PC-BASED CLOSED-CIRCUIT TELEVISION SYSTEM

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ABSTRACT

The PC-based closed-circuit television (CCTV) system is a low-cost, highly functional alternative to conventional video system equipment. The system provides routing switching, character generation, video presence detection, and solid-state video recording and replay by using four uniquely designed boards that fit into the backplane slots of an IBM PC-XT-compatible personal computer. Each board controls 16 separate channels, and the boards can be daisy-chained together to build larger, more powerful systems. The system can be configured to handle as many as 240 input signals or up to 48 output channels, and uses a redundant video bus loop. The video bus can be tapped into throughout the loop to provide (1) localized routing switching within several buildings, and (2) video termination at multiple locations, such as security operators' stations. This approach reduces cabling costs and allows additional routing switchers to be added easily with little impact on existing equipment. The system is capable of communicating with several control interfaces, and control software is currently in place for communicating via an RS-232 link and the Intel BitBus network. The hardware drivers are Microsoft C modules that can be linked with a user-developed control program.

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INTRODUCTION

The PC-based closed-circuit television (PC-CCTV) system was designed to provide a flexible, economic alternative to conventional CCTV systems. In the past, security systems that implemented closed-circuit television were forced to use expensive broadcast television equipment. Figure 1 shows a comparison between conventional technology and the PC-based CCTV system.

The basic PC-CCTV system is made up of four printed circuit boards that operate in an IBM PC-XT-compatible personal computer. Each board provides one or more unique system functions: video routing switching, video presence detection, character annotation, fault-tolerant redundancy, and solid-state video storing and replaying. By means of daisy-chaining, multiple boards can be installed in the system to build variable-sized video routing switchers. This modular approach to CCTV systems enables a facility to expand its CCTV capability as future needs dictate.

The video bus, another unique system feature, decentralizes the power of the routing switcher by connecting several smaller, PC-based routing switchers to a fault-tolerant video bus. This approach not only reduces cabling costs, but eliminates the need for very large routing switchers.

The following sections in this paper discuss the design features of the PC-based CCTV system.

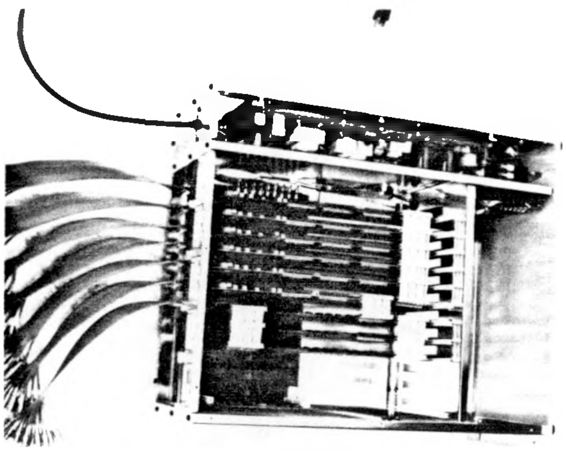

Figure 1: Conventional CCTV System (a) vs PC-CCTV System (b)

Video Routing Switcher

The video routing switcher board is the backbone of the PC-based CCTV system. The board accepts input from 16 local cameras via a coaxial ribbon cable and routes these inputs to a security operator's station. Because each board has a 16x16 crosspoint switch, the system can be expanded to outputs (e.g., 16x16, 32x16, 48x16, 16x32), using blocks of 16. Switching is controlled by software commands through the PC's backplane. For example, an 80x16 switcher could be configured into an IBM PC-XT-compatible machine using five video routing switcher boards and one character generator board. Larger configurations are possible using standard IBM PC expansion chassis.

The video routing switcher board continuously monitors for the presence of good video signal on all inputs, and detects camera failures in less than one second. Because video presence is checked in parallel on the video routing switcher boards, failure reporting time remains constant regardless of switcher size.

The video routing switcher provides three different switching modes that are selectable using on-board DIP switches. The first mode is vertical interval switching, where the signal is switched during the vertical interval of the input camera. The second mode is master sync mode, where the signal is switched according to a system "master sync." The third mode is immediate switching. Outputs from the video routing switcher are jumpered within the chassis to the character generator board.

