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(54) Integrated system and method for security monitoring and early fire alarming

(57) The present application discloses an integrated system and method for security monitoring and early fire alarming based on infrared imaging technology, the system comprising: a plurality of infrared cameras respectively set up in a plurality of places where it needs to carry out security monitoring, used to capture infrared thermal images of the monitored area, and output related to the infrared images including temperature values of the monitored area infrared thermal image analog signals; a plurality of data process modules each of which respectively provided near one infrared camera to transform the infrared thermal image analog signals into digital infrared signals for standard network transmission; and a monitor computer used to generate and output control signals for the cameras, and used to receive the digital signals to analyze, process, manage and control thereon, and determine types of threats and send out an alarm according to the abnormal situations therein. The present application improves the flexibility and agility for security monitoring and early fire alarming and the accuracy in alarming.

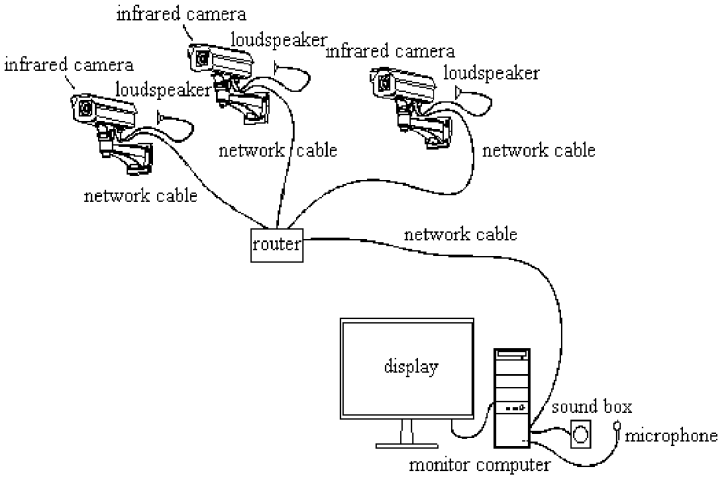

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present application relates to the security monitoring technology, especially it relates to a system and method for security monitoring and early fire automatic alarming on network.

BACKGROUND

[0002] Currently, in some places such as hotels, shops, large-scale warehouses and other important locations with higher security requirements in their environments, applications of real time monitoring technology on network and their facilities have been very well developed and widely employed. However, more than 98% of the security monitoring systems mainly use CCD visual cameras as monitor devices. Usually a CCD visual camera is set up at places that needs to be monitored, and the captured images from the CCD visual cameras are transferred to remote places via wire or wireless network, thus to achieve the purpose of remote monitoring.

[0003] Based on the principle that a photo diode will generate currents in different intensities when irradiated with light, and because of its photo-electricity conversion property, a CCD visual camera collects image information signals projected on its photosensitive surface and transforms them into corresponding electric signals, wherein the electric signals after amplification and A/D conversion are presented as \ digital image signals on a screen, thus to be recognized by an observer's eyes.

[0004] Based on the imaging principle of the CCD visual camera, its operation environment must have enough visual light therein, therefore the CCD visual camera is more suited to day light monitoring, and it needs supplementary active light-sources such as incandescence light or infrared light in order to work in the evening. However, since the irradiation distance and the irradiation angle of the incandescence lamp and the infrared lamp are limited, those lamps often fail to meet the requirements for monitoring of long-distance and large field of vision. Further, the conventional security monitoring system based on CCD visual cameras is not suited for temperature measuring and early fire automatically alarming.

[0005] Currently, conventional indoor systems for early fire alarming, which are usually mounted in buildings, often use smoke sensors for sensing smoke in the environment. When a fire occurs, smoke is rising upwards and may quickly reach the ceiling of one room in the building. The smoke sensor, which is usually mounted on the outer (the lowest) surface of the ceiling, will spot the fire in time by sensing smoke and fumes, and an alarm such as a shrill whistling is sent out continually even when most people haven't yet seen flames or smelled the smoke, until the smoke is totally banished .

[0006] There are two kinds of smoke sensors, one of which is an ion sensor, the other being a photoelectric sensor. However, there are two disadvantages for either of those two kinds of smoke sensors. Firstly, only in the event that a fire has really broken out and is causing smoke the smoke sensor can sense the smoke. But at this time people often have missed the early opportunity to eliminate hidden threats. Secondly the fire alarming system based on smoke sensors has no on-site camera function and can not visually reproduce fire scenarios, so the distribution of people and facilities can't be observed in time, which is disadvantageous for emergency rescue.

[0007] In summary, the conventional security monitoring system based on CCD visual cameras has no fire alarming function but only imaging function, and monitoring at evening needs to be carried out by way of supplementary light sources and nevertheless with very poor observation distance even though. While the conventional fire alarm system based on smoke sensors can only work in the event that a fire has really broken out and is causing smoke, the smoke sensor has no camera function.

[0008] In fact, security monitoring and early fire alarming are strongly interrelated with one another. For most of places that need to apply monitoring means, it's necessary to get hold of both of those two functions simultaneously and to pay more attention to both at any moment. For the places such as hotel corridors, shops, furniture stores, various large-scale warehouses, oil depots and military magazines etc., security and safety monitoring is certainly important, but early fire alarming is more important. However, at present, there is no device which can effectively solve not only the problem of security monitoring but also the problem of early fire automatic alarming. Especially for early fire alarming, there is no device which can be applied to the above-described places with larger area to perceive in advance and send out an alarm before a fire is actually broken out, so as to extinguish a fire in its early vagueness status to avoid casualties and property losses.

SUMMARY OF THE INVENTION

[0009] In order to solve the above problems in the prior art, an object of the present application is to provide a system and method for integrated security monitoring and early fire alarming based on infrared imaging technology, which applies infrared imaging and infrared temperature measuring technology to simultaneously solve the problems of security monitoring and automatic early fire alarming for places such as hotels, shops, large-scale warehouses and other important locations.

[0010] To achieve the above objects, the present invention provides a system for integrated security monitoring and early fire alarming, comprising: a plurality of infrared cameras respectively set up in a plurality of places where it needs to carry out security monitoring, to capture infrared thermal images of the monitored area, and output infrared thermal image analog signals related to

the infrared thermal images including temperature values of the monitored area; a plurality of data process modules each of which respectively provided near one of the infrared cameras transforming the infrared thermal image analog signals output from the infrared cameras into digital infrared signals for standard network transmission; and a monitor computer to generate and output control signals for the plurality of infrared cameras and intelligent monitor signals for the data process module, and used to receive the digital infrared signals to execute analysis, process, management and control thereon, so as to determine types and locations of threats according to abnormal situations therein as defined by claim 1.

[0011] According to an embodiment of the present application, the system further comprises: a plurality of CCD cameras each of which provided near one of the infrared cameras to capture visual images of the monitored area and output visual image analog signals related to the visual images of the monitored area, wherein each of the data process modules is respectively connected to one of the CCD cameras and transforms the visual image analog signals output from the CCD cameras into digital visual signals for standard network transmission; and the monitor computer also generates and outputs control signals for the plurality of CCD cameras, receives the digital visual signals, and provides for analysis and process on the received digital visual signals and the received digital infrared signals in combination, so as to determine types and locations of threats according to abnormal situations therein.

