The present invention discloses a security system for monitoring one or more security zones at a security site. The security system captures optical images in the security zones and transmits the images to a monitoring station for display to a human operator for analysis. In one aspect, the security system includes a plurality of imagers (52), a collector (14), and a monitoring station (40). Each imager (52) is positioned so as to sense an optical image in one or more of the security zones. Each imager (52) stores an image and provides electrical signals representing the image. The collector (14) is positioned at the security site. The collector (14) receives the electrical signals from each of the imagers (52) and transfers the electrical signals to the monitoring station (40).
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IMPROVED SITE SECURITY SYSTEM

FIELD OF THE INVENTION

This invention generally relates to the field of site security systems and, more particularly, to systems for capturing optical images in connection with a security alert triggering event at a given security site and transmitting the images to a remotely located monitoring station for review.

BACKGROUND OF THE INVENTION

A variety of security systems are currently in use that monitor property and notify appropriate authorities in response to an alarm event such as an intruder or fire. Security systems generally divide a security site, such as buildings or land, into security zones which are monitored by alarm sensors (e.g., motion detectors, contact switches, vibration detectors, and temperature sensors). The alarm sensors are positioned relative to the security zones so that an event, such as the entry of an intruder or the start of a fire, will trigger a sensor to output an alarm signal to activate the security system.

Many existing security systems are prone to false alarms due to an inability to identify the actual cause of an alarm signal. For example, an alarm signal generated by falling boxes in a warehouse. The number of false alarms from security systems has escalated to the point where they have become a major concern for law enforcement agencies, fire departments, and in turn the security industry. Law
enforcement agencies have reported that about 95% of the intrusion alarms they respond to are false alarms. Presently, some law enforcement agencies and fire departments impose penalties in the form of fines and/or discontinued response services for businesses that have security systems that generate false alarms.

To reduce the number of false alarms, security systems have evolved that employ a human to review images at several different security sites to identify the cause of an alarm signal before any authorities are notified. Some known security system include a plurality of cameras and a multiplex switch device at each security site. The cameras are positioned so as to view one or more security zones in a security site. The multiplex switch is located within the security site and has point-to-point connections to each camera. In response to an alarm signal, the multiplex switch activates a single camera associated with the triggered alarm sensor to sense and begin transmitting analog video signals of an observed image in a security zone. The multiplex switch device digitizes and stores the analog video signals and then relays the stored signals to the central station for analysis by the operator.

This type of security system is limited to sequentially collecting images from one camera at a time. As can be appreciated, if alarm signals occur closely spaced in time in two or more security zones then images are captured close to the time of the alarm event for only one of the triggered security zones and thereafter are
captured increasingly later in time for the remaining triggered security zones. As can be appreciated, the ability of an operator to determine the cause of an alarm signal substantially decreases as the delay in capturing images associated with the security zone increases. The image presented to the operator can be difficult to analyze due to degradation of the analog video signals (e.g., errors due to noise induced in the signals or dissipation of the signals) during transmission from a camera to the multiplex switch. Still further limitations are associated with the limited expandability of the security system due to the difficulty and cost of installing such point-to-point wire connections between each camera and the multiplex switch and the rapid increase in complexity of the multiplex switch as the number of cameras increases.

Although there have been significant advances in optical imaging systems for security systems, significant limitations with existing systems have yet to be addressed.

SUMMARY OF THE INVENTION

Accordingly, objectives of the present invention include the following:

To provide a security system that simultaneous captures images in a plurality of security zones responsive to simultaneous alarm signals.

To provide a security system that captures images prior to an alarm event.
To provide a security system that captures images periodically over time, responsive to an alarm signal, and/or responsive to an operator.

To provide a security system that minimizes image degradation during transmission to an operator.

To provide a security system that minimizes installation costs.

To provide a security system with improved expandability.

One or more of the above objectives are addressed by a security system that generally includes a plurality of alarm sensors (e.g., motion detectors, vibration sensors, and contact switches), a plurality of image capture and processing units (IPUs), a collector for collecting images from the IPUs, and a bus providing communication between the IPUs and the collector.

The IPUs and alarm sensors are arranged into security zones at a security site. Generally, security zones include defined spaces (e.g., rooms in buildings) and/or open spaces (e.g., land surrounding buildings). Each IPU converts optical images at one or more of the security zones into electrical image signals, performs processing functions on the image signals, and transmits the image signals to the collector. The collector is positioned within the security site and selectively receives image signals from each IPU and relays the image signals to the monitoring station for viewing by a human operator and/or recording. The collector can comprise a personal computer
configured as a card in a chassis or as a desktop unit. The monitoring station receives image signals from one or more collectors at one or more security sites. Generally, one or more of the IPUs, the collector, or the monitoring station are responsive to alarm signals generated by the alarm sensors.

In one aspect of the present invention, each IPU captures an image in one or more of the security zones and stores the image signals. At a predetermined frequency, subsequent images are sensed and locally stored as sequential frames of image signals. The collector sequentially receives image signals from each IPU and relays the image signals to the monitoring station. As can be appreciated, locally storing the images within each IPU enables multiple simultaneous alarm signals occurring in different security zones to be simultaneously sensed and stored by corresponding IPUs for sequential transmission to the collector and subsequent viewing at the monitoring station.

In another aspect of the present invention, the bus includes a first bus and a second bus. The IPUs and the collector are connected as nodes on the first bus. The first bus provides communication across shared communication lines. Generally, sharing of the first bus is provided through time multiplexed communication between the IPUs and the collector.

As can be appreciated by one skilled in the art, time multiplexed communication can be provided by a conventional
time multiplexed bus. The second bus provides communication between the collector and the monitoring station. The second bus can comprise a modem connectable to a phone line. Alternately, the second bus can comprise an RF communication transmitter for providing wireless communication between the collector and the monitoring station. As can be appreciated, the second bus can comprise a shared network (e.g. local area network) for providing communication between a plurality of collectors and the monitoring station.

