PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:	WO 94/10804
H04N 7/18	A1	(43) International Publication Date:	11 May 1994 (11.05.94)

(21) International Application Number: PCT/US93/10283

(22) International Filing Date: 27 October 1993 (27.10.93)

(30) Priority data:
07/968,058 27 October 1992 (27.10.92) US

(71) Applicant: OAKLEIGH SYSTEMS, INC. [US/US]; 810 East Arques Avenue, Sunnyvale, CA 94086 (US).

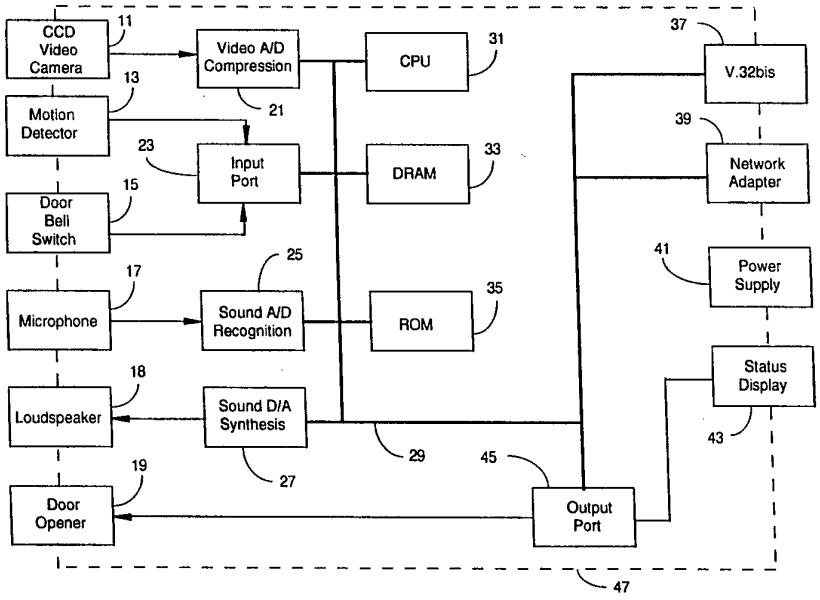
(72) Inventor: DORNIER, Pascal ; 374 North Murphy Avenue, Sunnyvale, CA 94086 (US).

(74) Agent: BOYS, Donald, R.; P.O. Box 187, Aromas, CA 95004 (US).

(81) Designated States: JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: ACCESS CONTROL SECURITY SYSTEM USING DIGITAL COMMUNICATION



(57) Abstract

A modular access control unit (47) for secured premises is provided with sensors (11, 13, 15, 17) and actuators (18, 19) coupled to analog to digital (21, 25) and digital to analog (27) conversion devices, communicating with an internal bus structure (29) connected to a CPU (31) and an electronic memory (33, 35). The unit (47) is self contained and communicates with other units and with manned workstations via either an LAN (39) or phone lines with modems (37). A security system utilizing the access control units may have several units and several workstations, as needed, and may also utilize a file server.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**GB**	United Kingdom	**MR**	Mauritania
AU	Australia	**GE**	Georgia	**MW**	Malawi
BB	Barbados	**GN**	Guinea	**NE**	Niger
BE	Belgium	**GR**	Greece	**NL**	Netherlands
BF	Burkina Faso	**HU**	Hungary	**NO**	Norway
BG	Bulgaria	**IE**	Ireland	**NZ**	New Zealand
BJ	Benin	**IT**	Italy	**PL**	Poland
BR	Brazil	**JP**	Japan	**PT**	Portugal
BY	Belarus	**KE**	Kenya	**RO**	Romania
CA	Canada	**KG**	Kyrgystan	**RU**	Russian Federation
CF	Central African Republic	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CG	Congo			**SE**	Sweden
CH	Switzerland	**KR**	Republic of Korea	**SI**	Slovenia
CI	Côte d'Ivoire	**KZ**	Kazakhstan	**SK**	Slovakia
CM	Cameroon	**LI**	Liechtenstein	**SN**	Senegal
CN	China	**LK**	Sri Lanka	**TD**	Chad
CS	Czechoslovakia	**LU**	Luxembourg	**TG**	Togo
CZ	Czech Republic	**LV**	Latvia	**TJ**	Tajikistan
DE	Germany	**MC**	Monaco	**TT**	Trinidad and Tobago
DK	Denmark	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**US**	United States of America
FI	Finland	**ML**	Mali	**UZ**	Uzbekistan
FR	France	**MN**	Mongolia	**VN**	Viet Nam
GA	Gabon				

