give police a clear picture of the burglar's face even after the computer had been stolen.

Recently webcam privacy software has been introduced by such companies such as Stop Being Watched or Webcamlock. The software exposes access to a webcam and prompts the user to allow or deny access by showing what program is trying to access the webcam. Allowing the user to accept a trusted program the user recognizes or terminate the attempt immediately. Other companies on the market manufacture and sell sliding lens covers that allow users to retrofit the computer and close access to the camera lens.

In December 2011, Russia announced that 290,000 Webcams would be installed in 90,000 polling stations to monitor the Russian presidential election, 2012.[8]

Video clips and stills

Webcams can be used to take video clips and still pictures. Various software tools in wide use can be employed for this, such as PicMaster (for use with Windows operating systems), Photo Booth (Mac), or Cheese (with Unix systems). For a more complete list see Comparison of webcam software.

Input control devices

Special software can use the video stream from a webcam to assist or enhance a user's control of applications and games. Video features, including faces, shapes, models and colors can be observed and tracked to produce a corresponding form of control. For example, the position of a single light source can be tracked and used to emulate a mouse pointer, a head mounted light would enable hands-free computing and would greatly improve computer accessibility. This can be applied to games, providing additional control, improved interactivity and immersiveness.

FreeTrack is a free webcam motion tracking application for Microsoft Windows that can track a special head mounted model in up to six degrees of freedom and output data to mouse, keyboard, joystick and FreeTrack-supported games. By removing the IR filter of the webcam, IR LEDs can be used, which has the advantage of being invisible to the naked eye, removing a distraction from the user. TrackIR is a commercial version of this technology.

The EyeToy for the PlayStation 2, PlayStation Eye for the PlayStation 3, and the Xbox Live Vision camera and Kinect motion sensor for the Xbox 360 and are color digital cameras that have been used as control input devices by some games.

Small webcam-based PC games are available as either standalone executables or inside web browser windows using Adobe Flash.

Astro photography

With very-low-light capability, a few specific models of webcams are very popular to photograph the night sky by astronomers and astro photographers. Mostly, these are manual focus cameras and contain an old CCD panel instead of comparatively newer CMOS panels. The lenses of the cameras are removed and then these are attached to telescopes to record images, video, still, or both. In newer techniques, videos of very faint objects are taken for a couple of seconds and then all the frames of the video are 'stacked' together to obtain a still image of respectable contrast. Philips PCVC 740K and SPC 900 are two of the few webcams liked by astro photographers.

History

Early development

First developed in 1991, a webcam was pointed at the Trojan Room coffee pot in the Cambridge University Computer Science Department. The camera was finally switched off on August 22, 2001. The final image captured by the camera can still be viewed at its homepage.[9][10] The oldest webcam still operating is FogCam at San Francisco State University, which has been running continuously since 1994.[11] A cam developed for CNN was later destroyed during Desert Shield/Storm.

Connectix QuickCam

The first commercial webcam, the black-and-white QuickCam, entered the marketplace in 1994, created by the U.S. computer company Connectix (which sold its product line to Logitech in 1998). QuickCam was available in August 1994 for the Apple Macintosh, connecting via a serial port, at a cost of $100. Jon Garber, the designer of the device, had wanted to call it the "Mac-camera", but was overruled by Connectix's marketing department; a version with a PC-compatible serial port and software for Microsoft Windows was launched in October 1995. The original QuickCam provided 320x240-pixel resolution with a grayscale depth of 16 shades at 60 frames per second, or 256 shades at 15 frames per second.[12] These cam were tested on several Delta II launch using a variety of communication protocols including CDMA, TDMA, GSM and HF.

In 2010, Time Magazine named the QuickCam as one of the top computer devices of all time.[13]

Videoconferencing via computers already existed, and at the time client-server based videoconferencing software such as CU-SeeMe had started to become popular.

Later developments

One of the most widely reported-on webcam sites was JenniCam, created in 1996, which allowed Internet users to observe the life of its namesake constantly, in the same vein as the reality TV series *Big Brother*, launched four years later.[14] Other cameras are mounted overlooking bridges, public squares, and other public places, their output made available on a public web page in accordance with the original concept of a "webcam". Aggregator websites have also been created, providing thousands of live video streams or up-to-date still pictures, allowing users to find live video streams based on location or other criteria.

