SECURE ACCESS CAMERA AND METHOD FOR CAMERA CONTROL.

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ABSTRACT

A camera and a method for controlling the camera. Also a face recognition secure access camera and a method of capturing an image that is not saturated or too dark.
SECURE ACCESS CAMERA AND METHOD FOR CAMERA CONTROL

CROSS REFERENCE TO RELATED APPLICATIONS

This application is entitled to the benefit of U.S. Provisional Patent Application Serial No. 60/289,655 filed in the United States Patent and Trademark Office on May 9, 2001, which is hereby incorporated herein by reference in its entirety for all purposes.

FIELD OF THE INVENTION

The present invention relates to a camera and a method for controlling the same and more specifically is concerned with a face recognition secure access camera and a method of capturing an image that is not saturated or too dark.

BACKGROUND OF THE INVENTION

Digital video cameras can be used for restricted area access control, time and attendance recording and computer network access control, video surveillance and other applications requiring personal identification to access entitlements, benefits or a service. These applications are known as "secure access" applications and shall be referred to in that manner throughout this document. Personal identification using a biometric for secure access is an emerging field. The prior art camera apparatus and methods of camera control used in secure access are represented by U.S. Pat. No. 4,423,934 granted on Jan. 3, 1983; U.S. Pat. No. 6,111,517 granted on Aug. 29, 2000; U.S. Pat. No. 5,594,816 granted on Jan. 14, 1997; U.S. Pat. No. 6,188,777 granted on Feb. 13, 2001; and, U.S. Pat. No. 6,172,706 granted on Jan. 9, 2001.

The prior art enabled the use of various biometric parameters such as facial features, knuckle features and iris scans to identify individuals and either grant or deny them access to a restricted place. These systems require the capture of a high fidelity image and the comparison of the captured image with a plurality of stored images. Less than ideal ambient lighting conditions at the time of image capture and movement of the individual being verified often results in the verification process failing due to an inability to match the target image with the stored image. As well, a large amount of memory storage and computing processing power is required to compare a target image with thousands of stored images and can result in several seconds being required per individual using the prior art. This renders the prior art either too slow or totally unable to operate in access control applications where personnel traffic is high.

The disadvantages and limitations associated with the prior art apparatus relate to the fact that they cannot produce a high-fidelity image of the target suitable for biometric comparisons in situations where the ambient lighting is not ideal or varies. The contrast between the background and the target face may cause the target face to be saturated by light or too dark. The prior art apparatus cannot scan the target individual, produce a biometric template and execute a biometric comparison with thousands of stored images fast enough to be of practical use in secure access applications. The prior art apparatus cannot be installed in remote locations as stand-alone units because it requires access to storage media and processing power, neither of which is necessarily available in remote locations.

Secure access applications require an apparatus and method that is capable of rendering a high-fidelity image of the target individual suitable for biometric comparisons using facial recognition where ambient lighting is not ideal or varies. The apparatus must be capable of comparing a target image with either one image in a one-to-one application, or a plurality of images in a one-to-many application and capable of being installed in remote locations with onboard memory and processing capacity. The camera apparatus must be small enough and inexpensive to manufacture so that it can be installed at a plurality of remote locations. Target scanning and identity verification must take place within one second in order for such apparatus and method to be useful in secure access applications.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an improved camera and camera control for secure access that overcome the deficiencies of the prior art patents.

Another object of the present invention is to provide an improved camera and camera control that is capable of acquiring a high-fidelity target image and rapidly compare that actual image or a codified or transformed version of that image to a single or a plurality of stored images for identity verification.

A further object of the present invention is to provide an improved camera and camera control that has on-board image processing and storage capacity for secure access applications.

Yet another object of the present invention is to provide fast, repeatable, real-time face verification (one-to-one image comparisons) and face recognition (one-to-many image comparisons) in less than ideal or varying illumination conditions.

In accordance with an aspect of the present invention there is provided a camera for capturing a target image, the camera comprises a body. An image detector for capturing a target image is housed in the body. The image detector has a digital signal output. Alternatively, the image detector may have an analogue output and be connected to an analogue to digital converter. Also housed within the camera body is a video digital signal processor connected to the image detector for processing the digital signal output of the image detector. In another embodiment of the invention there may be a second digital signal processor such as a micro-controller connected to the video digital signal processor for controlling the operation of the camera including pan, tilt, focus and zoom functions. A permanent memory is connected to the video digital signal processor for storing an operating system. In another embodiment of the invention the permanent memory is connected to the micro-controller when the micro-controller is used to control camera functions. A second removable memory is connected to the video digital signal processor for retrievably storing a plurality of images. A software program is included for comparing the target image with the plurality of stored images and authenticating the identity of the target image.