"ACCESS CONTROL SECURITY SYSTEM USING DIGITAL COMMUNICATION"

Field of the Invention

The present invention is in the area of multimedia computer technology and in particular the application of digital video, audio and network technologies to remotely controlled security and surveillance systems.

Background of the Invention

Historically, controlling or monitoring access to and egress from a facility was accomplished by posting sentries, guards, receptionists, by whatever title, persons charged with controlling a portal or perimeter. It has always been known to be boring work for which few people are naturally suited. On occasion it has also proven to be hazardous work.

Prior art technology in this field runs the gamut from signal fires and horns to remote solenoid operated door locks, closed circuit video systems, magnetic and optical badge readers and even anatomical feature recognition technology. These technologies have contributed a great deal to reducing manpower requirements and enhancing physical security of sentries. Technology has extended the reach and power of sentry personnel, but it is still a boring and usually low-paid task.

Existing remote security and surveillance technology tends to be quite expensive and its operation usually requires special training and dedicated staffing. Most systems require dedicated runs of video, audio and electrical cables. Revising such a system to add surveillance points or change the monitoring and control capabilities is usually expensive, time consuming and disruptive to operation.

What is needed is a surveillance system that does not require constant attention or special training to

operate and that can be operated by any authorized person inside the facility or at a remote facility. The system needs to be flexible, easily reconfigured and designed to operate over coaxial or twisted-pair information network wiring, or voice-grade telephone lines.

Summary of the Invention

In an embodiment an access control apparatus is provided for deployment at an access portal of a secured premise, comprising an enclosure for supporting and housing other elements, a microprocessor-based CPU means for managing operations of the apparatus, an electronic memory means for storing control routines and data, and a bus communication means connected to the CPU means and the electronic memory means for providing digital communication between elements of the apparatus. There is also detection means connected to the bus means for detecting a person at the access portal, actuation means connected to the bus means for actuating the portal for admission, and serial digital communication means for communicating with a remote manned workstation.

In another embodiment there is also an announcement means for conveying a message entered at the remote workstation to a person at the aces portal. The announcement means can be a loudspeaker coupled to a sound digital to analog conversion device. The serial digital communication means may be either a local area network or a modem connected phone line. The detection means of the invention may comprise one or more of a CCD video camera, a motion detector, a doorbell switch, a microphone, and a pressure pad. The CCD video camera is coupled to a frame digitizer, which may also include a data compression means to facilitate transfer of relatively large packets of graphics data.

In another aspect, the invention comprises a security control system with a computer workstation, an access control unit, and a digital communication means. The access control unit includes an enclosure, a CPU, an internal bus, an electronic memory, detection means, actuation means, and an interface for connection to the digital communication means. In this aspect, there may be several workstations, and also several access portals to secured premises, each with an access control unit. There can also be a file server computer for data a program management.

The present invention provides for the first time a fully digitized modular approach to security systems, allowing a user to mount control units at access portals, and to control them over simple communication links, such as phone lines, from remote workstations. There is no need for complicated and expensive connections between units, and deployment is quickly and easily accomplished.

Brief Description of the Drawings

Figure 1 is a largely schematic diagram of a microcomputer-controlled remote surveillance system according to a preferred embodiment of the present invention.

Figure 2 is a functional block diagram showing how the system of the invention is used as a visitor reception system.