[0012] According to an embodiment of the present application, each of the plurality of infrared cameras or each of the plurality of CCD cameras changes its capture orientation while driven by a pan and tilt integrated together with them, the pan and tilt being connected to the data process module via a RS485 serial interface for data communication therebetween.

[0013] According to an embodiment of the present application, the system further comprises: a protective hood wherein one of the infrared cameras, one of the CCD cameras and one of the data process modules are integrated therein together with their respective inner power supplies.

[0014] According to an embodiment of the present application, the system further comprises: a plurality of alarm modules including alarm loudspeakers and/or alarm lamps, wherein each of the alarm modules is respectively provided in the places where security monitoring is to be carried out and is connected to one of the data process modules, and adapted to send out acoustic alarms or acoustic-optical alarms when a threat occurs, while controlled by the monitor computer and/or of the infrared cameras; and a plurality of communication modules including loudspeakers and microphones, wherein each of the communication modules is respectively provided in the places where security monitoring is to be carried out and is connected to one of the data process module, and used to execute voice communicate with the outside.

[0015] According to an embodiment of the present application, each of the data process modules comprises: a network data transform unit transforming the analog signals from the cameras into digital signals for standard network transmission, wherein the cameras comprise the infrared cameras and the CCD cameras, the analog signals comprise the infrared thermal image analog signals and the visual image analog signals, and the digital signals comprise the digital infrared signals and the digital visual signals; a control unit of pan and tilt transforming the control signals for the pan and tilt from the monitor computer via network into control signals for RS-485 serial interface to control a corresponding pan and tilt for a corresponding operation, and receiving status information from the pan and tilt via a RS-485 serial interface and then sending them to the monitor computer; an alarm unit receiving over-temperature alarm signals emitted from the infrared cameras, transforming the over-temperature alarm signals into acoustic-optical signals, then sending them to the alarm loudspeaker and/or alarm lamp of the alarm module, and sending back the over-temperature alarm signals to the monitor computer via network; a communication unit sending voice communication signals received from the monitor computer via network to the loudspeaker of the communication module to broadcast, and sending the voice signals received from the microphone of the communication module to the monitor computer to execute remote communication; and an intelligent monitor unit receiving intelligent monitor signals from the monitor computer to divide the monitored area, so as to form monitored regions respectively for intrusions, traversing and borderline trespassing.

[0016] According to an embodiment of the present application, the monitor computer comprises: a data input interface receiving the digital signals from the plurality of data process modules; a data analysis module applying a threat analysis and process software to execute image interception process and data analysis on the digital signals received from the data input interface, determining types and locations of threats in the monitored area according to the processed data, and generating the control signals for the pan and tilt to be used to control the infrared cameras and the CCD cameras, wherein the intelligent monitor signals are used to control the data process module to divide the monitored areas for intelligent monitor and alarming; and a storage module storing the processed data and the determined results therein.

[0017] According to an embodiment of the present application, the monitor computer further comprises a display module used to visually display infrared thermal images of the monitored area in a form of video pictures, digital infrared signals, types and locations of the threats and suggested treatment solutions.

[0018] According to an embodiment of the present application, data transmission and network communication between the data input interface of the monitor computer and the data process module are executed via a RJ45

standard network interface.

[0019] According to an embodiment of the present application, the system further comprises: a plurality of network data transmission modules respectively connected to the data process module and the monitor computer to execute network communication therebetween.

[0020] According to an embodiment of the present application, the network data transmission module is a switch or a hub each to be connected to the data process module and the monitor computer via a network cable, or a router to be connected to the data process module and the monitor computer via a network cable.

[0021] To achieve the above objects, the present invention also provides an method for integrated security monitoring and early fire alarming, which applies the above-described integrated system for security monitoring and early fire alarming to execute security monitoring and early fire alarming, the method comprising steps of:

[0022] S1) turning on the infrared cameras, the CCD cameras and their respective data process modules set up in places security monitoring is to be carried out to capture infrared thermal images and visual images for the monitored area;

[0023] S2) receiving control signals for the pan and tilt from the monitor computer through wire or wireless network communication to control capture orientations of the infrared cameras and the CCD cameras;

[0024] S3) transmitting the captured infrared thermal image analog signals including temperature values and the captured visual image analog signals to the data process module in real time, wherein the data process module transforms the infrared thermal image analog signals and the visual image analog signals into digital signals and then sends them to the monitor computer;

[0025] S4) the infrared cameras generating over-temperature alarm signals based on the captured infrared thermal images including temperature values, wherein the data process module receives the over-temperature alarm signals and then sends them to the alarm module to execute acoustic-optical alarming on its alarm loudspeaker and/or alarm lamp, the data process module also receives communication signals in-situ from the microphone of the communication module and then sends them to the outside, or receives communication signals from the outside and then sends them to the loudspeaker of the communication module, and the data process module also receives intelligent monitor signals from the monitor computer to divide the monitored areas of the infrared cameras and the CCD cameras, so as to form monitored regions respectively for intrusions, traversing and borderline_trespassing;

[0026] S5) the monitor computer using the threat analysis and process software provided therein to execute image interception process and data analysis on the received digital signals;

[0027] S6) the monitor computer judging whether there is a threat based on the above analysis;

[0028] S7) when the judged result is yes, the monitor computer determining types and locations of the threats based on the above analysis, generating alarm signals and communication signals used for communication with the rescue spot in-situ and for commands for the rescue and salvation, and then advancing to step S8, otherwise returning to step S2; and

[0029] S8) when the judged result is yes, the monitor computer controlling and switching the displayed screens, sending control signals and alarm signals, and transmitting communication signals to/from the data process module.

[0030] According to an embodiment of the present application, the method further comprising step of:

[0031] S9) after step S7 has been executed, the monitor computer automatically storing video sections where a threat occurs, the relative data and the suggested treatment solutions into its storage module and/or into the database of the threat analysis and process software for future analysis and process.

[0032] The present invention integrates both functions of security monitoring and early fire alarming into one device, which greatly improves the flexibility and agility for security monitoring and early fire alarming and the accuracy in alarming. Especially in early fire alarming, the integrated system for security monitoring and early fire alarming of the present invention can find and alarm a fire in its early vagueness status, which effectively allows preventive treatment to be applied on a threat which even not really happens, thus decreasing casualties and property losses to the minimum extent.

[0033] Moreover, the early fire alarming functions of the present invention is implemented by way of infrared camera sensing the absolute temperatures of the environment within its vision of view, and there is no special requirement for the location to install the camera and for the space to be monitored no matter it is open or closed. Thus the system of the present invention is adapted not only to indoor security monitoring and early fire alarming, but also to outdoor security monitoring in a place having relatively open spaces to monitor fire and other security problems that may occur therein.

[0034] The system for integrated security monitoring and early fire alarming of the present invention uses infrared camera to implement on-site monitoring, without worrying about whether there is insufficient ambient light in the place to be monitored. The device of the present invention can be used no matter at day time, evening, or night, or even at a place in absence of any background light, and it can always obtain clear and accurate image data.