As can be appreciated, the shared first bus simplifies expansion and installation of the security system. The security system can be expanded by connecting additional IPUs or collectors as nodes on the first bus. Relatedly, installation is simplified with the shared communication lines between the nodes, thereby eliminating the point-to-point communication lines as previously described in some known security systems.

In another aspect of the present invention, each IPU includes an imager and a processing unit. The imager converts an optical image into an analog video signal which is provided to the processing unit. The processing unit digitizes the analog video signal into an array of digital image data and locally stores the image data. The processing unit transmits the array of digital image data across the bus to the collector. The bus generally includes logical functions for error detection and correction of transmitted data. Such error detection and correction
enables data transmission over large distances between the
IPUs and the collector without image degradation.

In another aspect of the present invention, each IPU
digitizes and compresses the electrical pixel signals for
an image before they are transmitted to the collector. The
collector relays the compressed signals across the bus to
the monitoring station where they are subsequently de-
compressed for display to an operator. In this manner, the
amount of electrical pixel signals for an image(s) is
decreased and the corresponding time to transmit the
image(s) is thereby decreased.

In another aspect of the present invention, each IPU
digitizes and compresses the image data, as in the above-
noted aspect, and further includes compression
identification information with the transmitted image data.
The monitoring station decompresses the image data
responsive to the compression identification information.
In one embodiment, the monitoring station includes a
plurality of decompression algorithms with one of the
decompression algorithms being selected for use in
decompressing the image data by the associated compression
identification information. In another embodiment, the
compression identification information includes information
that is used by the decompression algorithm to decompress
the corresponding image data. For example, for systems
having variable image resolutions, the compression
identification information can include a compression table
that is generated by an IPU for image data having a
selected image resolution. The compression table is transmitted along with the associated image data to the monitoring station for use in a decompression algorithm during decompression of the image data.

In another aspect of the present invention, each IPU provides a variable image resolution that is selectable for transmission to the collector. Selectable image resolution is provided by an IPU selecting for transmission a subset of the locally stored image data for each image frame. Transmission of the highest image resolution corresponds to transmission of all image data while lower resolution images correspond to transmission of less than all of the image data (e.g., every second pixel).

As can be appreciated, for a predetermined data transmission rate for the data bus, the selectable image resolution provides a selectable number of image frames that can be transmitted in a predetermined time period. A relatively high resolution image can be selected to provide an operator with an improved image for analysis of an observed area or for identification of an intruder. A relatively low resolution image can be selected to provide an operator with a higher rate of image frames which can be advantageous for analysis of moving objects.

In another aspect of the present invention, each IPU stores and transmits images according to operational modes which include a continuous image collection mode, a triggered image collection mode, and an operator call-back mode.
In a continuous collection mode, each IPU periodically senses images and locally stores the images for its security zone. In response to an alarm signal in a security zone, the collector requests an IPU associated with the security zone to transmit stored images and images sensed after the alarm event. As can be appreciated, an operator can thereby observe images of a security zone before and after the alarm event to determine the cause of the alarm event.

In a triggered image collection mode, each IPU senses a sequence of images in response to an alarm signal, stores the images at its remote site, and subsequently transmits the images to the collector.

In an operator call-back mode, an operator communicates through the monitoring station with the collector to command the collector to capture and transmit images from one or more of the IPUs. In this manner, an operator can simultaneously capture images at one or more of the security zones and then sequentially receive the images for analysis.

In another aspect of the present invention, each IPU includes a housing, a light, and a mounting bracket. The light illuminates at least part of a security zone to assist in sensing the image. The housing encloses and supports the components of the IPU and the light. The housing and bracket simplify installation of the IPUs by enabling integration of the wiring between the components of an IPU and simplifying mounting of an IPU in a security
zone such as in a corner of a room. In several embodiments, the housing further includes one or more focusing windows to distribute the illumination by the light across the field-of-view of the IPU and/or to adjust the field-of-view of an alarm sensor (e.g., IR motion sensor) integrated into the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and further advantages thereof, reference is now made to the following Detailed Description, taken in conjunction with the Drawings, in which:

FIG. 1 is an explanatory diagram illustrating a security system for capturing optical images in security zones inside and outside of a building and transmitting the images to a remotely located monitoring station;

FIG. 2 is a block diagram illustrating the components of an image processing unit (IPU), a first bus connecting the IPUs and the collector, and a modem and phone line connecting the collector to the monitoring station; and

FIG. 3 illustrates a housing enclosing an IPU, an IR motion detector, and a light, the housing being connectable to a wall with a pair of brackets.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a security system constructed in accordance with the present invention is shown. The security system monitors a security site consisting of a
building 20 and the land surrounding the building and transmits images from a plurality of security zones within the site to a human operator who is remotely located from the security site. The human operator generally monitors several remote security sites.

The illustrated security system includes an optical imaging system 10, three perimeter protection systems 30 positioned outside of the building 20, and a remotely located monitoring station 40. The monitoring station 40 includes a personal computer 41, a video monitor 42, and a modem 43. The optical imaging system 10 senses optical images and transmits image data representing the sensed images to the monitoring station 40 for viewing by a human operator.

The optical imaging system 10 includes a plurality of camera units 12, a collector 14, a bus 16 that provides communication between the camera units 12 and the collector 14, and a modem 18 (e.g., Hayes compatible modem and/or TVX modem from TVX Incorporated) that provides dial-up communication across a phone line 22 to the monitoring station 40. Each camera unit 12 includes an image processing unit (IPU) 50, a motion detection sensor 48, a light 46, and a housing 51 that encloses and supports these internal components.

The camera units 12 are positioned relative to security zones inside and outside the building 20 such as in rooms within the building 20 and areas of land adjacent to sides of the building 20. The collector 14 is positioned
within the building 20 and selectively receives image data from each camera unit 12 and transmits the image data through the modem 18 to the monitoring station 40 where the image data is displayed to a human operator for analysis. Implementations of the collector 14 include a personal computer configured as a card in a chassis or as a desktop platform.

The IPU 50 in each camera unit 12 converts incident electromagnetic energy from an optical image into an array of image data that is stored locally within each IPU 50. The IPU 50 and collector 14 can collect and transmit images in a continuous image collection mode, a triggered image collection mode, and an operator call-back mode.