Description of the Preferred Embodiments

General Description

Referring to Fig. 1, a Video Receptionist 47 according to the present invention is useful as an

automatic/remote audio-video surveillance and remote portal control system. Video receptionist 47 is located at a selected surveillance point in an embodiment of the invention, and comprises a motion detection device 13 and a switch 15 to detect a visitor. The motion detection device and switch are interfaced through an input port 23. There is a video camera 11 and a frame digitizer 21 to "see" the visitor, a microphone 17 and an A/D convertor 25 to "hear" the visitor, a D/A convertor 27 and a speaker 18 to respond to the visitor, an output port 45 and a door opener 19 to admit the visitor. There are also included a status display 43 connected to output port 45, a network adapter 39 for local control of the Video Receptionist, a high-speed data modem 37, such as one conforming to CCITT specification V.32bis, for remote operation over telephone lines, and a CPU 31 with DRAM 33 and ROM 35. There is an internal system bus 29 connecting CPU 31 and the peripheral devices. A direct current (DC) power supply 41 provides low-voltage electric energy for the electronic circuits of the Video Receptionist.

Fig. 2 is a functional block diagram for Video receptionist 47 networked to computer file servers such as 49 and workstations 51 and 53, demonstrating remote electronic detection of visitor arrivals and departures and one-way video-phone communication and remote control of facility access portals. A Video Receptionist, which can be configured to greet visitors with a stored voice message, alerts operators at designated networked computer workstations that a visitor has arrived and allows the operator of a computer workstation, equipped according to the invention, to view and converse with visitors and remotely control doors or gates to allow entry for visitors.

In Fig. 2 the network comprises but is not limited to, file server 49, workstations 51 and 53 and a Video

Receptionist 47, connected by network cable 57. Fig. 2 also shows the communication paths between "inside" person 55 at computer workstation 53 that is equipped with Video Receptionist application control routines, digital audio recording and reproduction convertors, and acoustic transducers to greet and interrogate Visitor 59.

Sound picked up by Video Receptionist microphone 17 and digitized by A/D convertor 25 is multiplexed with digitized video images captured by video camera 11 and frame digitizer 21 and transmitted in network data packets by CPU 31 via network adapter 39 and network cabling 57 to workstation 53. For remote operation the data is transmitted via phone modem 37 instead of network adapter 39. Upon receipt at workstation 53 the audio and video data is extracted from network packets and assembled into separate data streams by techniques known in the art. The digital audio data is directed to a D/A convertor and audio transducer device such as loudspeakers or headphones (not shown). A microphone (not shown) is connected to an A/D converter device in the workstation, which digitizes the operator's speech. The digitized sound is packeted and transmitted over network 57 to Video Receptionist network adapter 39 and then to CPU 31, which plays it through A/D convertor 27 and speaker 18.

To admit a visitor 59, the workstation operator 55 issues a program command, via workstation keyboard or pointer device, that causes a digital command message to be transmitted over network 57 to Video Receptionist CPU 31 instructing it to energize door opener device 19.

Video Box

In the preferred embodiment Video Receptionist 47 is a digital network node subsystem, and comprises, as shown in Fig. 1 and listed above, a miniature CCD video camera

11, motion detector 13, microphone 17, speaker 18, door opener solenoid driver 19, status display 43 and the microcomputer system. The microcomputer system is composed of CPU 31, DRAM 33, ROM 35, video capture frame buffer 21, input port 23, audio digitizer 25, audio synthesizer 27, system bus 29, optional phone modem 37, network adapter 39, output port 45 and power supply 41. Input port 23 provides an interface for a motion detector and/or a doorbell switch. In alternative embodiments these inputs might be provided by a variety of devices such as pressure pads, photo-electric "eyes", turnstiles, door switches or detection equipment utilizing thermal, sonic, microwave, magnetic, capacitive or artificial vision technologies.

Video Receptionist CPU 31 under management of control routines, which are typically loaded into DRAM 33 during a unit power-up sequence, monitors and controls the peripheral subsystems of Video Receptionist 47 using address, data and control signals on system bus 29.