[0035] When a serious fire has occurred, the infrared camera in the system for integrated security monitoring and early fire alarming of the present invention can clearly show up through the smoke the scenarios of the fire and the situation of victims, which is not available for the conventional CCD visual camera. Under these circumstances outside observers or rescue and command staffs may use microphone and other communication devices to in-

dicate victims groping in the dark smoke and escaping from the fire the most available escape path, or to guide rescue staffs to the most convenient search and rescue path, thus minimizing the disaster.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036]

Fig. 1 is a schematic view showing the configuration of the integrated system for security monitoring and early fire alarming according to an embodiment of the present invention.

Fig. 2 is a block diagram showing the integrated system for security monitoring and early fire alarming according to an embodiment of the present invention.

Fig. 3 is a schematic view showing the interfaces of the data process module in the integrated system for security monitoring and early fire alarming shown in Fig. 2.

Fig. 4 is a flowchart showing the operation processes of the integrated system for security monitoring and early fire alarming according to one embodiment of the present invention.

List of reference signs:

[0037]

1- infrared camera
2- data process module

- 21- network data transform unit
- 22- control unit for the pan and tilt
- 23- alarm unit
- 24- communication unit
- 25- intelligent monitor unit

3- monitor computer

- 31- data input interface
- 32- data analysis module
- 33- storage module
- 34- display module

4- network data transmission module
5-CCD camera
6- alarm module
7- communication module
8- protective hood

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] The foregoing and other objects, aspects and advantages of the present invention will become more apparent from the following detailed description of the present application when taken in conjunction with the preferred embodiments and accompanying drawings. The embodiments here are only used to illustrate but not to limit the present application.

[0039] Infrared cameras are widely used in the field of industrial or civil detection to capture infrared thermal images of the objects based on infrared technology, to detect locations and work status of the objects, and to obtain the digital infrared signals of the captured objects.

[0040] Infrared cameras are able to, by taking advantages of their working principle, capture images as well to measure temperatures, which image an object by measuring the temperature of the detected object to form and display infrared images with every pixel spot thereon having a corresponding temperature value. Since infrared cameras can measure temperature values of a monitored object while monitoring the object, they are able to predict a fire by sensing significant changes in local temperature. People can arbitrarily set temperature threshold for over-temperature alarm according to their experience. Since infrared cameras capture images based on the absolute ambient temperatures, and the image capture and display thereof are not light sensitive, monitoring can be carried out in absolute darkness. Therefore, use of infrared camera for security monitoring and early fire alarming has a very brilliant application prospect.

[0041] Fig. 1 is a schematic view showing the configuration of the system for integrated security monitoring and early fire alarming according to an embodiment of the present invention. As shown in Fig. 1, the system for integrated security monitoring and early fire alarming comprises a plurality of infrared cameras respectively set up in a plurality of places where security monitoring is to be carried out, each infrared camera being connected to a monitor computer in the monitoring center via wire or wireless network, used to transmit video images and temperature data captured by the infrared camera to the monitor computer in real time. The monitor computer comprises video analysis and process software and fire automatic alarm software (hereafter to be called threat analysis process software, wherein the threat may be one of intrusion, fire, or likewise threats) adapted to analysis the video images and temperature data and send out an alarm with respect to the abnormal situation therein.

[0042] Fig. 2 is a block diagram showing the system for integrated security monitoring and early fire alarming according to an embodiment of the present invention.

[0043] As shown in Fig. 2, this system comprises: a plurality of infrared cameras 1 respectively set up in a plurality of places where security monitoring is to be carried out, to capture infrared thermal images of the monitored area, and to output infrared thermal image analog signals (video signals) related to the infrared thermal images including temperature values of the monitored area; a plurality of data process modules 2 each of which respectively provided near one of the infrared camera 1 to

transform the infrared thermal image analog signals output from the infrared cameras 1 into digital infrared signals for standard network transmission; and a monitor computer 3 to generate and output control signals for the plurality of infrared cameras 1 and intelligent monitor signals for the data process module 2, and adapted to receive the digital infrared signals to execute analysis, process, management and control thereon, so as to determine types and locations of threats according to abnormal situations therein and output control signals and alarm signals etc..

[0044] One CCD camera 5 also may be provided near one infrared camera 1 to implement in infrared light and in visual light observations simultaneously, the capture actions of those two cameras simultaneously controlled by the monitor computer 3, and the analog data relative to the captured infrared thermal images including a temperature value of every spot and the captured visual images to the data process module 2. The data process module 2 is also adapted to transform the visual image analog signals (video signals) output from the CCD camera 5 into digital visual signals for standard network transmission.

[0045] The monitor computer 3 may also generate and output control signals for the plurality of CCD cameras (5), receive the digital visual signals, and analyze and process the received digital visual signals and the received digital infrared signals in combination, so as to determine types and locations of threats according to the abnormal situations.

[0046] Each of the infrared cameras 1 (and CCD cameras 5) as well as the data process module 2 are connected to their respective power supply via a power supply cable. Besides the power supply cable, there is also a network cable for each of the cameras to be connected to the data process module 2, wherein each of the cameras and the data process modules 2 together may be regarded as a computer located within the local network. Besides transforming signals of the video images, the data process module 2 may also be used to control capture actions of the cameras such as capture timings and capture angles, to set capture parameters of the cameras comprising parameters of intelligent monitor mode, and to carry out actions such as sending out an alarm, communicating with others etc. according to over-temperature alarm signals received from the infrared camera 1 and/or control signals, alarm signals and communication signals received from the monitor computer 3.

[0047] Each of the plurality of infrared cameras 1 or each of the plurality of CCD cameras 5 is adapted to change its capture orientation driven by a pan and tilt 22 integrated together with them. The pan and tilt 22 is connected to the data process module 2 via a 485 series for data communication therebetween.

[0048] One of the infrared cameras 1, one of the CCD cameras 5 and one of the data process modules 2 may be integrated in one protective hood 8 together with their respective inner power supplies. The pan and tilt 22 is connected to the protective hood 8 to control the orientation of the protective hood 8, thus in turn to control the capture orientations of the cameras in the protective hood 8.

[0049] The system further comprises: a plurality of alarm modules 6 comprising alarm loudspeakers and/or alarm lamps, wherein one alarm lamp may be an alarm lamp to be set next to the camera and glowing while the loudspeaker announcing an alarm, an alarm module 6 being respectively provided in every place where it needs to carry out security monitoring and it is connected to the data process module 2, used to send out acoustic alarms or acoustic-optical alarms under the control of the monitor computer 3 and/or the infrared camera 1 when a threat occurs; and a plurality of communication modules 7 comprising loudspeakers and microphones, wherein each of the communication modules 7 is respectively provided in a place where security monitoring is to be carried out and connected to the data process module 2, used to voice communicate with the outside.