In a further embodiment of the present invention the image detector is a complementary metal-oxide semiconductor sensor (CMOS) having a YUV output.
In another embodiment of the present invention the image detector has a resolution of at least 640 pixels by 480 pixels and is capable of operation in ambient lighting as low as 100 lumens.

In one embodiment of the present invention the video digital signal processor has at least 32 bits and an operating speed of at least 100 megahertz. The video digital signal processor has a memory port, an input port, an output port and a host port. In still another embodiment of the present invention the camera adjusts image exposure and gain or any other pertinent camera control function, to obtain an acceptable facial image under many different ambient lighting conditions, some very stringent.

In yet another embodiment of the present invention the camera further comprises a video encoder having a video output connection interfaced with the video digital signal processor by way of its output port by means of a direct memory access bus. The video encoder is connected to a remote monitor for viewing of the target image.

In another embodiment of the present invention the first permanent memory means is a flash random access memory connected to the video digital signal processor. Optionally, in another embodiment of the invention, it can be connected to the microcontroller. The operating system is stored in the flash random access memory. In one embodiment of the present invention and upon camera start-up the operating system is loaded from the flash random access memory to the video digital signal processor. In another embodiment of the invention the operating system is loaded into the micro-controller.

In still another embodiment of the present invention the micro-controller and video digital signal processor have universal asynchronous transmitter receivers for connecting to a bit-serial communications network.

In another embodiment of the present invention a control loop automatically adjusts image exposure. The control loop is a software program stored in the camera’s flash random access memory.

In one embodiment of the present invention the replaceable memory storage means consists of a random access memory module connected to the video digital signal processor by way of its memory bus. The random access memory module has a capacity of at least 8 mega bytes and is capable of storing a plurality of coded or transformed images.

In another embodiment of the present invention the video digital signal processor is connected to at least one peripheral device chosen from a group of peripheral devices consisting of proximity card readers, magnetic card readers, bar card readers, smart card readers, finger print readers, voice recognition devices, LCD displays, printers and keypads.

Another aspect of the present invention is directed to a method of camera control to capture an image of a face that is not saturated or too dark. This kind of control is useful when the background is of different intensity than the face (darker or brighter). In one embodiment of the present invention several sequential images of the same target are taken using different exposures or gains. These images can then be combined into a single one to produce a much better rendering of the face in spite of the variability of the lighting conditions over the surface.

In still another embodiment of the invention, the control loop is divided into two sub-loops. Each of these sub-loops controls the resulting intensity on one side of the face of the target image. When each control loop has converged for its own side of the face, the views are merged using a technique called “Gamma Correction”. This technique has the effect of amplifying the low intensity pixels more than the high-intensity pixels showing more detail in the dark regions of the image. “Gamma Correction” is used to compress the dynamic range of intensities measured by the two acquired images. In this way the measured intensities are made to fit into a standard image in which each pixel’s intensity value is represented by 8 bits.

The method of camera control comprises the steps of: providing a camera control loop consisting of a first exposure control loop for a first side of the face of an individual and a second exposure control loop for a second side of the face of an individual; then acquiring a target image; then acquiring the face of the target image; capture a first image of the face of the target; then using the first exposure control loop measuring the average intensity of the pixels on a first side of said face; comparing measured intensity to a predetermined set point; adjusting camera exposure levels so that the measured intensity meets said predetermined set point; capturing a second image of the face; then using the second exposure control loop measuring the average intensity of the pixels on the side of said second image of the face opposite to that measured on the first image; comparing measured intensity to a predetermined set point; adjusting camera exposure levels to said predetermined set point; merge the output of said first and second exposure control loops into one image using an image merging method.