Character Generator

The character generator board provides two primary functions: (1) character annotation on all output channels, and (2) adjustable output signal amplification. Each board controls 16 output channels. Annotation can easily be embedded into the video signal using C language software commands to control the board. Figure 2 shows an example of the annotation generated by this board.

Figure 2: Character Generator Board Annotation

The on-screen annotation provides 16 different font sizes, and can be enabled to blink. The annotation window, consisting of nine rows and 20 columns, can be placed at any position in the viewing area. By using these variables, the system can be configured to place virtually any size annotation anywhere on the screen.

The outputs from the character generator board are amplified through a high-speed video amplifier. Potentiometers are provided on the board to adjust the amount of amplification independently on each output.

Video Bus Controller

The video bus controller board provides two unique capabilities: (1) fault-tolerant, redundant video communication, and (2) de-centralized video routing switching. The board operates independently on each output channel and has two modes.

In one mode, the controller separates the video signal and transmits it in two directions. The two signals are isolated from each other so that reflections from a failure on one line will not affect the transmission on the other line.

The second mode is a passive signal pass-through configuration. This configuration allows the system to share communication channels among multiple switchers connected together in a closed loop. For example, when routing switcher A is transmitting on a particular channel (i.e., is operating in mode one), routing switchers B, C, D, etc., will configure themselves automatically to passive signal pass-through mode, but will remain unaffected on all other channels. Assigning the channel to a unique output device provides the ability to connect input from any switcher to the channel in a fault tolerant, de-centralized manner. By placing switchers at convenient video collection points around a facility, the cost of individually routing each video input to a single, common point can be reduced.

Solid-State Video Store

The fourth board in the PC-CCTV system, the solid-state video store board, provides frame-grabbing and continuous replay using solid-state memory. Each board can store 32 frames of 256x256, 8-bit, digitized video (16 frames on two channels), and can record or view two events simultaneously. As with the video routing switcher boards, additional solid-state video store boards can be daisy-chained into the system to increase the system's capacity. DIP switches on the board allow the user to select the rate at which the frames are recorded and played back, from real time to two seconds per frame.

Control Interfaces

The four boards in the PC-CCTV system are controlled through a small set of software commands. For each application, a system program is written to define the configuration and to communicate with the hardware. The system hardware drivers are in a Microsoft C language library.

Because the personal computer is an industry standard, there are several control interfaces that can be connected to the PC-CCTV system. For example, a local area network would be one practical interface. Any PC-compatible network board can be installed to create remote control of the PC-CCTV system. A fully functional link to the Intel BitBus network has been designed and implemented.

An RS-232 protocol command set is provided with the system software. This protocol can be modified so that the system emulates an industry standard routing switcher. Manual control is also provided through the PC's keyboard.

<u>Benefits</u>

Although there are many benefits to the PC-CCTV system, the primary benefit is reduced cost. The cost of the system is considerably less than conventional CCTV systems. For example, the cost of a 126x32 routing switcher is about $10K; a comparable conventional system can cost $175K. Smaller PC-CCTV systems can be built for as little as $2K. The CCTV system can also be expanded easily and inexpensively, because the size of the routing switcher can be expanded for only the cost of installing extra boards.

Another benefit is the equipment's compact size. Whereas conventional CCTV systems typically occupy entire rooms, the PC-CCTV system can be packed into a single chassis.

The PC-CCTV system also reduces the amount of software and hardware maintenance required. Software maintenance is reduced because all components (routing switcher, character generator, and solid-state video store) have a similar software interface. Hardware maintenance is simplified because (1) the chassis is an industry standard, and (2) the system components are low-cost and easy to replace.

Conclusion

The PC-based CCTV system is a low-cost alternative to conventional CCTV systems. Besides providing many of the popular features of traditional CCTV systems, the PC-CCTV system also provides fault-tolerant redundancy and distributed routing switching. The system is modular, flexible, and can be easily expanded as needed. It provides a variety of control interfaces that allow the system designer to tailor the system to best suit a specific application.

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