[0050] Each of the data process modules 2 comprises: a network data transform unit 21 transforming the analog signals from the cameras into digital signals for standard network transmission, wherein the cameras comprise the infrared cameras 1 and the CCD cameras 5, the analog signals comprise the infrared thermal image analog signals and the visual image analog signals, and the digital signals comprise the digital infrared signals and the digital visual signals; a control unit of pan and tilt 22 transforming the control signals for the pan and tilt from the monitor computer 3 via network into control signals to control a corresponding pan and tilt in a corresponding operation, and receiving status information from the pan and tilt via a RS-485 serial interface and then sending them to the monitor computer 3; an alarm unit 23 receiving over-temperature alarm signals emitted from the infrared cameras 1, transforming the over-temperature alarm signals into acoustic-optical signals and sending them to the alarm loudspeaker and/or alarm lamp of the alarm module 6, and sending back the over-temperature alarm signals to the monitor computer 3 via network; a communication unit 24 sending voice communication signals coming from the monitor computer 3 via network to the loudspeaker of the communication module 7 to broadcast, and sending the voice signals received from the microphone of the communication module 7 to the monitor computer 3 to execute remote communication; and an intelligent monitor unit 25 receiving intelligent monitor signals from the monitor computer 3 to divide the monitored area, so as to form monitored regions respectively for intrusions, traversing and borderlines.

[0051] The data process module 2 may be, for example, a DSP chip in compliance with the H.264 video compression standard, or it may be implemented by other chips able to fulfill the above functions of the data process module 2.

[0052] The monitor computer 3 comprises: a data input interface 31 receiving the digital signals from the plurality

of data process modules 2; a data analysis module 32 applying a threat analysis and process software to execute image interception process and data analysis on the digital signals (which comprising digital infrared signals and digital visual signals) received from the data input interface 31, determining types and locations of threats in the monitored area according to the processed data, and generating the control signals for the pan and tilts used to control the infrared cameras 1 and the CCD cameras 5, wherein the intelligent monitor signals are used to control the data process module 2 to divide the monitored areas for intelligent monitor and alarming; and a storage module 33 storing the processed data and the determined results therein.

[0053] The monitor computer 3 further comprises a display module 34 used to visually display infrared thermal images of the monitored area in form of video figures, digital infrared signals, types and locations of the threats and suggested treatment solutions.

[0054] The data input interface 31 of the monitor computer 3 executes data transmission and network communication with the data process module 2 via a RJ45 standard network interface.

[0055] Based on the RJ45 standard network interface, it may be applied with ISDN (Integrated Service Digital Network) functions by using PoE (Power Over Ethernet) configuration to implement data communication as well as power supply between the data process module 2 and the monitor computer 3. In other words, there is only one network cable to be led out from the protective hood 8 and to be connected to the monitor computer 3, thus being able to accomplish power supply and communication for all of those above parts.

[0056] Wherein the PoE configuration is a technology that, in the case not making any change to the basic wiring configuration of the conventional Ethernet Cat. 5, can provide direct current power supply for some of the terminals based on IP (such as IP telephones, wireless local network access point AP, network cameras etc.) while transmitting data signals for them. The POE technology guarantees normal operation of the current networks while in the same time providing the safety of the conventional structural wiring, thus minimizing the cost thereof.

[0057] The integrated system for security monitoring and early fire alarming of the present application further comprises a plurality of network data transmission modules 4 respectively connected to the data process module 2 and the monitor computer 3, so as to carry out network communications therebetween.

[0058] The network data transmission module 4 may be a switch, a hub or a router each to be connected to the data process module 2 and to the monitor computer 3 via a network cable.

[0059] Fig. 3 is a schematic view showing the interfaces of the data process module in the integrated system for security monitoring and early fire alarming shown in Fig. 2.

[0060] As shown in Fig. 3, the interfaces and their connection relationships of the data process module 2 (such as a DSP chip in H. 264 video compression standard) are explained as below.

[0061] Interface A is a video signals input interface (i.e. a VGA interface) receiving analog signals received from the infrared camera 1 and the CCD camera 5, and transforming those analog signals into corresponding standard network signals, and then transmitting them to the monitor computer 3 via a RJ45 network cable (i.e. an interface F to be described hereafter).

[0062] Interface B is a standard audio signal input interface self-provided by the data process module. The data process module 2 may, when connected with a microphone of the communication module 7, transform the audio signals coming from the microphone into standard network signals, and then transmit them to the monitor computer 3 via a RJ45 network cable (the interface F).

[0063] Interface C is a standard audio signal output interface self-equipped by the data process module. Thereby the data process module 2 may, when connected with a loudspeaker of the alarm module 6 or the communication module 7, broadcast alarm signals coming from the infrared camera 1 and/or the monitor computer 3, or broadcast the audio signals coming from a RJ45 network cable (the interface F).

[0064] Interface D is an alarm signal input terminal, which is a set of twin cables for power supply and connected to the infrared camera 1. The infrared camera 1 automatically emits over-temperature alarm signals when the temperature of an object exceeds the predetermined temperature, connects the two cables of the alarm signals input terminal, and the data process module 2 may directly send the received acoustic-optical alarm signals through the interface C and the loudspeaker and/or the alarm lamp of the alarm module 6 after receiving the signals, start up the inner processes, and send back the signals to the monitor computer 3 via a RJ45 network cable (the interface F). Thus the monitor computer 3 may send out alarm information such as acoustic-optical signals, figure screen signals and the like.

[0065] Interface E is a 485 series input/output interface, which uses computer software to send the control signals for the pan and tilt 22 from the monitor computer 3 to the pan and tilt 22 via the RS-485serial interface, such that the actions of the pan and tilt 22 can be controlled to thereby control the capture actions of the infrared camera 1 and the CCD camera 5. The data process module 2 may also receive status information and the like from the pan and tilt 22 via the RS-485 serial interface (the data process module 2 may be deemed as a camera controller).

[0066] Interface F is a standard communication interface of RJ45 network cable, which is connected to the data input interface 31 of the monitor computer 3 to carry out bidirectional data transmission between the data process module 2 and the monitor computer 3 with re-

spect to video signals, audio signals, camera control signals and alarm signals.

[0067] Fig. 4 is a flowchart showing the operation processes of the integrated system for security monitoring and early fire alarming according to one embodiment of the present application.

[0068] The monitoring method applied by the system for integrated security monitoring and early fire alarming of the present application is hereafter described in detail while referring to Fig. 4. The method comprises the steps of:

[0069] S1) turning on the infrared cameras 1, the CCD cameras 5 and their respective data process modules 2 set up in places where security monitoring is to be carried out to capture infrared thermal images and visual images for the monitored area;

[0070] S2) receiving control signals for the pan and tilt 22 from the monitor computer 3 through wire or wireless network communication to control capture orientations of the infrared cameras 1 and the CCD cameras 5;

[0071] S3) transmitting the captured infrared thermal image analog signals including temperature values and the captured visual image analog signals to the data process module 2 in real time, wherein the data process module 2 transforms the infrared thermal image analog signals and the visual image analog signals into digital signals (including digital infrared signals and digital visual signals) and then sends them to the monitor computer 3;

[0072] S4) the infrared cameras 1 generating over-temperature alarm signals based on the captured infrared thermal images including temperature values, wherein the data process module 2 receives the over-temperature alarm signals and then sends them to the alarm module 6 to execute acoustic-optical alarming on its alarm loudspeaker and/or alarm lamp, the data process module 2 also receiving communication signals in-situ from the microphone of the communication module 7 and then sending them to the outside or receives communication signals from the outside and then sends them to the loudspeaker of the communication module 7, and the data process module 2)also receiving intelligent monitor signals from the monitor computer 3 to divide the monitored areas of the infrared cameras 1 and the CCD cameras 5, so as to form monitored regions for intrusions, traversing and borderline trespassing;