Generally, in the continuous image collection mode and the triggered image collection mode the optical imaging system 10 is responsive to an alarm signal. Alarm signals are generated by alarm sensors which include the motion detector sensor 48 in each camera unit 12 and the perimeter protection systems 30. The motion detection sensors sense motion within their field-of-view and output an alarm signal to the associated image processing unit. The perimeter protection system 30 can include the IPS-1000 system manufactured by HESA S.p.A. and marketed by TVX Incorporated. The IPS-1000 is a passive outdoor perimeter alarm system that senses vibrations transmitted through the ground or the building 20 and correlates the pattern of the vibrations to reference patterns that are associated with valid triggering events (e.g., vibrations created by an
intruder's movement). In response to a valid triggering event, the IPS-1000 outputs an alarm signal to an IPU that is connected to the perimeter protection system.

In a continuous collection mode, each IPU 50 periodically senses images and locally stores the arrays of image data in a circular buffer. In response to an alarm signal, the IPU 50 saves the stored image data, captures one or more images during or after the event, and sets a status flag for the alarm signal. In this manner, after an alarm signal occurs, image data already stored in the IPU 50 can be transmitted to the collector followed by the image(s) sensed during or after the alarm event. The collector 14, which periodically polls the status of each IPU, responds to the status flag by requesting transmission of the image data from the IPU 50. As can be appreciated, an operator can thereby observe images that occurred before, during, and after the alarm event and determine the cause of the alarm signal.

In a triggered image collection mode, an IPU 50 is activated by an alarm signal to sense a sequence of images, to store the image data for each image at its remote site, and to set the event status flag. The image data is subsequently transmitted to the collector 14 where it is relayed to the monitoring station 40.

In an operator call-back mode, an operator communicates through the monitoring station 40 with the collector 14 to command the collector 14 to capture and transmit images from one or more of the IPUs. In this
manner, an operator can simultaneously capture images at one or more of the security zones and then sequentially receive the images for analysis. This mode further enables an operator to visually monitor the present status of one or more security zones so as to further analyze an alarm event within a security site.

Referring now to FIG. 2, a more detailed block diagram illustrates the components of the IPU 50, the bus 16 connecting the IPUs and the collector 14, and the modems 18 and 43 interconnecting the optical imaging system 10 with personal computer.

The IPU 50 includes an imager 52, an analog/digital converter 54, a memory 56, and a processor 58. At a predetermined frequency, the imager 52 converts incident electromagnetic energy from an optical image into an image frame of analog video signals which are provided to the analog/digital converter 54. The imager 52 can generally include any source of analog video, such as a CMOS image detection integrated circuit from TVX Incorporated which outputs an analog video signal representing a 320 by 240 pixel resolution image at a selectable frame rate of generally 50 Hz or 60 Hz. This CMOS image detection integrated circuit further provides a capability to slow the frame rate of the analog video signals down (currently to as low as about 1/8th of the 50 Hz or 60 Hz rate). The slower frame rates are advantageous for capturing images in lower light conditions. The analog/digital converter 54 digitizes the analog video signals into an array of digital
image data that is stored locally in the memory 56 according to one of the three previously described operational modes (i.e., continuous, triggered, or operator call-back). The memory 56 can provide a circular buffer so that image frames can be continuously stored with the oldest stored image frames being overwritten by the newest image frames.

The processor 58 provides a variable image resolution that is selectable by commands from the collector 14. Additionally, an operator at the monitoring station 40 can call the collector 14 and select an image resolution. The processor 58 selects and transmits a subset of the array of image data for each image frame to provide the selected image resolution. For example, the processor 58 transmits a high, medium, or low resolution image by selecting 320 by 240, 156 by 100, or 80 by 48 of the array of image data respectively.

The processor 58 compresses the image data before it is transmitted to the collector 14. The compressed image data is subsequently decompressed in the personal computer 41. One or more data compression/decompression algorithms can be included in the processor 58 and the personal computer 41. The compression algorithm used by the processor 58 is selectable by a command from the collector 14. The processor 58 transmits compression identification information with the compressed image data that selects the decompression algorithm used by the personal computer 41 to decompress the image data.
The compression/decompression algorithm can include a differential pulse-code modulation (DPCM) standard algorithm. For DPCM compression the processor 58 transmits substantially all of the image data in the first frame and thereafter transmits only the image data that changes in subsequent frames. Alternatively, the compression/decompression algorithm can be a discrete cosine transformation (DCT) compression algorithm with run length encoding (RLE) data reduction or a Huffman algorithm such as used in the Joint Photographic Experts Group (JPEG) standard. However, according to the present invention, the data compression/decompression algorithms are adapted to support the variable image resolutions as provided by the IPU 50. In one such adaptation the processor 58 transmits compression identification information that includes information developed by the compression algorithm for image data having a selected image resolution. The compression identification information is used by the decompression algorithm in the personal computer 41 to decompress the transmitted image data.

With continuing reference to FIG. 2, the IPUs 50 and the collector 14 are connected as nodes on the shared bus 16. The bus provides time multiplexed digital communication between the IPUs 50 and the collector 14. In one embodiment, each IPU 50 and the collector 14 have RS-485 standard communication ports which are connected to two pairs of wires according to the RS-485 standard. One of the pairs of wires provides communication while the other
pair of wires provides an auxiliary +12 Vdc and ground for powering components. The RS-485 bus 16 provides communication over a distance of 1000 meters (3,280 feet) and has an address range that allows up to 253 nodes to be connected. The collector 14 operates as bus master while the IPUs 50 operate as slaves according to the RS-485 standard interface. The bus 16 provides logical functions for error detection and error correction. As can be appreciated, such error detection and error correction enables data transmission over large distances without image degradation.

With reference now to FIG. 3, A cut-away view of a camera unit 12 is illustrated. The housing 51 provides support to the light 46, the motion detection sensor 48, and the IPU 50. The housing 51 is connectable to a wall with a pair of brackets 56 and 58 that provide a notch 60 and grove 62 connection. The bracket 56 is attachable to the housing 51 with standard attachment means such as screws or double-sided tape.

