Technical Info 1/2004

Security-Vision-Systems

MOBOTIX AG

…the new face of IP video

Video recording with (almost) zero network load

(September 22, 2004) Increasingly, PCs today are used in conjunction with video management software to record video from network cameras. However, this form of centralized processing represents a bottleneck and generates a substantial network load. This is because images have to be transmitted to the central PC for evaluation, even when no events are captured. By contrast, new "smart" network camera systems with integrated PCs reduce the network load to practically nothing, and there is no limit on the number of these cameras that can be connected to a network.

Network Cameras Are Leading the Way

Instead of analog video cables, network cameras use TCP/IP – a standard commonly found in IT network technology – to transmit images. This gives them several advantages:

- Affordable, universal image transmission: All kinds of network technology, including WLAN, DSL, ISDN, GSM and Ethernet, can be used to transmit the cameras' images inexpensively. There is no need for special analog cabling. Using leased lines or the Internet, the cameras can even be accessed from anywhere in the world. And because there is no need to comply with rigid analog video standards, there are no longer any restrictions on image resolution. This means that the first megapixel security cameras are now available.

- License-free web technology: Access to the images and recordings is web-based using browser software available on any PC (ExplorerTM, NetscapeTM). Regardless of the operating system used and the number of users viewing images from the cameras, there are no license charges for software or maintenance.

- High security: In contrast to analog video cable, which can be tapped electromagnetically using just simple equipment, network cameras can be protected in a variety of ways, including software encryption with well-known technologies like PGP or secured VPN routers (virtual private networks) over the Internet.

- Unlimited expandability: Large companies typically run hundreds of PCs, networked worldwide, that keep their data on company servers. Hundreds of cameras can be networked in exactly the same way. This kind of network structure is easy to expand – using WLAN technology instead of cables if necessary.

Task

As a rule, simple live monitoring is not sufficient in video surveillance. When used for evidence recording or in situations requiring unattended monitoring, scenes must also be tape-recorded. To

- keep the costs of storage capacity low and to
- optimize searching through recorded material for events,

usually only those sequences are recorded in which changes of scene or motion have been detected. These events don't need to be just recorded, they may need to trigger an alarm as well.

Recording all the important scenes and avoiding unnecessary recordings calls for scene change detection (video motion detection); here, video sensor systems play an important role. Due to the need to document the scene prior to an event or incident (pre-alarm), the recording system also has to be equipped with a ring buffer capable of storing a few seconds of video.
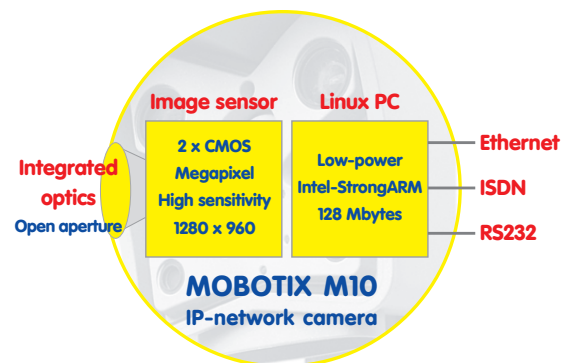
Problems of Centralized Management

Centralized PC-based recording has two disadvantages when it comes to motion detection and recording footage in the pre-alarm buffer:

- Reliable video motion detection is extremely compute-intensive, which means that the performance of the PC imposes a limit on the number of cameras that can be evaluated at the same time.
- Detecting motion and maintaining the pre-alarm buffer require images to be read out of all the cameras constantly generating a considerable network load, even though no recording is actually taking place.

Previous Solutions Failed to Deliver

Until now, these constraints were circumvented by dropping the frame rate, resolution and picture quality in advance of events so as to reduce the network load and the computation involved, and then by raising the image quality and frame rate back to normal levels after events. However, this approach is less than optimal because a good, high-resolution image is important for reliable motion detection. Also, in applications that call for alarms to be triggered, pre-alarm image quality should not be substandard.

Integrated optics
Open aperture

Image sensor
2 x CMOS Megapixel High sensitivity 1280 x 960

Linux PC
Low-power Intel-StrongARM 128 Mbytes

Ethernet
ISDN
RS232

MOBOTIX M10
IP-network camera

The Solution: Put Everything in the Camera

The solution for reducing network load and eliminating the system constraints is simple:

- move the motion detection functionality and
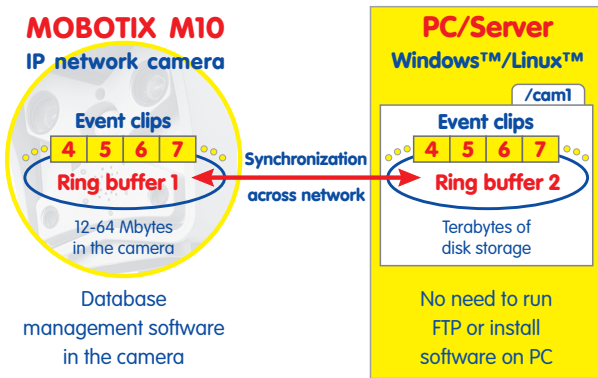- the pre-alarm ring buffer from the PC into the camera itself.