[0073] S5) the monitor computer 3 using the threat analysis and process software and fire automatic alarm software (hereafter called as threat analysis and process software) provided therein to execute image interception process and data analysis on the received digital signals, in the threat analysis and process software, alarm species (such as of intrusions, traversing and borderline trespassing.) and their corresponding monitored regions may be set for security monitoring; a temperature threshold of over-temperature alarm may also be set for early fire alarming (for example, it may be set as an alarm that will be triggered when the temperature of any spot in the monitored area is over 60°C); wherein "borderline trespassing" means that in a monitoring screen, whenever a person or an unexpected object enters within borderlines (such as circular or rectangular borderlines) the system pre-delimit for the monitored area, an alarm will be triggered;

[0074] S6) the monitor computer 3 judging whether there is a threat based on the above analysis;

[0075] S7) when the judged result is yes (that means a threat occurs), the monitor computer 3 is determining types and locations of the threats based on the above analysis, generating alarm signals and communication signals used for communication with the rescue spot in-situ and for commands for the rescue and salvation, and then advancing to step S8, otherwise returning to step S2;

[0076] S8) when a threat occurs, the monitor computer 3 is controlling and switching the displayed screens, sending control signals and alarm signals, and transmitting communication signals to/from the data process module 2.

[0077] when a security threat such as an intrusion occurs, the monitor computer 3 may send out an alarm prompt simultaneously on its monitoring display screen and on its outside acoustic-optical siren, the observer may switch the display screen and judge on the situation, and then give caution to the intruder to overawe through the communication device such as a microphone, thus reducing unnecessary patrolling to the monitored area. When a serious fire occurs, the monitor computer 3 may send out an alarm prompt simultaneously on its monitoring display screen and on its outside acoustic-optical siren. Since the infrared camera 1 can penetrate smoke, the observer or commander in back line from the fire can see the fire scenarios and the victims in front line of the fire through the smoke and fumes, at this time the observer may also use microphone and other communication devices to indicate victims groping in the dark smoke and escaping from the fire the most available escape path, thus minimizing the disaster.

[0078] The monitored area may be preset in every monitoring screen of the monitor computer 3, therefore different ways of processes may be reset for different situations and to be represented on the monitoring screen. Once a threat occurs, people may spot the threat on the monitoring screen (such as in which floor of a building), apply different fire extinguishing means based on different causes for a fire, such as caused by an electric or gasoline threat and the like, and guide the people on-site through a front-end vocal calling for evacuation and fire extinguishing.

[0079] Moreover, the integrated method for security monitoring and early fire alarming of the present application may further comprise the step of:

[0080] S9) after step S7 has been executed, the monitor computer 3 automatically storing video sections where a threat occurs, the relative data and the suggested treatment solutions into its storage module and/or into the database of the threat analysis and process software for future analysis and process.

[0081] Compared with the prior art, the integrated system and method for security monitoring and early fire alarming based on infrared imaging technology the present invention has following advantages:

[0082] The existing security monitoring system or early fire alarming system is usually separated from each other in disposition. Either it can only display video figures of the monitored area, or it can only be used for prompt early fire alarming. The present invention integrates both functions of security monitoring and early fire alarming into one device, which is able to measure temperatures for early fire alarming while in the same time to display vision images of the monitored area. The system of the present invention may also provide CCD camera together with infrared camera in one body to carry out multi-function monitoring, thus greatly improving the flexibility and agility for security monitoring and early fire alarming and the accuracy in alarming, thereby constituting an ideal device for security and safety monitoring.

[0083] In the conventional early fire alarming technology, the smoke sensor is used for fire alarming by sensing smoke that is caused under a precondition of object's burning, therefore the fire alarm is usually sent out and noticed too late, and even if an alarm has been sent out, people still can't see actual situation of the fire scenarios since the smoke sensor has no camera function. On the contrary, the present application is adapted to implement real time temperature measuring while executing on-site screen monitoring as well. The infrared camera which is very sensitive on temperature (with a temperature sensitivity of 0. 08 °C) as it captures images based on temperature, can capture any hidden fire in its early delitescence period, thus it can find and alarm a fire in its early vagueness status. Therefore, people can take preventive measures in time to greatly reduce the opportunity of a fire occurring.

[0084] When a serious fire has occurred, the infrared camera in the integrated system for security monitoring and early fire alarming of the present application can clearly show up through the smoke the scenarios of the fire and the situation of victims to provide first hand video information for the fireman, which is not available for the conventional CCD visual camera. At this moment the outside observers or rescue and command staffs may use microphone and other communication devices to indicate victims groping in the dark smoke and escaping from the fire the most available escape path, or to guide rescue staffs to the most convenient search and rescue path, thus minimizing the disaster and decreasing casualties and property losses to minimum extent.

[0085] The integrated system for security monitoring and early fire alarming of the present application uses infrared cameras to implement on-site monitoring, without worrying about whether there is insufficient ambient light in the places to be monitored. The device of the present invention can be used no matter at day or night time, or even at a place in absence of any background light, and it always obtains clear and accurate image data.

[0086] Moreover, the early fire alarming functions of the present invention is implemented by way of the infrared camera sensing the absolute temperatures of the environment within its field of vision, and there is no special requirement for the location to install the camera and for the space to be monitored no matter it is open or not. Thus the system of the present invention is adapted to not only indoor security monitoring and early fire alarming, but also to outdoor security monitoring and early fire alarming in a place having relatively open spaces to monitor fire and other security problems that may occur therein.

[0087] Finally, the present invention also carries out data transmission and network communications between the data process module and the monitor computer therein by applying ISDN (Integrated Service Digital Network) technology. With advanced computer compression technology and network transmission technology, the system of the present invention can realize, with only one internet cable, the data transmission for dynamic infrared images, visual images and temperature data, data storage, analysis and process executed by a remote monitor computer, automatic alarm for any threat situation and for setup and control of various monitoring cameras in situ, while using a RJ45 standard Ethernet communication interface. Therefore, the system for integrated security monitoring and early fire alarming of the present application is a kind of network monitoring system based on computer network, all data of which (data of visual images, infrared thermal images, temperatures, control commands and status display modes, etc.) are transmitted as digital signals other than as analog signals. Full-way digital transmission greatly simplifies the system wiring (no video cable, control cable or collection card and the like is needed anymore), reduces the cost of system wiring, and improves the reliability of data transmission, the accuracy of the threat analysis, and the flexibility of the threat analysis and calculation.

[0088] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of embodiments. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

1. A system for integrated security monitoring and early fire alarming, comprising:

a plurality of infrared cameras (1) respectively set up in a plurality of places where security monitoring is to be carried out, adapted to capture infrared thermal images of the monitored area, and output infrared thermal image analog signals related to the infrared thermal images including temperature values of the monitored area;

a plurality of data process modules (2) each of which respectively provided near one of the infrared cameras (1) and adapted to transform the infrared thermal image analog signals output from the infrared cameras (1) into digital infrared signals for standard network transmission; and

a monitor computer (3) adapted to generate and output control signals for the plurality of infrared cameras (1) and intelligent monitor signals for the data process module (2), and

adapted to receive the digital infrared signals to execute analysis, process, management and control thereon, so as to determine types and locations of threats according to abnormal situations therein.