The housing 51 provides integrated wiring 64 between the light 46, the motion detection sensor 48, and the IPU 50. The integrated wiring 64 includes a common pair of power wires. Additionally, the integrated wiring 64 provides a communication path for the IPU 50 to activate the light 46. The light 46 is activated when the IPU 50 senses ambient light below a predetermined threshold level. The light 46 can emit IR wavelength light to illuminate an observation area for the IPU 50 without the emitted light
being observable to an unaided human eye. The light 46 can comprise a light bulb 45 and a reflector 47 positioned adjacent the light bulb for focusing the light across the field-of-view of the IPU 50.

The housing 51 includes light transmission windows 53, 54, and 55 that are positioned in front of the internal components 46, 48, and 50 respectively. As can be appreciated, one or more of the light transmission windows 53, 54, and 55 can provide a focusing effect for the internal components 46, 48, and 50 respectively. For example, the window 55 can provide a focusing effect that establishes the field-of-view of the IPU 50. Similarly, the window 53 can provide a focusing effect to distribute the emitted light from the light 46 across the field-of-view of the IPU 50. Similarly, the window 54 can provide a focusing effect to provide the motion detection sensor 48 with a field-of-view similar to the IPU 50. As can also be appreciated, the internal components 46, 48, and 50 and associated light transmission windows 53, 54, and 55 can be arranged in a different order in the housing 51 than as shown in FIG. 3.

While various embodiments of the present invention have been described in detail, it is apparent that further modifications and adaptations of the invention will occur to those skilled in the art. However, it is to be expressly understood that such modifications and adaptations are within the spirit and scope of the present invention.
What is claimed is:

1. A security system for monitoring one or more security zones at a security site, comprising:

   a plurality of imaging means, positioned relative to said one or more security zones, for sensing an image in said one or more security zones, for storing said image, and for providing electrical pixel signals representing said image;

   collector means, positioned at said security site, for receiving said electrical pixel signals from each of said plurality of imaging means and for transferring said electrical pixel signals to a monitoring station; and

   transmission means for providing communication between said plurality of imaging means, said collector means, and said monitoring station.

2. The security system of Claim 1, wherein:

   each of said plurality of imaging means includes a CMOS image detection integrated circuit.

3. The security system of Claim 1, wherein:

   each of said plurality of imaging means includes an analog to digital conversion device for converting an analog video signal into said electrical pixel signals.

4. The security system of Claim 1, wherein:

   each of said plurality of imaging means stores a plurality of images sensed at a predetermined time interval.
5. The security system of Claim 1, wherein:
each of said plurality of imaging means stores an image responsive to a triggering signal.

6. The security system of Claim 1, wherein:
each of said plurality of imaging means stops storing an image responsive to a triggering signal.

7. The security system of Claim 1, wherein:
each of said plurality of imaging means includes a circular buffer for storing said image.

8. The security system of Claim 1, wherein:
said transmission means includes a bus for transmission of digital data.

9. The security system of Claim 1, wherein:
said transmission means includes a first bus connected between said plurality of imaging means and said collector means.

10. The security system of Claim 9, wherein:
said first bus provides time multiplexed communication across shared communication lines connected to each of said plurality of imaging means and said collector means.

11. The security system of Claim 10, wherein:
said first bus includes a RS-485 standard bus.

12. The security system of Claim 9, wherein:
said transmission means further includes a modem connectable to a phone line for providing communication between said collector and said monitoring station.
13. The security system of Claim 9, wherein:
said collector means includes a RS-232 standard serial
port for communicating with said monitoring station via
said second communication bus.

14. A security system for monitoring one or more
security zones at a security site, comprising:
a plurality of imaging means, positioned relative to
said one or more security zones, for sensing a plurality of
images in said one or more security zones, for storing said
plurality of images, and for providing electrical pixel
signals representing said image;

collector means, positioned at said security site, for
receiving said electrical pixel signals from each of said
plurality of imaging means and for transferring said
electrical pixel signals to a monitoring station; and

transmission means for providing communication between
said plurality of imaging means, said collector means, and
said monitoring station.

15. The security system of Claim 14, wherein:
each of said plurality of imaging means stores at
least five images.

16. The security system of Claim 14, wherein:
each of said plurality of imaging means stores images
at a predetermined time interval.

17. The security system of Claim 14, wherein:
each of said plurality of imaging means stops storing
said images after a predetermined elapsed time from a
triggering signal.
18. A security system for monitoring one or more security zones at a security site, comprising:

a plurality of imaging means, positioned relative to said one or more security zones, for sensing an image in said one or more security zones and for providing analog electrical pixel signals representing said image;

digitizing means, positioned locally with each of said plurality of imaging means, for converting said analog electrical pixel signals into an array of digital electrical pixel signals;

image storing means, positioned locally with each of said plurality of imaging means, for storing said array of digital electrical pixel signals;

collector means, positioned at said security site, for receiving said array of digital electrical pixel signals from said image storing means and for transferring said array of digital electrical pixel signals to a monitoring station; and

transmission means for providing communication between said image storing means, said collector means, and said monitoring station.

19. The security system of Claim 18, wherein:

said transmission means includes a bus for transmission of digital data.

20. The security system of Claim 18, wherein:

said transmission means includes a shared bus connected between said image storage means and said collector means.
21. The security system of Claim 18, wherein:
said transmission means provides error detection and
error correction of said array of digital electrical pixel
signals.

22. A security system for monitoring one or more
security zones at a security site, comprising:
a plurality of imaging means, positioned relative to
said one or more security zones, for sensing an image in
said one or more security zones and for providing analog
electrical pixel signals representing said image;
digitizing means, positioned locally with each of said
plurality of imaging means, for converting said analog
electrical pixel signals into a first array of digital
electrical pixel signals;
compression means for compressing said first array of
digital electrical pixel signals into a second array of
digital electrical pixel signals;
collector means, positioned at said security site, for
receiving said second array from said compression means and
for transferring said second array to a monitoring station;
and
transmission means for providing communication between
said compression means, said collector means, and said
monitoring station.