In one embodiment of the present invention camera sensitivity is controlled by first acquiring a first image of a first side of the face of a person and then measuring the intensity on that first side of the face. The average intensity on the first side of the face is estimated. For example, the average intensity may be 115 out of a maximum value of 255. The predetermined set point may be 140. Therefore it is necessary to increase the exposure of the camera to bring the measured intensity to the desired intensity. Alternatively, if the exposure setting of the camera is at maximum then it is necessary to increase the gain of the camera. Due to camera sensitivity it may not be possible to obtain the predetermined set point. Camera sensitivity is a measure of the ability of the camera to achieve the predetermined set point. Camera sensitivity is one factor used to compute the change in exposure or gain necessary to meet the predetermined set point for any given intensity reading. The predetermined set point may be achieved within plus or minus 10 units, that is, between 130 and 150. Therefore, in this example, the difference between the predetermined set point and the measured intensity is 25 units. Camera sensitivity will determine whether or not the exposure should be increased by the full 25 units or some other greater or lesser value. In this embodiment of the present invention the camera will anticipate the reaction of the camera to exposure or gain corrections and provide an estimated correction factor for camera sensitivity. For example, if the camera
sensitivity were assumed to be a factor of one and the exposure were increased by 25 units resulting in a new exposure of 155, then the sensitivity of the camera would have to be reduced to bring the exposure value to within
tolerance.

[0025] Each image for each side of the face is acquired by: measuring the average intensity on the left or on the right of the face for the first or the second image respectively; adjusting the camera settings so as to increase or decrease the intensity on this region of the face; updating the estimate of the camera response sensitivity. If the change in gain of the camera is adjusted to be too high, the control loop will produce unstable image intensity and if it is too low the control will be slow. This parameter is an estimate of the gain of the camera. When the camera response sensitivity is well established the new gain and exposure settings of the camera can be determined more precisely.

[0026] In another embodiment of the present invention a method of merging the images is provided consisting of the steps of: calculating the average intensity of each pixel of each image by first correcting the intensity of each pixel of the first and second image by an exposure factor, second, summing the intensity of the same pixel of the first and second image and then dividing the summed intensity by two; calculating the maximum averaged intensity of each pixel; dividing the average intensity of each pixel by the maximum averaged intensity of each pixel; applying a compression factor to the quotient.

[0027] In yet another embodiment of the present invention gain control is used when camera exposure has been set to its maximum value.

[0028] The use of the camera and camera control of the present invention makes it possible to produce a camera for secure access and personal identification applications that can function in less than ideal and varying illumination conditions. The increased speed of image recognition will allow the present invention to be applied in a variety of security, access control and authorized person verification applications.

[0029] In yet another aspect of the present invention there is a provision for a method of authorized personnel identity authentication using face recognition and using a camera comprising: a body; an image detector for capturing a target image said image detector having a digital signal output; a video digital signal processor connected to said image detector for camera control and processing said digital signal output wherein said image detector and said digital processor are adjacent to each other and contained in said camera body; a first permanent memory means connected to the video digital signal processor for storing said operating system; a second removable memory means connected to said first digital processor for retrievably storing a plurality of images comprising the steps of:

[0030] a. placing a plurality of cameras at locations where personnel authentication using face recognition is required;
[0031] b. connecting said plurality of cameras in a networked configuration;
[0032] c. connecting said networked configuration to a central processing unit wherein said central processing unit includes a database of a plurality of images of authorized personnel;
[0033] d. capturing the image of an authorized person;
[0034] e. transmitting said image to said central processing unit by the network;
[0035] f. verifying the image as the image of an authorized person.

[0036] In still another aspect of the present invention there is provided a method of surveillance of restricted areas using face recognition and using a camera comprising: a body; an image detector for capturing a target image said image detector having a digital signal output; a video digital signal processor connected to said image detector for camera control and processing said digital signal output wherein said image detector and said digital processor are adjacent to each other and contained in said camera body; a first permanent memory means connected to said video digital signal processor for storing said operating system; a second removable memory means connected to said first digital processor for retrievably storing a plurality of images, comprising the steps of:

[0037] a. placing a plurality of cameras at locations where personnel authentication using face recognition is required;
[0038] b. connecting said plurality of cameras in a networked configuration;
[0039] c. connecting said networked configuration to a central processing unit wherein said central processing unit;
[0040] d. capturing the facial image of a person entering the restricted area;
[0041] e. transforming said captured image to a digital format;
[0042] f. indexing the captured image for time and location;
[0043] g. transmitting said image to said central processing unit by the network;
[0044] h. storing the image for subsequent retrieval.

BRIEF DESCRIPTION OF DRAWINGS

[0045] The present invention will be further understood from the following description with references to the drawings in which:

[0046] FIG. 1 illustrates in block diagram form a camera in accordance with one embodiment of the present invention.
[0047] FIG. 2 illustrates in block diagram form a camera in accordance with another embodiment of the present invention.
[0048] FIG. 3 illustrates in block diagram form a camera in accordance with yet another embodiment of the present invention.
[0049] FIG. 4 illustrates in block diagram form a camera control loop in accordance with one embodiment of the present invention.
FIG. 5 illustrates in block diagram form a camera control loop in accordance with yet another embodiment of the present invention.