2. The system of claim 1, wherein the system further comprises:

a plurality of CCD cameras (5) each of which provided near one of the infrared cameras (1) to capture visual images of the monitored area and output visual image analog signals related to the visual images of the monitored area, wherein

each of the data process modules (2) is respectively connected to one of the CCD cameras (5) and transforms the visual image analog signals output from the CCD cameras (5) into digital visual signals for standard network transmission; and

the monitor computer (3) generates and outputs control signals for the plurality of CCD cameras (5), receives the digital visual signals, and provides for analysis and process on the received digital visual signals and the received digital infrared signals in combination,

so as to determine types and locations of threats according to abnormal situations therein.

3. The system of claim 2, wherein each of the plurality of infrared cameras (1) or each of the plurality of CCD cameras (5) changes its capture orientation while driven by a pan and tilt (22) integrated together with them, the pan and tilt (22) being connected to the data process module (2) via a RS-485 serial interface for data communication therebetween.

4. The system of claim 2 further comprising:

a protective hood (8) wherein one of the infrared cameras (1), one of the CCD cameras (5) and one of the data process modules (2) are integrated therein together with their respective inner power supplies.

5. The system of claim 3, further comprising:

a plurality of alarm modules (6) including alarm loudspeakers and/or alarm lamps, wherein

each of the alarm modules (6) is respectively provided in the places where security monitoring is to be carried out, connected to one of the data process modules (2), and

adapted to send out acoustic alarm or acoustic-optical alarm, when a threat occurs, while controlled by the monitor computer (3) and/or of the infrared cameras (1); and

a plurality of communication modules (7) including loudspeakers and microphones,

wherein each of the communication modules (7) is respectively provided in the places where security monitoring is to be carried out, connected to one of the data process modules (2), and is used to execute voice communication with the outside.

6. The system of claim 5, wherein each of the data process modules (2) comprises:

a network data transform unit (21) transforming the analog signals from the cameras into digital signals for standard network transmission, wherein the cameras comprise the infrared cameras (1) and the CCD cameras (5), the analog signals comprise the infrared thermal image analog signals and the visual image analog signals, and the digital signals comprise the digital infrared signals and the digital visual signals;

a control unit of pan and tilt (22) transforming the control signals for the pan and tilt (22) from the monitor computer (3) via network into control signals for a RS-485 serial interface to control a corresponding pan and tilt in a corresponding operation, and receiving status information from the pan and tilt via a RS-485 serial interface and then sending it to the monitor computer (3);

an alarm unit (23) receiving over-temperature alarm signals emitted from the infrared cameras (1), transforming the over-temperature alarm signals into acoustic-optical signals, then sending them to the alarm loudspeaker and/or alarm lamp of the alarm module (6), and sending back the over-temperature alarm signals to the monitor computer (3) via the network;

a communication unit (24) sending voice communication signals received from the monitor computer (3) via the network to the loudspeaker

of the communication module (7) to broadcast, and sending the voice signals received from the microphone of the communication module (7) to the monitor computer (3) to execute remote communication; and
an intelligent monitor unit (25) receiving intelligent monitor signals from the monitor computer (3) to divide the monitored area, so as to form monitored regions respectively for intrusions, traversing and borderline trespassing.

7. The system of claim 6, wherein the monitor computer (3) comprises:

a data input interface (31) receiving the digital signals from the plurality of data process modules (2);
a data analysis module (32) applying a threat analysis and process software to execute image interception process and data analysis on the digital signals received from the data input interface (31), determining types and locations of threats in the monitored area according to the processed data, and generating the control signals for the pan and tilt (22) used to control the infrared cameras (1) and the CCD cameras (5), wherein the intelligent monitor signals are adapted to control the data process module (2) to divide the monitored areas for intelligent monitor and alarming; and
a storage module (33) storing the processed data and the determined results therein.

8. The system of claim 7, wherein the monitor computer (3) further comprises a display module (34) used to visually display infrared thermal images of the monitored area in a form of video figures, digital infrared signals, types and locations of the threats and suggested treatment solutions.

9. The system of claim 7, wherein data transmission and network communication between the data input interface (31) of the monitor computer (3) and the data process module (2) are executed via a RJ45 standard network interface.

10. The integrated system for security monitoring and early fire alarming according to claim 1, wherein the system further comprises:

a plurality of network data transmission modules (4) respectively connected to the data process module (2) and the monitor computer (3) to execute network communication therebetween.

11. The system of claim 10, wherein the network data transmission module (4) is a switch or a hub connected to the data process module (2) and the monitor computer (3) via a network cable, or a router to be connected to the data process module (2) and the monitor computer (3) via a network cable.

12. An method for integrated security monitoring and early fire alarming, which applies the system of any one of claims 1 to 11 to execute security monitoring and early fire alarming, the method comprising steps of:

S1) turning on the infrared cameras (1), the CCD cameras (5) and their respective data process modules (2) set up in places where security monitoring is to be carried out to capture infrared thermal images and visual images for the monitored area;
S2) receiving control signals for the pan and tilt (22) from the monitor computer (3) through wire or wireless network communication to control capture orientations of the infrared cameras (1) and the CCD cameras (5);
S3) transmitting the captured infrared thermal image analog signals including temperature values and the captured visual image analog signals to the data process module (2) in real time, wherein the data process module (2) transforms the infrared thermal image analog signals and the visual image analog signals into digital signals and then sends them to the monitor computer (3);
S4) the infrared cameras (1) generating over-temperature alarm signals based on the captured infrared thermal images including temperature values, wherein the data process module (2) receives the over-temperature alarm signals and then sends them to the alarm module (6) to execute acoustic-optical alarming on its alarm loudspeaker and/or alarm lamp, the data process module (2) receives communication signals in-situ from the microphone of the communication module (7) and then sends them to the outside or receives communication signals from the outside and then sends them to the loudspeaker of the communication module (7), and the data process module (2) receives intelligent monitor signals from the monitor computer (3) to divide the monitored areas of the infrared cameras (1) and the CCD cameras (5), so as to form monitored regions for intrusions, traversing and borderline trespassing;
S5) the monitor computer (3) using the threat analysis and process software provided therein to execute image interception process and data analysis on the received digital signals;
S6) the monitor computer (3) judging whether there is a threat based on the above analysis;
S7) when the judged result is yes, the monitor computer (3) determining types and locations of

the threats based on the above analysis, generating alarm signals and communication signals for communication with the rescue spot and in-situ and for commands for the rescue and salvation, and then advancing to step S8, otherwise returning to step S2; and

S8) when the judged result is yes, the monitor computer (3) controlling and switching the displayed screens, sending control signals and alarm signals, and transmitting communication signals to/from the data process module (2).