In an age of high-performance microcomputers and the low cost per megabyte of memory, this is not a major cost factor. For the first time, MOBOTIX has implemented this decentralized video management in a MOBOTIX smart network camera.

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Unlimited Long-Term Recordings

Incorporating the computing power needed to detect changes of scene and recording a pre-alarm buffer into the camera has also made it possible for the camera to organize its own long-term storage. In other words, the camera can independently manage disk storage allocated to it on a PC/server on the network. In combination with large server installations and RAID storage based on inexpensive standard IT components, there are almost no limits on storage capacity and reliability.

MOBOTIX M10
IP network camera

Event clips
| 4 | 5 | 6 | 7 |

Ring buffer 1

12-64 Mbytes
in the camera

Database
management software
in the camera

Synchronization
across network

PC/Server
Windows™/Linux™
/cam1

Event clips
| 4 | 5 | 6 | 7 |

Ring buffer 2

Terabytes of
disk storage

No need to run
FTP or install
software on PC

This means that in many applications central software is <u>no</u> longer needed to record or play back material or to scan recorded material for events. Smart network cameras provide the following functions:

- Motion-based detection of events;
- Maintenance of a pre-alarm ring buffer for events;
- Storage of individual events in ring memory in the camera;
- Ring memory expansion on a network PC/server;
- Deletion of old events;
- Event playback and search.

The Future of Video Management Systems

If just recordings are required (as opposed to the kind of round-the-clock live surveillance typical in banking applications, for example), additional video management systems are, in fact, dispensable. If an incident occurs, all you need to view the event is a web browser. However, specialized management systems do have an advantage if the focus is on functions rather than mere storage:

- User and group management;
- Building oversight and management;
- Reporting of intrusions, assaults and fires;
- Advanced functions, such as event searches based on extended criteria;
- Integration of different platforms (analog, digital and intelligent systems).

The load of the central management systems can be reduced substantially if the video motion detection and pre-alarm ring storage capabilities of the new smart network cameras are used properly. It is up to users to determine whether their systems of choice don't just use the smart cameras as an image source but can also support the cameras' advanced function and storage ability to reduce network load.

The Future of DVR Solutions

Alongside PC-based software solutions, there are also classic digital video recorders (DVRs), which, as closed hardware and software systems, only provide vendor-specific video functionality. Because they are closed systems, DVRs can be more secure and more stable than software solutions. However, issues such as memory expansion or choosing the right recording system are more complex than with PC systems. If DVRs are to have any kind of future, they too, need to add support for high-resolution network cameras.
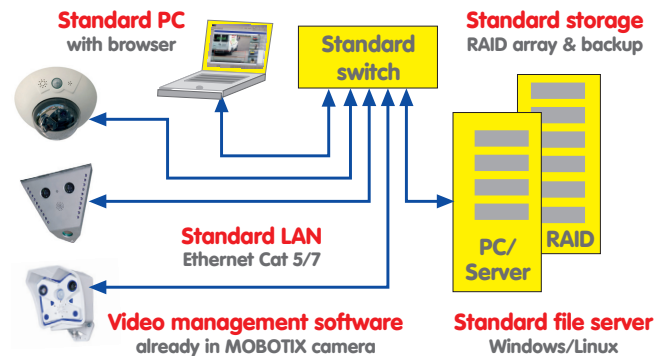
The Advantages of Decentralized Management

Overall, the new approach to video recording with smart network cameras has a number of key advantages:

- No system limitations regarding the number of cameras;
- Video system can be expanded easily if necessary;
- Extremely rapid response, because the intelligence is built into the camera;
- Exceptionally low network load (only generated during storage operations);
- Robust system architecture due to the lack of a central control system;
- Uses standard IT components to transmit and store images.

Rapid Performance Growth

Thanks to the decentralized arrangement and the compression of video data inside the camera down to 1-2 Mbps, around 25 intelligent cameras operating <u>live</u> (25 f/s with audio) can be connected to an ordinary PC (P-IV, 2.8GHz, Windows Server) equipped with a quality hard drive. A similar setup would be difficult to implement using just one DVR. With event-driven recording, as many as 100 cameras can be connected to one PC thanks to the cameras' internal ring buffers. In combination with professional RAID storage systems and servers, the level of performance can be increased still further with little effort.

Standard PC
with browser

Standard switch

Standard storage
RAID array & backup

Standard LAN
Ethernet Cat 5/7

PC/Server

RAID

Video management software
already in MOBOTIX camera

Standard file server
Windows/Linux

Outlook: Recording Without Network Load

In many applications in which the cameras are not at risk of being stolen (at filling stations and in banks, for example), <u>internal recording</u> in the camera is sufficient on its own. In this case, flash memory without moving parts built into the camera (already available in capacities up to 2GB) can be used instead of PC hard drives, which, because of their moving parts, have limited lifetime. In the future, this kind of solid-state flash storage will allow many cameras to operate autonomously, performing their duties without a central PC or DVR and only generating network traffic when live images are viewed or played back.