23. The security system of Claim 22, wherein:
said compression means includes memory for storing
said first and second arrays.
24. The security system of Claim 22, wherein:
said compression means includes a differential pulse-
code modulation algorithm.

25. The security system of Claim 22, wherein:
said imaging means provides a plurality of image
resolutions; and
said compression means includes a compression
algorithm adaptable to said plurality of image
resolutions.

26. The security system of Claim 22, wherein:
said imaging means provides a plurality of image
resolutions; and
sought compression means includes a differential pulse-
code modulation algorithm adaptable to said plurality of
image resolutions.

27. A security system for monitoring one or more
security zones at a security site, comprising:
a plurality of imaging means, positioned relative to
said one or more security zones, for sensing an image in
said one or more security zones and for providing a first
array of electrical pixel signals representing said image;
compression means, positioned locally with each of
said plurality of imaging means, for compressing said first
array into a second array of electrical pixel signals and
for providing compression identification information so as
to identify the characteristics of said second array;
collector means, positioned at said security site, for
receiving said compression identification information and
said second array from said compression means and for transferring said compression identification information and said second array to a monitoring station; and transmission means for providing communication between said compression means, said collector means, and said monitoring station; and
decompression means in communication with said monitoring station for decompressing said second array responsive to said compression identification information.

28. The security system of Claim 27, wherein:
said compression means includes a plurality of compression algorithms.

29. The security system of Claim 27, wherein:
said compression means includes a plurality of compression algorithms, one of said plurality of compression algorithms being selectable responsive to a command from said monitoring station.

30. The security system of Claim 27, wherein:
said decompression means includes a plurality of decompression algorithms.

31. The security system of Claim 27, wherein:
said decompression means includes a plurality of decompression algorithms, one of said plurality of decompression algorithms being selectable responsive to said compression identification information.

32. The security system of Claim 27, wherein:
said compression means includes a differential pulse-code modulation algorithm.
33. The security system of Claim 27, wherein:
said imaging means provides a plurality of image
resolutions; and
said compression means includes a differential pulse-
5 code modulation algorithm adaptable to said plurality of
image resolutions.

34. The security system of Claim 27, wherein:
said imaging means provides a plurality of image
resolutions; and
10 said compression means includes a compression
algorithm adaptable to said plurality of image resolutions.

35. The security system of Claim 27, wherein:
said imaging means provides a plurality of image
resolutions; and
15 said compression identification command includes a
compression table for one of said plurality of image
resolutions corresponding to said first array of electrical
pixel signals.

36. A security system for monitoring one or more
20 security zones at a security site, comprising:

a plurality of imaging means, positioned relative to
said one or more security zones, for sensing an image in
said one or more security zones, for storing said image as
a first array of electrical pixel signals having a first
25 image resolution;

image resolution regulation means for selecting pixels
in said first array of electrical pixel signals to provide
a second array of electrical pixel signals having a second image resolution;

collector means, positioned at said security site, for receiving said second array from each of said plurality of imaging means and for transferring said second array to a monitoring station; and

transmission means for providing communication between said plurality of imaging means, said collector means, and said monitoring station.

37. The security system of Claim 36, wherein:
said image resolution regulation means regulates said second image resolution responsive to a command signal from said collector means.

38. The security system of Claim 36, wherein:
said image resolution regulation means includes a memory for storing said first array and a processing device for selectively choosing pixels among said first array to generate said second array.

39. The security system of Claim 36, wherein:
said image resolution regulation means provides a second array at least as small as said first array.

40. The security system of Claim 36, wherein:
said first image resolution is 320 pixels by 240 pixels and said second image resolution is selectable among 320 pixels by 240 pixels, 156 pixels by 100 pixels, and 80 pixels by 48 pixels.
41. The security system of Claim 36 wherein:
said second array includes resolution identification information.

42. A security system for monitoring one or more security zones at a security site, comprising:
a plurality of imaging means, positioned relative to said one or more security zones, for sensing an image in said one or more security zones and for providing electrical pixel signals representing said image;
image storing means, positioned locally with each of said plurality of imaging means, for storing said electrical pixel signals in a mode selectable among a periodic collection mode, a triggered event mode, and a monitoring station request mode;
collector means, positioned at said security site, for receiving said electrical pixel signals from each of said plurality of image storing means and for transferring said electrical pixel signals to a monitoring station; and
transmission means for providing communication between said plurality of image storage means, said collector means, and said monitoring station.

43. The security system of Claim 42, wherein:
the periodic collection mode includes said image storing means storing said electrical pixel signals at a predetermined periodic time interval.
44. The security system of Claim 42, wherein:
the triggered event mode includes said image storing
means storing said electrical pixel signals responsive to
a triggering signal.

45. The security system of Claim 44, wherein:
the triggering signal is generated by a motion
detection sensor.

46. The security system of Claim 44, wherein:
the triggering signal is generated by a contact
switch.

47. The security system of Claim 44, wherein:
the triggering signal is generated by a smoke
detection sensor.

48. The security system of Claim 44 wherein:
the triggering signal is generated by a temperature
sensor.

49. The security system of Claim 42, wherein:
the monitoring station request mode includes said
image storing means storing said electrical pixel signals
responsive to a request signal from said monitoring
station.

50. A security system for monitoring one or more
security zones at a security site, comprising:

a plurality of imaging means, positioned relative to
said one or more security zones, for sensing an image in
said one or more security zones and for providing
electrical pixel signals representing said image;
image storing means, positioned locally with each of said plurality of imaging means, for storing said electrical pixel signals as a first array of electrical pixel signals having a first image resolution in responsive to an image storing command;

image resolution regulation means for selecting pixels in said first array of electrical pixel signals to provide a second array of electrical pixel signals having a second image resolution responsive to an image resolution command;

collector means, positioned at said security site, for receiving said second array of electrical pixel signals from said image resolution means and for transferring said second array of electrical pixel signal signals to said monitoring station responsive to an image transfer command;

and

transmission means for providing communication between said plurality of image resolution means, said collector means, and said monitoring station.