13. The method of claim 12, further comprising step of:

S9) after step S7 has been executed, the monitor computer (3) automatically storing video sections where a threat occurs, the relative data and the suggested treatment solutions into its storage module and/or into the database of the threat analysis and process software for future analysis and process.

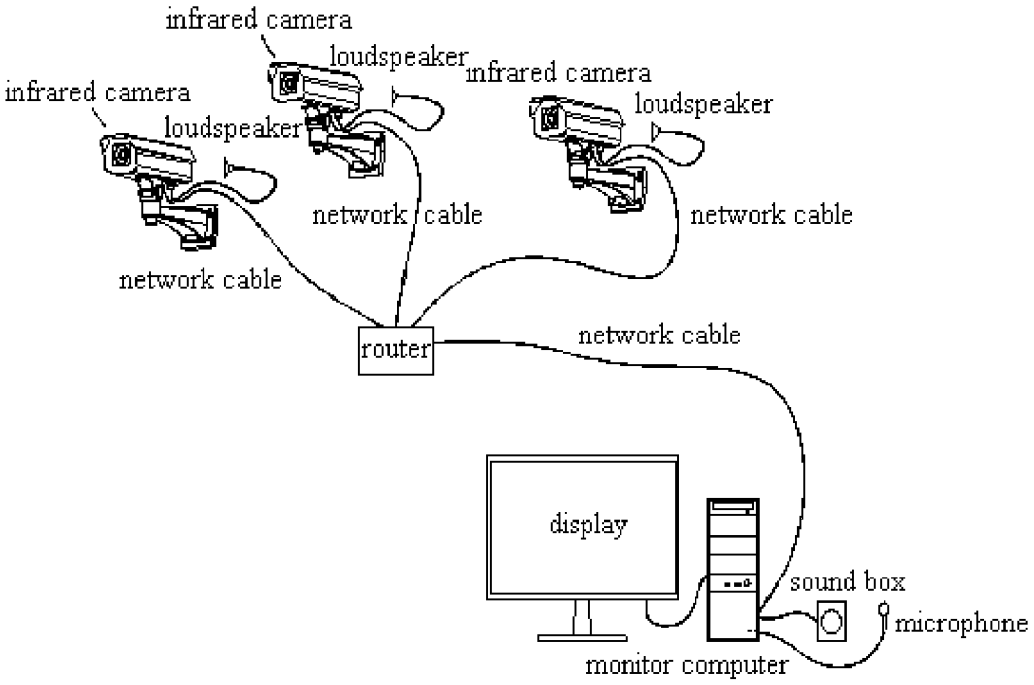
infrared camera
loudspeaker
infrared camera
loudspeaker
infrared camera
loudspeaker
network cable
network cable
network cable
router
network cable
display
sound box
microphone
monitor computer

Fig. 1

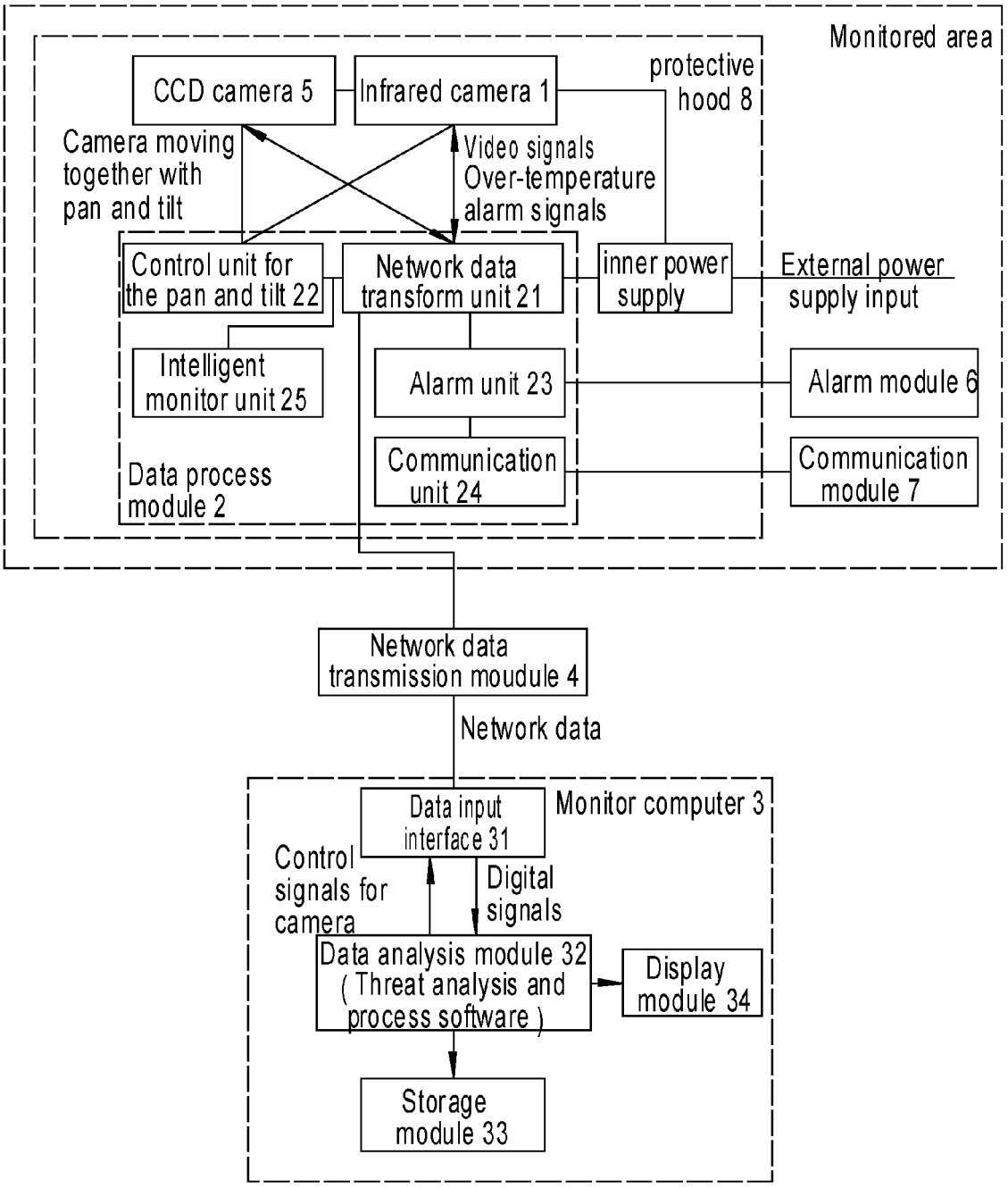
Monitored area
CCD camera 5
Infrared camera 1
protective hood 8
Camera moving together with pan and tilt
Video signals
Over-temperature alarm signals
Control unit for the pan and tilt 22
Network data transform unit 21
inner power supply
External power supply input
Intelligent monitor unit 25
Alarm unit 23
Alarm module 6
Communication unit 24
Communication module 7
Data process module 2
Network data transmission moudule 4
Network data
Monitor computer 3
Data input interface 31
Control signals for camera
Digital signals
Data analysis module 32 (Threat analysis and process software)
Display module 34
Storage module 33