CPU 31 "senses" the arrival of a visitor 59 through state changes at input port 23 triggered by motion detector 13 or door bell switch 15. CPU 31 responds to arrival of a visitor by transmitting an "alert" message and a frame of digitized video, captured by video camera 11 and video frame digitizer 21, via system bus 29, network adapter 39 and network 57 to file server 49 and workstation 53. Optionally, other workstations such as workstation 51 may also receive the Video Receptionist's transmission. An optional data compression device in video frame digitizer 21 can reduce the quantity of data transmitted, facilitating operation over lower-bandwidth or high-traffic networks.

Network driver software for network adapter 39 allows communication over a LAN 57 with routines for a variety of network protocols such as IPX and NetBIOS.

Phone modem software allows remote connection over a V.32bis or faster data modem 37. CPU 31 controls the state of output port 45 via system bus 29 to control status display 43 and electronic door opener control device 19.

Microphone 17 converts sounds into analog electrical signals sent to audio digitizer 25, which samples the signal at an ultrasonic frequency (typically 44.1 kilohertz) and converts the sampled amplitude to a digital value. CPU 31 transmits these digital audio values to a remote workstation such as 53 when the workstation requests it.

CPU 31 sends digital audio streams received from a workstation such as 53 to sound synthesizer 27, which contains a D/A conversion device (not shown). The amplified analog output drives a loudspeaker 18, which is audible to visitor 59.

Network

In the preferred embodiment network 57 is a 10 megabit/second Ethernet protocol and wiring connecting the Video Receptionist 47, file server 49, and workstation computers 51 and 53. Alternative embodiments might use other network technologies and topologies such as Token Ring, ARCNET, FDDI, RS-485 or other.

Video Receptionist units 47 physically connect to a LAN in the same manner as other computer equipment. The Video Receptionist operates as a non-routing node and may be compatible with many current art network protocols such as Novell's IPX and Microsoft's NetBIOS.

A high-speed data modem 37, in the preferred embodiment a V.32bis and V.42bis compatible modem, such as a Twincom 14.4DF, and modem data-link protocol, allows telephone line connection of Video Receptionist 47 to

workstations at remote sites equipped with similar modems.

Workstation

In the preferred embodiment workstations, such as 51 and 53, are personal computers based on a microprocessor CPU compatible with the Intel 80386 microprocessor instruction set and running an Operating System capable of what is known in the art as multitasking, such as Microsoft's MS-Windows, International Business Machines' (IBM) OS/2 or American Telephone and Telegraph's (AT&T) UNIX. Workstation peripheral devices include a video graphics display capability, audio subsystems capable of playing digitized audio and digitizing audio frequency input signals, and network interface adapter(s) or data modem(s). Loudspeakers, or headphones, and a microphone serve as audio output and input transducers for the workstation digitized audio subsystem. The workstation network software supports what is known in the art as task-to-task communication.

Workstation application control routines for Video Receptionist use these subsystems to establish data communication links to Video Receptionist units, receive visitor arrival alerts from such units, display digitized video frames received from such units, play digitized audio received from such a unit, send digitized audio such as from a microphone to such a unit, and control such units.

A person 55 at a computer workstation 53 that receives an arrival alert from Video Receptionist 47 via network 57 acknowledges the alert using the workstation keyboard or pointing device, such as a mouse, (not shown) to invoke the appropriate function. Video images transmitted in digitized form by Video Receptionist 47 are reconverted to video by the workstation video graphics

subsystem (not shown) and displayed for the computer operator on the workstation video screen. Such display may be either full-screen or confined to a window on the screen as determined by operator-controlled software functions. A single workstation can monitor multiple Video Receptionists 47. For surveillance purposes, video from multiple Video Receptionists can be displayed simultaneously on the video screen (not shown) of a workstation 53 with automatic highlighting or enlargement of a video window when its associated Video Receptionist detects presence of a visitor.