DETAILED DESCRIPTION

[0051] Referring to FIG. 1 there is illustrated in block diagram form a camera in accordance with one embodiment of the present invention. The camera (10) includes an image detector (12) having a digital signal output (14), a video digital signal processor (16), a flash random access memory (20) for storing an operating system, and removable memory (18) for storing a plurality of images. Upon camera start-up the operating system (22) is loaded from the flash random access memory (20) to the video digital signal processor (16). The video digital signal processor (16) has a universal asynchronous transmitter receiver (24) for connecting to a bit-serial communications network (26).

[0052] The image detector (12) is a complementary metal-oxide semi conductor sensor (CMOS) having a YUV output (14) and is connected to the video digital signal processor (16) from the YUV output (14) of the image detector to the left input (28) of the video digital signal processor by way of direct memory access bus (30). Memory (18) is connected to the video digital signal processor memory port (32) by way of memory bus (34). Memory (18) has at least a capacity of 8 mega bytes and is capable of storing a large number of transformed or coded images. The video digital signal processor has at least 32 bits and operates at a speed of at least 100 megahertz and has a memory port (32), a left input port (28), a right output port (36) and a host port (38). The camera includes software (40) for adjusting image exposure and gain, and tracking the image across a visual field. The video digital signal processor (16) operates a variety of camera control functions including pan (42), zoom (44), tilt (46) and focus (48). Analogue sensors (50) and limit sensors (52) provide input to the video digital signal processor for camera control. A video encoder (54) is connected to the right output port (36) of the video digital signal processor (16) by way of direct memory access bus (56). The video out connection (58) of the video encoder (54) is connected to a monitor (60) for remote viewing of the target image.

[0053] Referring to FIG. 2 there is shown a block diagram of another embodiment of the present invention. Microcontroller (62) is connected to the video digital signal processor (16) from host port (38) on the video digital signal processor by way of bus (64). Microcontroller (62) controls camera pan (42), tilt (44), focus (46) and zoom (48) functions using limit sensors (52) and analogue sensors (50). Flash memory (20) is connected to micro-controller (62) and stores operating system software (22) and camera control software (40). Micro-controller (62) is connected to a universal asynchronous transmitter receiver (24) for connecting to a bit-serial communications network (26).

[0054] Image detector (12) has a resolution of at least 640 pixels by 480 pixels and is capable of operation in ambient lighting as low as 100 lumens.

[0055] Referring to FIG. 3 there is shown in block diagram format yet another embodiment of the present invention. The video digital signal processor (16) is connected to at least one peripheral device chosen from a group of peripheral devices consisting of a proximity card reader (70), a magnetic card reader (72), a bar card reader (74), a smart card readers (76), a finger print reader (78), a voice recognition device (80), a LCD display (82), a printer (84) and a keypad (88).

[0056] Referring to FIG. 4, there is illustrated a control loop in block diagram form of an embodiment of the present invention. Camera (100) is used to acquire a target image and produces video stream (200). Imaging software (300) acquires the face of the target image and captures a first image of the face. As represented by block (400) the average intensity of each pixel on a first side of said face is measured. As represented by block (500) there is a time delay in the order of several milliseconds for the average intensity on the side of the face to be estimated. A comparator (600) compares the estimated intensity with a predetermined set point intensity (700). As represented by block (800) an adjustment to camera exposure is calculated based on the difference between the measured average intensity on the first side of the face and the predetermined set point. As represented by block (850) a new camera exposure level is calculated. Then as represented by block (900) the camera settings are adjusted to the new exposure level. The process is repeated until the average intensity meets the predetermined set point within plus or minus about 10 units.

[0057] Referring to FIG. 5 there is shown in block diagram format a control loop in accordance with another embodiment of the invention. If the exposure setting of the camera is at a maximum value then it will be necessary to increase the gain on the camera. The measured average exposure intensity is compared by comparator (1000) with a predicted exposure intensity (1010) based on the current gain (1020) of the camera. As represented by block (1030) where camera exposure is already at a maximum a new gain value is calculated in order to obtain the desired exposure. The new gain value is used to adjust the camera settings (900). The process is repeated until the average intensity meets the predetermined set point within plus or minus about 10 units.

[0058] Referring to FIGS. 4 and 5, the process is repeated for the opposite side the face of the captured image.