Fig. 2

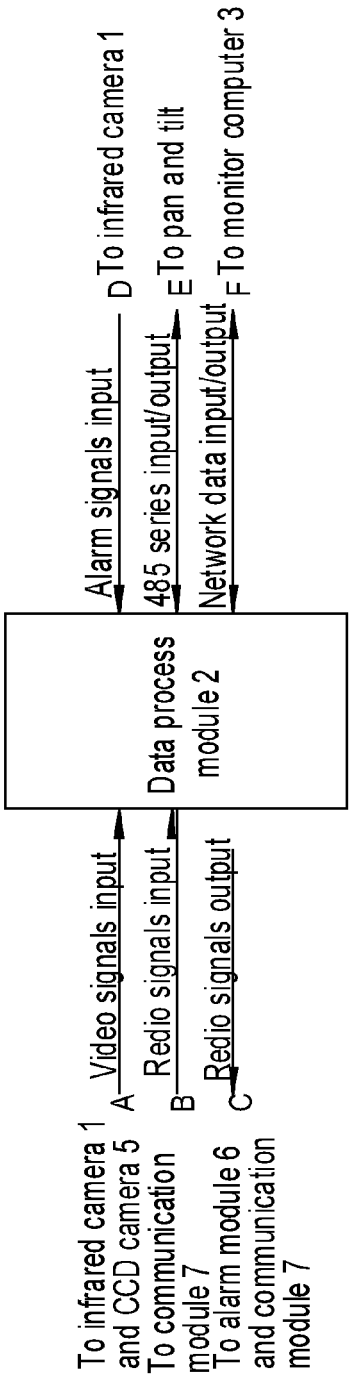
To infrared camera 1 and CCD camera 5
To communication module 7
To alarm module 6 and communication module 7
A
B
C
Video signals input
Redio signals input
Redio signals output
Data process module 2
Alarm signals input
485 series input/output
Network data input/output
D
E
F
To infrared camera 1
To pan and tilt
To monitor computer 3

Fig. 3

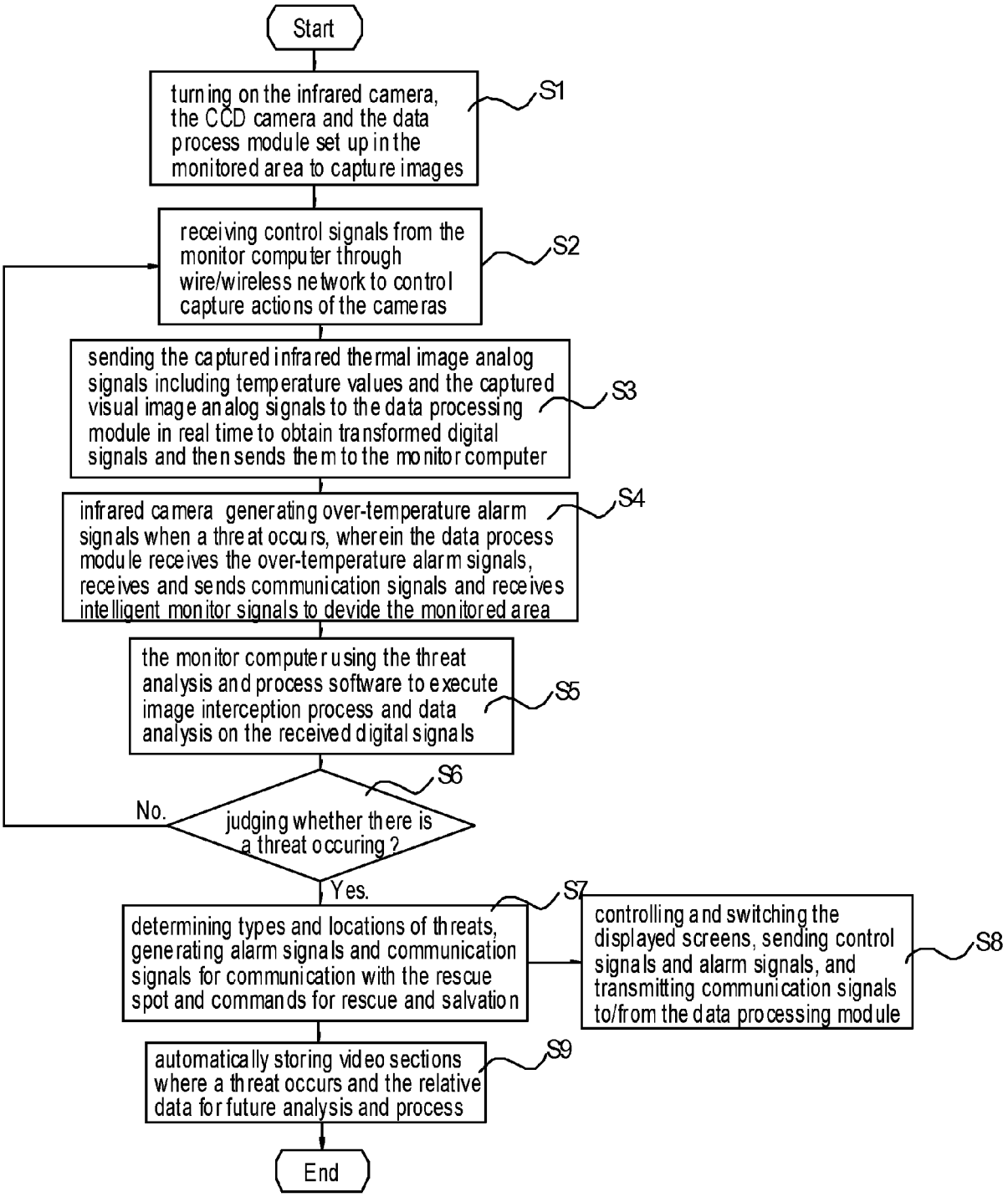
Start
turning on the infrared camera, the CCD camera and the data process module set up in the monitored area to capture images
S1
receiving control signals from the monitor computer through wire/wireless network to control capture actions of the cameras
S2
sending the captured infrared thermal image analog signals including temperature values and the captured visual image analog signals to the data processing module in real time to obtain transformed digital signals and then sends them to the monitor computer
S3
infrared camera generating over-temperature alarm signals when a threat occurs, wherein the data process module receives the over-temperature alarm signals, receives and sends communication signals and receives intelligent monitor signals to devide the monitored area
S4
the monitor computer using the threat analysis and process software to execute image interception process and data analysis on the received digital signals
S5
S6
judging whether there is a threat occuring ?
No.
Yes.
S7
determining types and locations of threats, generating alarm signals and communication signals for communication with the rescue spot and commands for rescue and salvation
controlling and switching the displayed screens, sending control signals and alarm signals, and transmitting communication signals to/from the data processing module
S8
automatically storing video sections where a threat occurs and the relative data for future analysis and process
S9
End

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 11 17 5209

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 December 2011	Wright, Jonathan

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X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

2

EPO FORM 1503 03.82 (P04C01)

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EUROPEAN SEARCH REPORT

Application Number
EP 11 17 5209

DOCUMENTS CONSIDERED TO BE RELEVANT

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			TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 December 2011	Wright, Jonathan

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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