Other operator-controlled functions allow operator 55 to control additional functions such as routing audio transmitted in digitized form from Video Receptionist 47 to the workstation audio subsystem (not shown) which converts it to amplified analog signals driving a loudspeaker or headphones, allowing person 55 to hear visitor 59. Person 55 may also use software controls to speak to visitor 59 via a microphone, workstation 53 audio digitizer, workstation 53 CPU, workstation 53 network adapter, network 57, Video Receptionist 47 network adapter 39, system bus 29, Video Receptionist CPU 31, sound synthesizer 27 and loudspeaker 18. Another operator-controlled function causes workstation 53 CPU to transmit commands via workstation 53 network adapter over network 57 to Video Receptionist 47 CPU 31, via network adapter 39 and system bus 29, instructing CPU 31 to change the state of output port 45 such that it will cause door opener 19 to be energized and unlock an entry door.

File Server

Many computer networks include one or more file server computers, which typically function as remote data storage controllers transmitting executable code and data

to other network systems upon demand and storing data received from them. File servers also function as master controllers of network facilities in some network systems. In some networks a computer designated as a file server may also function as a workstation.

In the preferred embodiment a file server 49 connected to network 57 monitors network transmissions of Video Receptionists 47. File server 49 provides mass storage of all program and data files required for the operation of Video Receptionist CPU 31. An audit trail of Video Receptionist usage can also be stored by file server 49.

Application of electrical power to Video Receptionist 47 by power supply 41 initiates self-test routines stored in ROM 35. Upon successful completion of self-test a network packet is broadcast by network adapter 39 addressed to all network nodes, which contains a request for what is known in the art as a bootstrap load of system software. File server 49 has system control routines (not shown) for Video Receptionist 47 stored on its mass storage device (not shown). When a network bootstrap request from Video Receptionist 47 is decoded, file server 49 retrieves these system routines and transmits it enveloped in network packets to Video Receptionist network adapter 39, which strips off some of the network packet information and sends the system routines over system bus 29 to be stored in DRAM 33. When loading of Video Receptionist system routines is complete CPU 31 begins executing them making Video Receptionist 47 operational.

Detection of a visitor's arrival 59 causes an alert to be transmitted by Video Receptionist, as detailed under Video Box and Workstation sections. File server 49 decodes the alert message and stores a date-and-time stamped entry in an audit trail log file on its mass

storage device. File server 49 can also capture a video image frame from Video Receptionist 47 and store it in the audit trail file(s). An audit trail entry can also be made by file server 49 when Video Receptionist 47 detects a departure from the surveillance area.

Optional voice recognition devices, incorporated in Video Receptionist audio digitizer 25, and voice recognition routines (not shown) for Video Receptionist 47 allow visitors such as 59 to leave voice messages for unavailable personnel. Video Receptionist CPU 31 transmits the digitized voice of visitor 59 via system bus 29, network adapter 39 and network 57 to file server 49. File server 49 stores the digitized voice message of visitor 59 in what is known in the art as a voice mail mailbox, assigned to the intended recipient, on its mass storage device(s). The recipient can retrieve the recorded message from file server 49 using a workstation such as 53 or in some systems from a telephone.

It will be apparent to one with skill in the art that there are many changes that might be made without departing from the spirit and scope of the invention. Some of these alternatives have already been described, such as arrival detection inputs might be provided by a variety of devices such as pressure pads, photo-electric "eyes", turnstiles, door switches or detection equipment utilizing thermal, sonic, microwave, magnetic, capacitive or artificial vision technologies. Other examples are the use of different video cameras, different LANs, different computer workstation technologies, and different Video Receptionist microcomputer technologies.

What is claimed is:

1. An access control apparatus for deployment at an access portal of a secured premise, comprising:

enclosure means for supporting and housing functional elements of said apparatus;

microprocessor-based CPU means for managing operations of said apparatus;

electronic memory means for storing control routines for use by said CPU means and for storing data;

bus communication means connected to said CPU means and to said electronic memory means for providing digital communication between elements of said access control apparatus;

detection means connected to said bus communication means for detecting a person at said access portal;

actuation means connected to said bus communication means and responsive to communication from said CPU means for actuating said portal for admission; and

serial digital communication means for communicating with a remote manned workstation.

2. An access control apparatus as in claim 1 further comprising announcing means connected to said bus communication means for providing information entered at said remote manned workstation to said person at said access portal.