51. The security system of Claim 50, wherein:

said collector means provides at least one of said image storing command and said image resolution command.

52. The security system of Claim 50, wherein:

said monitoring station provides at least one of said image storing command, said image resolution command, and said image transfer command.

53. A security system for monitoring one or more security zones at a security site, comprising:
a plurality of imaging means, positioned relative to said one or more security zones, for sensing an image in said one or more security zones, for storing said image, and for providing electrical pixel signals representing said image;

a plurality of lighting means for emitting light so as to illuminate the image, each of said lighting means positioned locally with each of said plurality of imaging means;

a plurality of housings, each of said housings at least partially enclosing and supporting one of said imaging means and one of said lighting means; and

a plurality of mounting devices, each of said mounting devices connectable to one of said housings for mounting said one of said housings relative to one of the security zones.

54. The security system of Claim 53, further comprising:

a plurality of compression means for compressing the size of said electrical pixel signals, each of said compression means at least partially disposed inside and supported by each of said housings.

55. The security system of Claim 53, further comprising:

a plurality of motion detecting means for detecting motion, each of said motion detecting means at least partially disposed inside and supported by each of said
housings, said imaging means being responsive to said
motion detecting means.

56. The security system of Claim 53, wherein:
each of said lighting means includes a light source
for emitting light and a reflector for focusing the light
across the field-of-view of said imaging means.

57. The security system of Claim 53, wherein:
each of said housings includes a focusing window
positioned in front of said lighting means so as to
distribute the emitted light across the field-of-view of
said imaging means.

58. The security system of Claim 53, wherein:
each of said housings includes a focusing window
positioned in front of said imaging means so as to adjust
the field-of-view of said imaging means.

59. The security system of Claim 53, further
comprising:
a plurality of motion detecting means for emitting IR
light and detecting motion, each of said motion detecting
means at least partially disposed inside and supported by
each of said housings, said imaging means being responsive
to said motion detecting means; and
each of said housings includes a focusing window
positioned in front of said motion detecting means so as to
focus the emitted IR light and to adjust the field-of-view
of said motion detecting means.

60. The security system of Claim 53, further
comprising:
a plurality of power circuits, each of said power
circuits at least partially enclosed within each of said
housings and connecting said imaging means and said
lighting means and being connectable to an external power
supply.

61. The security system of Claim 53, further
comprising:

a plurality of electrical connection means for
providing electrical connection between one of said imaging
means and one of said lighting means, each of said
electrical connection means at least partially enclosed
within said housing; and

said lighting means being activated by a signal from
said imaging means via said electrical connection means.
AMENDED CLAIMS

[received by the International Bureau on 29 July 1997 (29.07.97);
original claims 1-7,9,10,13-18,21,22,25-27,33-37,42-44,49,50,53
and 55-61 amended; remaining claims unchanged (16 pages)]

1. A security system for monitoring one or more
security zones at a security site, comprising:

   a plurality of digital cameras, each of said plurality
   of digital cameras being positioned relative to said one or
   more security zones, for capturing one or more
   corresponding discrete images in said one or more security
   zones, for locally storing said one or more corresponding
   discrete images, and for providing digital signals
   representing said one or more corresponding discrete
   images;

   a collector, positioned at said security site, for
   receiving said digital signals corresponding with said one
   or more discrete images from said plurality of digital
   cameras and for transferring said digital signals to a
   monitoring station; and

   transmission means for providing digital communication
   between each of said plurality of digital cameras, said
   collector and said monitoring station.

2. The security system of Claim 1, wherein:
   each of said plurality of digital cameras includes a
   CMOS image detection integrated circuit.

3. The security system of Claim 1, wherein:
   each of said plurality of digital cameras includes an
   analog to digital conversion device for converting an
   analog video signal into said digital signals.
4. The security system of Claim 1, wherein:
   each of said plurality of digital cameras stores a plurality of images captured at a predetermined time interval.

5. The security system of Claim 1, wherein:
   each of said plurality of digital cameras stores an image responsive to a triggering signal.

6. The security system of Claim 1, wherein:
   each of said plurality of digital cameras stops storing an image responsive to a triggering signal.

7. The security system of Claim 1, wherein:
   each of said plurality of digital cameras includes a circular buffer for storing said image.

8. The security system of Claim 1, wherein:
   said transmission means includes a bus for transmission of digital data.

9. The security system of Claim 1, wherein:
   said transmission means includes a first bus connected between said plurality of digital cameras and said collector.

10. The security system of Claim 9, wherein:
    said first bus provides time multiplexed communication across shared communication lines connected to each of said plurality of digital cameras and said collector.

11. The security system of Claim 10, wherein:
    said first bus includes a RS-485 standard bus.
12. The security system of Claim 9, wherein:
   said transmission means further includes a modem
   connectable to a phone line for providing communication
   between said collector and said monitoring station.

13. The security system of Claim 9, wherein:
   said collector includes a RS-232 standard serial port
   for communicating with said monitoring station via said
   second communication bus.

14. A security system for monitoring one or more
    security zones at a security site, comprising:
    a plurality of digital cameras, each of said plurality
    of digital cameras being positioned relative to said one
    or more security zones, for capturing one or more
    corresponding discrete images in said one or more
    security zones, for locally storing with said digital cameras said
    one or more corresponding discrete images, and for
    providing digital signals representing said one or more
    corresponding discrete images;
    a collector, positioned at said security site, for
    receiving said digital signals corresponding with said one
    or more discrete images from each of said plurality of
    digital cameras and for transferring said digital signals
    to a monitoring station; and
    transmission means for providing communication between
    said plurality of digital cameras, said collector, and said
    monitoring station, wherein at least a portion of said
    transmission means is used for providing communication
    between said collector and each of said plurality of
digital cameras, wherein said transmission means includes a shared bus connected between said plurality of digital cameras and said collector for transmission of digital data.

15. The security system of Claim 14, wherein:
   each of said plurality of digital cameras stores at least five images.

16. The security system of Claim 14, wherein:
   each of said plurality of digital cameras stores images at a predetermined time interval.