[0059] The first and second images are then merged into one image using an image merging method. The method of merging the two images can be explained by reference to the following formulae and explanation:

\[ I_p = \frac{2 (I_p / \text{Expo}_p)^2}{I_{\text{merged}} (I_p / \text{Expo}_p)^2} \]

\[ I_{\text{merged}} = I_p \cdot \text{Expo}_p \]

[0060] Where:

\[ [0061] I_p \text{ is the intensity on image (i) pixel (p)} \]

\[ [0062] \text{Expo}_p \text{ is the exposure used for image (i)} \]

\[ [0063] I_p \text{ is the averaged intensity on pixel (p)} \]

\[ [0064] I_{\text{merged}} \text{ is the maximum averaged intensity} \]

\[ [0065] I_{\text{merged}} \text{ is the averaged image after dynamic range compression using “Gamma Correction”}. \]

[0066] In Formula (1) the intensity of each pixel is first averaged by taking into consideration the exposure used to acquire the corresponding image. For example, this equation expresses the fact that a bright pixel taken at high exposure is equivalent to a dark pixel taken at low exposure. This
equation provides a way to average the intensities in the two images. Other algorithms for this function are also possible.

[0067] Formula (2) is used to compress the dynamic range of the resulting averaged image. Such an image does not fit into a regular 8-bit image. It needs to be “compressed”. The kind of compression applied by equation (2) has the effect of giving more range to the dark regions and less to the bright ones. The resulting image is usually more pleasing to the eye and tends to expose the small details hidden within the dark regions. Other algorithms for this function are also possible.

[0068] Numerous modifications, variations, and adaptations may be made to the particular embodiments of the invention described above without departing from the scope of the invention that is defined in the claims.

What is claimed is:

1. A camera comprising:
   a. a body;
   b. an image detector for capturing a target image housed in said body, said image detector having a digital signal output;
   c. a video digital signal processor connected to said image detector for camera control and processing said digital signal output wherein said image detector and said digital processor are adjacent to each other and housed in said camera body;
   d. an operating system for controlling camera functions;
   e. a first permanent memory means connected to said video digital signal processor for storing said operating system;
   f. a second removable memory means connected to the video digital signal processor for retrievably storing a plurality of images.

2. The camera as claimed in claim 1 wherein the image detector has an analogue signal output and is connected to an analogue to digital signal converter.

3. The camera as claimed in claim 1 wherein said camera control is accomplished by a micro-controller connected to the video digital signal processor.

4. The camera as claimed in claim 3 wherein said first permanent memory means is connected to said micro-controller.

5. The camera as claimed in claims 1 and 4 wherein camera control comprises control of pan, tilt, focus and zoom.

6. The camera as claimed in claim 1 wherein said image detector is a complementary metal-oxide semi-conductor sensor having a YUV output.

7. The camera as claimed in claim 6 wherein the camera is adjustable for pan, tilt, focus and zoom.

8. The camera as claimed in claim 7 wherein said image detector has a resolution of at least 640 pixels by 480 pixels and is capable of operation in ambient lighting of no less than 100 lumens.

9. The camera as claimed in claim 8 wherein the first digital signal processing means is a video digital signal processor.

10. The camera as claimed in claim 9 wherein the video digital signal processor has at least 32 bits and operates at a speed of at least 100 megahertz, further having a memory port, an input port, an output port and a host port.

11. The camera as claimed in claim 10 wherein the video digital signal processor includes a control loop for adjusting image exposure and gain.

12. The camera as claimed in claim 11 wherein said input port of the video digital signal processor is directly interfaced with the YUV output of the complementary metal-oxide semi-conductor sensor by means of a direct memory access bus.

13. The camera as claimed in claim 12 further comprising a video encoder having a video output connection interfaced with the video digital signal processor by way of its output port by means of a direct memory access bus.

14. The camera as claimed in claim 13 wherein the video output connection of the video encoder is connected to a monitor.

15. The camera as claimed in claim 4 wherein the micro-controller is connected to the host port of the video digital signal processor.

16. The camera as claimed in claim 14 or 15 wherein the first permanent memory means is a flash random access memory.

17. The camera as claimed in claim 15 wherein said flash random access memory is connected to the micro-controller.

18. The camera as claimed in claim 16 wherein an operating system is stored in the flash random access memory.

19. The camera as claimed in claim 18 wherein the operating system is stored on a replaceable recordable micro disk.

20. The camera as claimed in claim 19 wherein upon camera start-up the operating system is loaded from the flash random access memory to the video digital signal processor.