3. An access control apparatus as in claim 2 wherein said announcing means comprises a loudspeaker coupled to a sound digital to analog synthesis device.

4. An access control apparatus as in claim 1 wherein said serial digital communication means comprises a local area network port for communicating with said remote manned

workstation over a local area network (LAN).

5. An access control apparatus as in claim 1 wherein said serial digital communication means comprises a modem with an interface for a telephone cable for communication with said remote manned workstation.

6. An access control apparatus as in claim 1 wherein said

detection means comprises one or more of a CCD video camera coupled to a video frame digitizer, a motion detector coupled with a digitizing input port, a doorbell switch coupled to the digitizing input port, a microphone coupled to a sound analog to digital converter, and a pressure pad coupled to the digitizing input port.

7. An access control apparatus as in claim 1 wherein said actuation means comprises a solenoid-operated door opener coupled to an output port, the output port for receiving a digital signal and providing in response suitable power to actuate said door opener.

8. An access control apparatus as in claim 1 wherein said detection means comprises a CCD video camera coupled to a video frame digitizer having a data compression device for limiting data capacity requirements for said digital communication means.

9. A security control system for a secured premise having at least one access portal, said system comprising:

a computer workstation for monitoring operation of said system and entering instructions and data;

an access control unit deployed at said at least one access portal; and

digital communication means connected to said

computer workstation and to said at least one access control unit for carrying said instructions and data from said computer workstation to said access control unit, and for carrying information from said access control unit to said computer workstation;

said access control unit comprising:

enclosure means for supporting and housing functional elements of said access control unit;

microprocessor-based CPU means for managing operations of said access control unit;

electronic memory means for storing control routines for use by said CPU means and for storing data;

bus communication means connected to said CPU means and to said electronic memory means for providing digital communication between elements of said access control apparatus;

detection means connected to said bus communication means for detecting a person at said access portal;

actuation means connected to said bus communication means and responsive to communication from said CPU means for actuating said portal for admission; and

digital interface means for interfacing with said digital communication means.

10. A security control system as in claim 9 wherein said access control unit further comprises announcing means connected to said bus communication means for providing information entered at said computer workstation to said person at said access portal.

11. A security control system as in claim 10 wherein said announcing means comprises a loudspeaker coupled to a

sound digital to analog synthesis device.

12. A security control system as in claim 9 wherein said digital communication means comprises a local area network for communicating between said computer workstation and said access control unit.

13. A security control system as in claim 9 wherein said digital communication means comprises a modem at each of said access control unit and said computer workstation, and a telephone cable connected between the modems for carrying signals.

14. A security control system as in claim 9 wherein said detection means comprises one or more of a CCD video camera coupled to a video frame digitizer, a motion detector coupled with a digitizing input port, a doorbell switch coupled to the digitizing input port, a microphone coupled to a sound analog to digital converter, and a pressure pad coupled to the digitizing input port.

15. A security control system as in claim 9 wherein said actuation means comprises a solenoid-operated door opener coupled to an output port, the output port for receiving a digital signal and providing in response suitable power to actuate said door opener.

16. A security control system as in claim 9 wherein said detection means comprises a CCD video camera coupled to a video frame digitizer having a data compression device for limiting data capacity requirements for said digital communication means.

17. A security control system as in claim 9 further comprising a file server computer for storing and managing

data and control routines.

18. A security control system as in claim 17 wherein said file server computer stores a security audit trail of events and usage of said security control system.