17. The security system of Claim 14, wherein:
   each of said plurality of digital cameras stops storing said images after a predetermined elapsed time from a triggering signal.

18. A security system for monitoring one or more security zones at a security site, comprising:
   a plurality of cameras, each of said plurality of cameras being positioned relative to said one or more security zones, for capturing one or more corresponding images in said one or more security zones and for providing analog signals representing said one or more corresponding images;
   digitizing means, positioned locally with each of said plurality of cameras, for converting said analog signals into an array of digital signals representing said one or more corresponding images;
   digital image storing means, positioned locally with each of said plurality of cameras, for storing said array of images.

AMENDED SHEET (ARTICLE 19)
of digital signals representing said one or more corresponding images;

a collector, positioned at said security site, for receiving said array of digital signals from said digital image storing means and for transferring said array of digital signals to a monitoring station; and

transmission means for providing digital communication between said digital image storing means, said collector, and said monitoring station.

19. The security system of Claim 18, wherein:
said transmission means includes a bus for transmission of digital data.

20. The security system of Claim 18, wherein:
said transmission means includes a shared bus connected between said image storage means and said collector means.

21. The security system of Claim 18, wherein:
said transmission means provides error detection and error correction of said array of digital signals.

22. A security system for monitoring one or more security zones at a security site, comprising:
a plurality of cameras, each of said plurality of cameras being positioned relative to said one or more security zones, and each of said cameras for capturing one or more corresponding images in said one or more security zones, for locally storing said one or more corresponding images with said cameras and for providing analog signals representing said one or more corresponding images;
digitizing means, positioned locally with each of said plurality of cameras, for converting said analog signals into a first array of digital signals representing said one or more corresponding images;

5 compression means for compressing said first array of digital signals into a second array of digital signals;

a collector, positioned at said security site, for receiving said second array from said compression means and for transferring said second array to a monitoring station;

10 and

transmission means for providing digital communication between said compression means, said collector, and said monitoring station.

23. The security system of Claim 22, wherein:

15 said compression means includes memory for storing said first and second arrays.

24. The security system of Claim 22, wherein:

said compression means includes a differential pulse-code modulation algorithm.

25. The security system of Claim 22, wherein:

said cameras provide a plurality of image resolutions; and

said compression means includes a compression algorithm adaptable to said plurality of image resolutions.

26. The security system of Claim 22, wherein:

said digital cameras provide a plurality of image resolutions; and

AMENDED SHEET (ARTICLE 19)
said compression means includes a differential pulse-code modulation algorithm adaptable to said plurality of image resolutions.

27. A security system for monitoring one or more security zones at a security site, comprising:

a plurality of digital cameras, each of said plurality of digital cameras being positioned relative to said one or more security zones, for capturing one or more corresponding discrete images in said one or more security zones, for locally storing said one or more corresponding discrete images and for providing a first array of digital signals representing said one or more corresponding discrete images;

compression means, positioned locally with each of said plurality of digital cameras, for compressing said first array into a second array of digital signals and for providing compression identification information so as to identify the characteristics of said second array;

a collector, positioned at said security site, for receiving said compression identification information and said second array from said compression means and for transferring said compression identification information and said second array to a monitoring station;

transmission means for providing digital communication between said compression means, said collector means, and said monitoring station; and

decompression means in communication with said monitoring station for decompressing said second array
responsive to said compression identification information.

28. The security system of Claim 27, wherein:
said compression means includes a plurality of compression algorithms.

29. The security system of Claim 27, wherein:
said compression means includes a plurality of compression algorithms, one of said plurality of compression algorithms being selectable responsive to a command from said monitoring station.

30. The security system of Claim 27, wherein:
said decompression means includes a plurality of decompression algorithms.

31. The security system of Claim 27, wherein:
said decompression means includes a plurality of decompression algorithms, one of said plurality of decompression algorithms being selectable responsive to said compression identification information.

32. The security system of Claim 27, wherein:
said compression means includes a differential pulse-code modulation algorithm.

33. The security system of Claim 27, wherein:
said digital cameras provide a plurality of image resolutions; and
said compression means includes a differential pulse-code modulation algorithm adaptable to said plurality of image resolutions.

AMENDED SHEET (ARTICLE 19)
34. The security system of Claim 27, wherein:
   said digital cameras provide a plurality of image resolutions; and
   said compression means includes a compression algorithm adaptable to said plurality of image resolutions.

35. The security system of Claim 27, wherein:
   said digital cameras provide a plurality of image resolutions; and
   said compression identification information includes a compression table for one of said plurality of image resolutions corresponding to said first array of digital signals.

36. A security system for monitoring one or more security zones at a security site, comprising:
   a plurality of digital cameras, each of said plurality of digital cameras being positioned relative to said one or more security zones, for capturing one or more corresponding discrete images in said one or more security zones, for locally storing said one or more corresponding discrete images as a first array of digital signals having a first image resolution;
   image resolution regulation means for selecting pixels in said first array of digital signals to provide a second array of digital signals having a second image resolution;
   a collector, positioned at said security site, for receiving said second array from each of said plurality of digital cameras and for transferring said second array to a monitoring station; and
transmission means for providing digital communication between said plurality of digital cameras, said collector, and said monitoring station.

37. The security system of Claim 36, wherein:
said image resolution regulation means regulates said second image resolution responsive to a command signal from said collector.

38. The security system of Claim 36, wherein:
said image resolution regulation means includes a memory for storing said first array and a processing device for selectively choosing pixels among said first array to generate said second array.

39. The security system of Claim 36, wherein:
said image resolution regulation means provides a second array at least as small as said first array.

40. The security system of Claim 36, wherein:
said first image resolution is 320 pixels by 240 pixels and said second image resolution is selectable among 320 pixels by 240 pixels, 156 pixels by 100 pixels, and 80 pixels by 48 pixels.