Around the turn of the 21st century, computer hardware manufacturers began building webcams directly into laptop and desktop screens, thus eliminating the need to use an external USB or FireWire camera. Gradually webcams came to be used more for telecommunications, or videotelephony, between two people, or among several people, than for offering a view on a Web page to an unknown public.

For less than US$100 in 2012, a Three-dimensional space webcam became available, producing videos and photos in 3D Anaglyph image with a resolution up to 1280 x 480 pixels. Both sender and receiver of the images must use 3D glasses to see the effect of three dimensional image.[15]

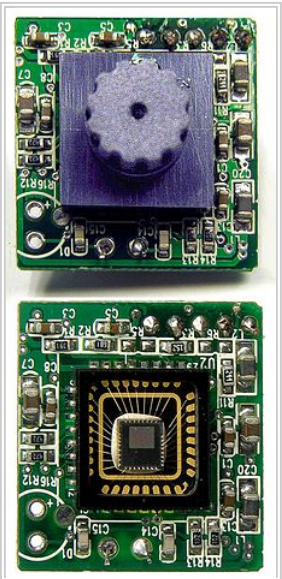
Technology

Webcams typically include a lens, an image sensor, support electronics, and may also include a microphone for sound. Various lenses are available, the most common in consumer-grade webcams being a plastic lens that can be screwed in and out to focus the camera. Fixed focus lenses, which have no provision for adjustment, are also available. As a camera system's depth of field is greater for small image formats and is greater for lenses with a large f-number (small aperture), the systems used in webcams have a sufficiently large depth of field that the use of a fixed focus lens does not impact image sharpness to a great extent.

Image sensors can be CMOS or CCD, the former being dominant for low-cost cameras, but CCD cameras do not necessarily outperform CMOS-based cameras in the low cost price range. Most consumer webcams are capable of providing VGA resolution video at a frame rate of 30 frames per second. Many newer devices can produce video in multi-megapixel resolutions, and a few can run at high frame rates such as the PlayStation Eye, which can produce 320×240 video at 120 frames per second.

Support electronics read the image from the sensor and transmit it to the host computer. The camera pictured to the right, for example, uses a Sonix SN9C101 to transmit its image over USB. Typically, each frame is transmitted uncompressed in RGB or YUV or compressed as JPEG. Some cameras, such as mobile phone cameras, use a CMOS sensor with supporting electronics "on die", i.e. the sensor and the support electronics are built on a single silicon chip to save space and manufacturing costs. Most webcams feature built-in microphones to make video calling and videoconferencing more convenient.

The USB video device class (UVC) specification allows for interconnectivity of webcams to computers without the need for proprietary device drivers. Microsoft Windows XP SP2, Linux[16] and Mac OS X (since October 2005) have UVC support built in and do not require extra device drivers, although they are often installed to add additional features.



Webcams typically include a lens (shown at top), an image sensor (shown at bottom), and supporting circuitry.

Privacy

Many users do not wish the continuous exposure for which webcams were originally intended, but rather prefer privacy.[17] Such privacy is lost when malware allow malicious hackers to activate the webcam without the user's knowledge, providing the hackers with a live video and audio feed.[18] Cameras such as Apple's older external iSight cameras include lens covers to thwart this. Some webcams have built-in hardwired LED indicators that light up whenever the camera is active sometimes only in video mode. It is not clear whether these indicators can be circumvented when webcams are surreptitiously activated without the user's knowledge or intent, via spyware.

In the field of computer security, camfecting is the fraudulent process of attempting to hack into a person's webcam and activate it without the webcam owner's permission. The remotely activated webcam can be used to watch anything within the webcam's field of vision, sometimes the webcam owner itself. Camfecting is most often carried out by infecting the victim's computer with a virus that can provide the hacker access to the victim's webcam. This attack is specifically targeted at the victim's webcam, and hence the name *camfecting*, a portmanteau of the words *cam* and *infecting*.