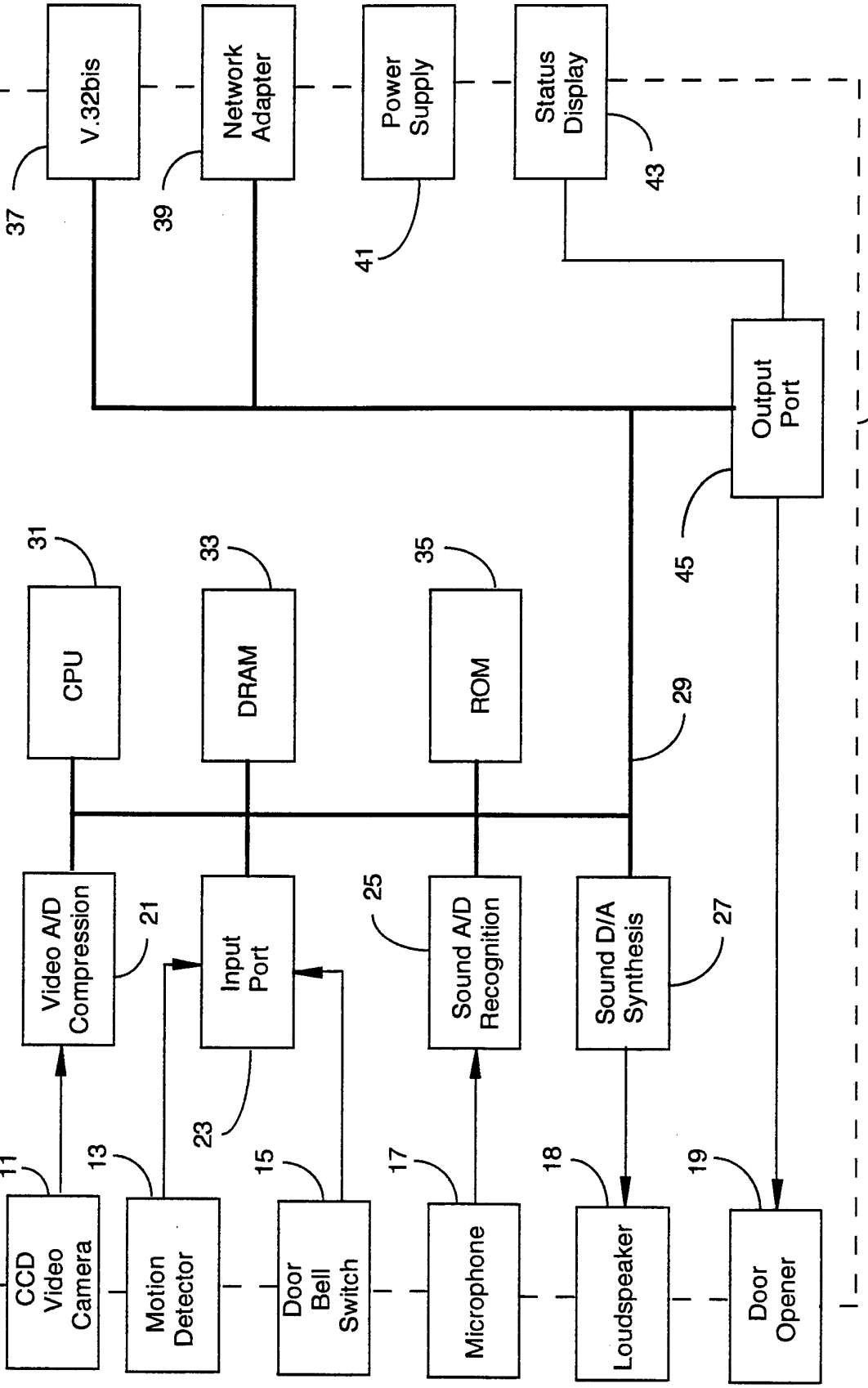

V.32bis
Network Adapter
Power Supply
Status Display
37
39
41
43
Output Port
47
45
CPU
DRAM
ROM
31
33
35
29
Video A/D Compression
21
Input Port
23
Sound A/D Recognition
25
Sound D/A Synthesis
27
CCD Video Camera
11
Motion Detector
13
Door Bell Switch
15
Microphone
17
Loudspeaker
18
Door Opener
19