41. The security system of Claim 36 wherein:
said second array includes resolution identification information.

42. A security system for monitoring one or more security zones at a security site, comprising:
a plurality of digital cameras, each of said plurality of digital cameras being positioned relative to said one or more security zones, for capturing one or more
corresponding discrete images in said one or more security zones and for providing digital signals representing said one or more corresponding discrete images;

digital image storing means, positioned locally with each of said plurality of digital cameras, for storing said digital signals representing said one or more corresponding discrete images in a mode selectable among a periodic collection mode, a triggered event mode, and a monitoring station request mode;

a collector, positioned at said security site, for receiving said digital signals from each of said plurality of digital image storing means and for transferring said digital signals to a monitoring station; and transmission means for providing digital communication between said plurality of digital image storage means, said collector means, and said monitoring station.

43. The security system of Claim 42, wherein:

the periodic collection mode includes said digital image storing means storing said electrical pixel signals at a predetermined periodic time interval.

44. The security system of Claim 42, wherein:

the triggered event mode includes said digital image storing means storing said electrical pixel signals responsive to a triggering signal.

45. The security system of Claim 44, wherein:

the triggering signal is generated by a motion detection sensor.
46. The security system of Claim 44, wherein:
the triggering signal is generated by a contact switch.

47. The security system of Claim 44, wherein:
the triggering signal is generated by a smoke detection sensor.

48. The security system of Claim 44 wherein:
the triggering signal is generated by a temperature sensor.

49. The security system of Claim 42, wherein:
the monitoring station request mode includes said digital image storing means storing said electrical pixel signals responsive to a request signal from said monitoring station.

50. A security system for monitoring one or more security zones at a security site, comprising:
a plurality of digital cameras, each of said plurality of digital cameras being positioned relative to said one or more security zones, for capturing one or more corresponding discrete images in said one or more security zones and for providing digital signals representing said one or more corresponding discrete images;
image storing means, positioned locally with each of said plurality of digital cameras, for storing said digital signals as a first array of digital signals having a first image resolution responsive to an image storing command;
image resolution regulation means for selecting pixels in said first array of digital signals to provide a second array of digital signals having a second image resolution responsive to an image resolution command;

collector means, positioned at said security site, for receiving said second array of digital signals from said image resolution means and for transferring said second array of digital signals to said monitoring station responsive to an image transfer command; and

transmission means for providing digital communication between said plurality of image resolution means, said collector means, and said monitoring station.

51. The security system of Claim 50, wherein:
said collector means provides at least one of said image storing command and said image resolution command.

52. The security system of Claim 50, wherein:
said monitoring station provides at least one of said image storing command, said image resolution command, and said image transfer command.

53. A security system for monitoring one or more security zones at a security site, comprising:

a plurality of digital cameras, each of said plurality of digital cameras being positioned relative to said one or more security zones, for capturing one or more corresponding discrete images in said one or more security zones, for locally storing said one or more corresponding discrete images, and for providing digital signals
representing said one or more corresponding discrete images;

a plurality of lighting means for emitting light so as to illuminate the image, each of said lighting means positioned locally with each of said plurality of digital cameras;

a plurality of housings, each of said housings at least partially enclosing and supporting one or said digital cameras and one of said lighting means; and

a plurality of mounting devices, each of said mounting devices connectable to one of said housings for mounting said one of said housings relative to one of the security zones.

54. The security system of Claim 53, further comprising:

a plurality of compression means for compressing the size of said electrical pixel signals, each of said compression means at least partially disposed inside and supported by each of said housings.

55. The security system of Claim 53, further comprising:

a plurality of motion detecting means for detecting motion, each of said motion detecting means at least partially disposed inside and supported by each of said housings, said digital cameras being responsive to said motion detecting means.
56. The security system of Claim 53, wherein:
   each of said lighting means includes a light source
for emitting light and a reflector for focusing the light
across the field-of-view of said digital cameras.

57. The security system of Claim 53, wherein:
   each of said housings includes a focusing window
positioned in front of said lighting means so as to
distribute the emitted light across the field-of-view of
said digital cameras.

58. The security system of Claim 53, wherein:
   each of said housings includes a focusing window
positioned in front of said digital cameras so as to adjust
the field-of-view of said digital cameras.

59. The security system of Claim 53, further
   comprising:
   a plurality of motion detecting means for emitting IR
light and detecting motion, each of said motion detecting
means at least partially disposed inside and supported by
each of said housings, said digital cameras being
responsive to said motion detecting means; and
   each of said housings includes a focusing window
positioned in front of said motion detecting means so as to
focus the emitted IR light and to adjust the field-of-view
of said motion detecting means.

60. The security system of Claim 53, further
   comprising:
   a plurality of power circuits, each of said power
circuits at least partially enclosed within each of said
housings and connecting said digital cameras and said lighting means and being connectable to an external power supply.

61. The security system of Claim 53, further comprising:

a plurality of electrical connection means for providing electrical connection between one of said digital cameras and one of said lighting means, each of said electrical connection means at least partially enclosed within said housing; and

said lighting means being activated by a signal from said digital cameras via said electrical connection means.
Fig. 2
# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER
- IPC(6) : H04N 7/18
- US CL : 348/143, 151-155, 159
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. : 348/143, 151-155 and 159
  - 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

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 4,831,438 A (BELLMAN, Jr. et al) 16 May 1989, Fig. 1</td>
<td>1-10, 13-14 and 16-20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11-12, 15, and 21-61N</td>
</tr>
<tr>
<td>Y</td>
<td>US 4,876,597 A (ROY et al.) 24 October 1989, Fig. 1 or summary</td>
<td>24-61</td>
</tr>
<tr>
<td>Y</td>
<td>US 4,994,971 A (POELSTRA) 19 February 1991, Fig. 1-3 and 5-6</td>
<td>1-61</td>
</tr>
<tr>
<td>Y</td>
<td>US 5,237,408 A (BLUM et al.) 17 August 1993, see entire document</td>
<td>1-61</td>
</tr>
</tbody>
</table>

- Further documents are listed in the continuation of Box C.
- See patent family annex.

- Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier document published on or after the international filing date
  - "L" document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - "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
  - "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
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Date of the actual completion of the international search: 18 DECEMBER 1996
Date of mailing of the international search report: 21 JAN 1997

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