In January 2005, some search engine queries were published in an online forum[19] which allow anyone to find thousands of Panasonic- and Axis high-end web cameras, provided that they have a web-based interface for remote viewing. Many such cameras are running on default configuration, which does not require any password login or IP address verification, making them viewable by anyone.

Some laptop computers have built in webcams which present both privacy and security issues, as such cameras cannot normally be physically disabled if hijacked by a Trojan Horse program or other similar spyware programs. In the 2010 *Robbins v. Lower Merion School District* "WebcamGate" case, plaintiffs charged that two suburban Philadelphia high schools secretly spied on students - by surreptitiously remotely activating iSight webcams embedded in school-issued MacBook laptops the students were using at home — and thereby infringed on their privacy rights. School authorities admitted to secretly snapping over 66,000 photographs, including shots of students in the privacy of their bedrooms, including some with teenagers in various state of undress.[20][21] The school board involved quickly disabled their laptop spyware program after parents filed lawsuits against the board and various individuals.[22][23]

Effects on modern society

Webcams allow for inexpensive, real-time video chat and webcasting, in both amateur and professional pursuits. They are frequently used in online dating and for online personal services offered mainly by women when camgirling. However, the ease of webcam use through the Internet for video chat has also caused issues. For example, moderation system of various video chat websites such as Omegle has been criticized as being ineffective, with sexual content still rampant.[24] In a 2013 case, the transmission of nude photos and videos via Omegle from a teenage girl to a schoolteacher resulted in a child pornography charge.[25]

YouTube is a popular website hosting many videos made using webcams. News websites such as the BBC also produce professional live news videos using webcams rather than traditional cameras.[26]

Webcams can also encourage telecommuting, enabling people to work from home via the Internet, rather than traveling to their office.

The popularity of webcams among teenagers with Internet access has raised concern about the use of webcams for cyber-bullying.[27] Webcam recordings of teenagers, including underage teenagers, are frequently posted on popular Web forums and imageboards such as 4chan.[28][29]

Descriptive names and terminology

Videophone calls (also: *videocalls* and *video chat*),[30] differ from videoconferencing in that they expect to serve individuals, not groups.[31] However that distinction has become increasingly blurred with technology improvements such as increased bandwidth and sophisticated software clients that can allow for multiple parties on a call. In general everyday usage the term *videoconferencing* is now frequently used instead of *videocall* for point-to-point calls between two units. Both videophone calls and videoconferencing are also now commonly referred to as a *video link*.

Webcams are popular, relatively low cost devices which can provide live video and audio streams via personal computers, and can be used with many software clients for both video calls and videoconferencing.[32]

A videoconference system is generally higher cost than a videophone and deploys greater capabilities. A *videoconference* (also known as a *videoteleconference*) allows two or more locations to communicate via live, simultaneous two-way video and audio transmissions. This is often accomplished by the use of a multipoint control unit (a centralized distribution and call management system) or by a similar non-centralized multipoint capability embedded in each videoconferencing unit. Again, technology improvements have circumvented traditional definitions by allowing multiple party videoconferencing via web-based applications.[33][34] A separate webpage article is devoted to videoconferencing.

A telepresence system is a high-end videoconferencing system and service usually employed by enterprise-level corporate offices. Telepresence conference rooms use state-of-the art room designs, video cameras, displays, sound-systems and processors, coupled with high-to-very-high capacity bandwidth transmissions.

Typical use of the various technologies described above include calling or conferencing on a one-on-one, one-to-many or many-to-many basis for personal, business, educational, deaf Video Relay Service and tele-medical, diagnostic and rehabilitative use or services. New services utilizing videocalling and videoconferencing, such as teachers and psychologists conducting online sessions,[35] personal videocalls to inmates incarcerated in penitentiaries, and videoconferencing to resolve airline engineering issues at maintenance facilities, are being created or evolving on an ongoing basis.

See also

- Camfecting
- Camgirling
- Comparison of webcam software
- Document camera
- IP camera
- iSight
- List of webcameras and videophones
- Optic Nerve (GCHQ) [36]
- Pan tilt zoom camera
- QuickCam
- Trail Camera - special outdoor Digital Camera that operates on batteries and saves motion detected images to SDcard

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