Fig. 1

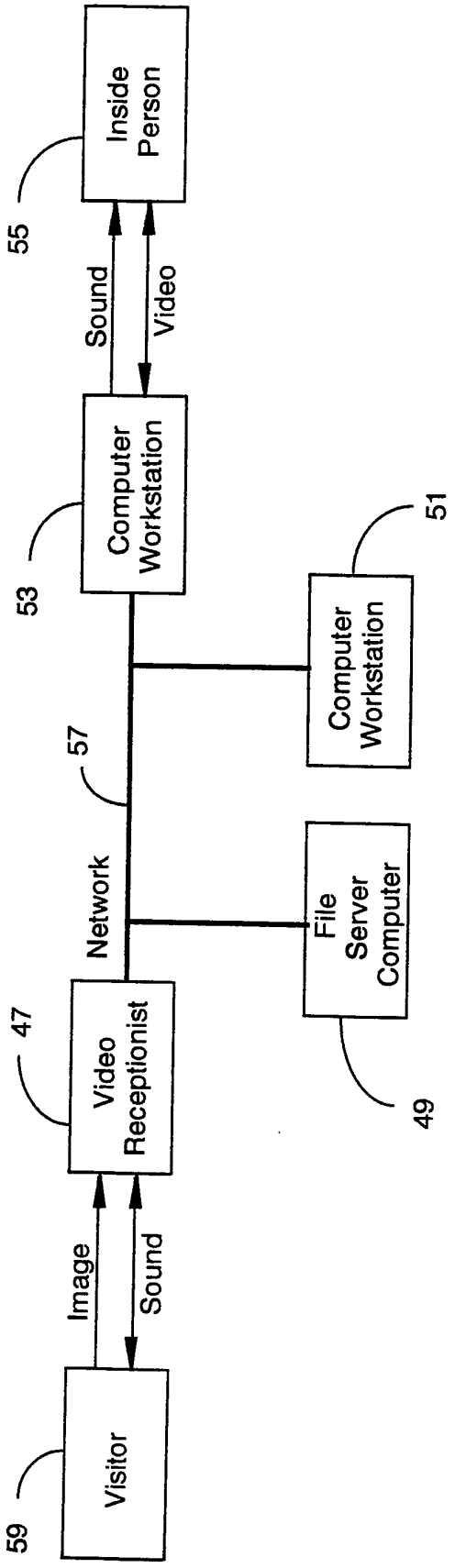

Inside Person
55
Sound
Video
Computer Workstation
53
51
Computer Workstation
57
Network
File Server Computer
49
47
Video Receptionist
Image
Sound
Visitor
59

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/10283

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :HO4N 7/18
US CL :358/108; 340/825.31
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 358/108; 340/825.31

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US, A, 5,202,759 (LAYCOCK) 13 ARPIL 1993, col. 1, lines 38-46; col. 2, lines 10-28, 34-49, and 62-64; col. 3, lines 22-26, 33-42, and 53-60; col. 2, line 65 to col. 3, line 13.	1-18
Y	US, A, 4,581,634 (WILLIAMS) 08 APRIL 1986, col. 2, line 41 to col.3, line 5.	1-18
Y	US, A, 4,721,954 (MAUCH) 26 JANUARY 1988, Abstract.	4 and 12
A	US, A, 4,780,821 (CROSSLEY) 25 OCTOBER 1988.	17-18
A	US, A, 4,993,068 (PIOSENKA ET AL) 12 FEBRUARY 1991.	1-18
A	US, A, 4,821,118 (LAFRENIERE) 11 APRIL 1989.	1-18

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 30 November 1993	Date of mailing of the international search report 18 FEB 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer TOMMY P CHIN Telephone No. (703) 305-4700

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/10283

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5,144,661 (SHAMOSH ET AL) 01 SEPTEMBER 1992.	5 and 13
A	US, A, 4,876,597 (ROY ET AL) 24 OCTOBER 1989.	5 and 13
A	US, A, 4,218,690 (ULCH ET AL) 19 AUGUST 1980.	1-18
A	JP, A, 60-20693 (TOKUI) 01 FEBRUARY 1985.	7 and 15
A	EP, A, 0 188 286 (ITO) 23 JULY 1986.	5 and 13
A	PROJECT ASSISTANCE, "Electron. & Appl. Ind. (France)" No.271, 15 JUNE 1979, p. 1-7.	5 and 13