21. The camera as claimed in claim 17 wherein upon camera start-up the operating system is loaded from the flash random access memory to the micro-controller.

22. The camera as claimed in claim 21 wherein the micro-controller is connected to a universal asynchronous transmitter receiver for connecting to a bit-serial communications network.

23. The camera as claimed in claim 1 wherein the video digital signal processor is connected to a universal asynchronous transmitter receiver for connecting to a bit-serial communications network.

24. The camera as claimed in claim 23 wherein means for adjusting image exposure and gain comprises an exposure control loop and a gain control loop respectively.

25. The camera as claimed in claim 24 wherein means for tracking the image across a visual field comprises a tracking control loop.

26. The camera as claimed in claim 25 wherein the replaceable memory storage means consists of a random access memory module connected to the video digital signal processor by way of its memory bus.

27. The camera as claimed in claim 26 wherein said random access memory module has a capacity of at least 8 mega bytes and is capable of storing a plurality of images.

28. The camera as claimed in claim 27 wherein said video digital signal processor is connected to at least one peripheral device chosen from a group of peripheral devices consisting of proximity card readers, magnetic card readers, bar card readers, smart card readers, fingerprint readers, voice recognition devices, LCD displays, printers and keypads.
29. A method of camera control comprising the steps of:
   a. providing a camera control loop consisting of a first exposure control loop for a first side of the face of a target image and a second exposure control loop for the second side of the face of a target image;
   b. using the camera, acquire a target image;
   c. acquiring the face of the target image;
   d. capture a first image of the face;
   e. using the first exposure control loop measuring the average intensity of the pixels on a first side of said face;
   f. comparing measured intensity to a predetermined set point;
   g. adjusting camera exposure levels so that measured intensity meets said predetermined set point;
   h. capturing a second image of the face;
   i. using the second exposure control loop measuring the average intensity of the pixels on the side of said second image of the face opposite to that measured on the first image;
   j. comparing measured intensity to a predetermined set point;
   k. adjusting camera exposure levels so that the measured average intensity meets a predetermined set point;
   l. merging the output of said first and second exposure control loops into one image using an image merging method.

30. The method of claim 29 wherein said image merging method consists of the following steps:
   a. Calculating the average intensity of each pixel of each image by:
      i. correcting the intensity of each pixel of the first and second image by an exposure factor;
      ii. summing the intensity of the same pixel of the first and second image;
      iii. dividing the summed intensity by two.
   b. calculating the maximum averaged intensity of each pixel;
   c. dividing the average intensity of each pixel by the maximum averaged intensity of each pixel;
   d. applying a compression factor to the quotient of step c.

31. A method of authorized personnel identity authentication using face recognition and using a camera comprising: a body; an image detector for capturing a target image said image detector having a digital signal output; a video digital signal processor connected to said image detector for camera control and processing said digital output wherein said image detector and said digital processor are adjacent to each other and contained in said camera body; a first permanent memory means connected to said video digital signal processor for storing said operating system; a second removable memory means connected to said first digital processor for retrievably storing a plurality of images; comprising the steps of:
   a. placing a plurality of cameras at locations where personnel authentication using face recognition is required;
   b. connecting said plurality of cameras in a networked configuration;
   c. connecting said networked configuration to a central processing unit wherein said central processing unit includes a database of a plurality of images of authorized personnel;
   d. capturing the image of an authorized person;
   e. transmitting said image to said central processing unit by the network;
   f. verifying the image as the image of an authorized person.

32. A method of surveillance of restricted areas using face recognition and using a camera comprising: a body; an image detector for capturing a target image said image detector having a digital signal output; a video digital signal processor connected to said image detector for camera control and processing said digital signal output wherein said image detector and said digital processor are adjacent to each other and contained in said camera body; a first permanent memory means connected to said digital processor for storing said operating system; a second removable memory means connected to said first digital processor for retrievably storing a plurality of images, comprising the steps of:
   a. placing a plurality of cameras at locations where personnel authentication using face recognition is required;
   b. connecting said plurality of cameras in a networked configuration;
   c. connecting said networked configuration to a central processing unit wherein said central processing unit;
   d. capturing the facial image of a person entering the restricted area;
   e. transforming said captured image to a digital format;
   f. indexing the captured image for time and location;
   g. transmitting said image to said central processing unit by the network;
   h. storing the image for subsequent retrieval.