

A Method of Recording Quality Images

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Field of invention:

The present invention relates to a method of recording quality images during an important event detected by Video Content Analysis (VCA) in digital video
10 recorders.

Background of invention:

There are known methods for recording quality images during an important
15 event in prior art.

US patent application 20060171452 describes a method and apparatus for dual mode digital video recording. This patent focuses on a surveillance system comprising receiving video data from a surveillance camera, recording
20 the received video data at a first rate, and recording the received video data at a second rate with the second rate being slower than the first rate. The quality images can be retrieved from the video data that is recorded at the slower rate.

25 US patent 6757008 describes a video surveillance system where a linescan camera is used in conjunction with a mechanical scanning mechanism to acquire high-resolution images of an area under video surveillance. The video

- signal from the linescan camera is converted into a digital data stream, compressed, and stored in a digital memory. Under control of an operator, full-field images are selectively recalled from the digital memory and converted to a lower resolution for display on a monitor. The operator selects
- 5 a region-of-interest from the full-field display through the use of a computer pointing device, such as a mouse. The selected area is then displayed on the monitor in its full acquired resolution, thereby allowing the operator to view high-resolution images of a large area under surveillance.
- 10 US patent application 20040001149 describes a surveillance system formed from two video cameras monitoring the same area, where the first camera provides high temporal resolution, such as a conventional CCTV camera operating at 30 frames per second with 640 pixels per image width. The second camera provides high spatial resolution, such as a linescan sensor
- 15 with a mechanical scanning assembly, providing 2 images per second with 5120 pixels per image width. The combination of these two cameras provides a video record of the monitored region with simultaneous high spatial resolution and high temporal resolution.
- 20 There also known methods and apparatus for detecting and analyzing potential events in prior art.
- US patent application 20040161133 describes a system and method for video content-based detection, surveillance and alarm management, which is used
- 25 in detection of unattended objects.

The main characteristics of MPEG are the compression of motion images by storing key images and motion information of intermediate frames, thus achieving a smaller file size stored, compared to storing each separate image. Depending on the bit-rate per second, the quality of the compression may be
5 chosen by the user. The disadvantage of this compression method is that video defects known as artifacts may occur, due to insufficient information for reconstructing the intermediate frames. This is usually caused by a recording of busy images set with a lower bit-rate than desired, or during the streaming of MPEG data which is degraded due to network infrastructure.

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Digital video recorder systems utilizing the MPEG video compression method enable compact and efficient storage of video images with configurable preset video size-per-second to achieve the desired recording period within a defined of limited storage space. MPEG compression also allows for the quick
15 transmission and replay of the stored video file.

MJPEG (Motion JPEG) is a multimedia format where each frame of a video is compressed individually using the JPEG standard. MJPEG results in high quality minimally compressed images; however, this results in comparatively
20 large file sizes.

Conventional digital video recorders (DVRs) use the MPEG standard to overcome the minimal storage system. However, when there is an important event, the images recorded are not of desired quality and it is difficult to
25 extract useful information from the images due to poor quality. The prior art mentioned above address this problem by introducing high resolution cameras. However the issue of limited storage is not addressed. The present

invention will offer a system where quality images are recorded when potential events are detected using Video Content Analysis (VCA) technology, while continuously compressing the images using the MPEG format to provide 24 hours digital video recording. This invention offers the best possible balance
5 between providing quality images during potential events such as security breaches and fulfilling the 24 hours digital video recording on a limited storage space.

Summary of invention:

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It is an object of the present invention to provide a method of recording quality images when a potential event is detected.

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It is also an object of the present invention to continuously compress images using a high quality video compression format to provide 24 hours of continuous digital video recording.

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It is another object of the present invention to offer the best balance between providing of quality images during potential security breaches and fulfilling the 24 hours digital video recording on a predefined storage space.

Most preferably, the method is used in capturing video for a live streaming video signal from surveillance cameras.

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Most preferably, the quality images are compressed in the MJPEG (Motion JPEG) format.

Most preferably, the video images are compressed in the MPEG format.

Preferably, the images are stored in the MJPEG format before, during and immediately after an event occurs. This will ensure that the event can be
5 played back with minimal quality degradation and useful information can be extracted from the recorded images.

Preferably, the non-volatile storage would be a secondary storage device, such as a hard disk, server or any other effective non-volatile magnetic disks
10 or storage devices.

It is an essential feature of the invention to record high quality images in the MJPEG format during a detected potential event while concurrently recording and compressing images in MPEG standard.
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Brief description of figures:

Figure 1 illustrates the process flowchart of the invention.

20 Detail description of invention:

Changes therein and other uses will occur to those skilled in the art which are encompassed within the scope of the invention as defined by the scope of the claims. The most preferred embodiment of the invention will now be described
25 hereforth. While specific configurations and parameters are discussed, a person skilled in the art will recognize that the others could be used without departing from the spirit and scope of the invention.

Figure 1 illustrates the process flowchart of the dual digital video recording based on trigger signal from Video Content Analysis (VCA) system. There are two main processes running simultaneously, wherein each process branches
5 into two sub-processes.

The present invention provides a method for recording quality images when a potential event is detected, as in shown in Figure 1. The image(s) are copied to an event buffer (15) when an alert is triggered from the VCA Result
10 Analyzer (11). The image(s) are then converted into the MJPEG format and copied to a non-volatile storage medium (16) such as a hard disk, where the event images in the non-volatile storage medium (17) may be accessed later when needed.

15 Images recorded with the MJPEG format are higher quality images with less occurring artifacts. The file sizes are comparatively larger than the formats conventionally used; therefore the present invention solves this by recording in this format when needed only.

20 The images are stored in the MJPEG format before, during and immediately after an event occurs. This will ensure that the event can be played back with minimal quality degradation and useful information can be extracted from the recorded images.

The storage used in this invention is a non-volatile secondary storage device, such as a hard disk. However, any other effective non-volatile storage may be used to store the images.

5 The present invention further provides a method for detecting potential events by utilizing Video Content Analysis. The image is captured using a camera and is converted into a RAW image format (1), which is stored in a RAW image buffer (3) when required (2). This RAW image format is copied (4) and further converted to an image format required by the VCA module (5). After
10 conversion, the image is transferred to the VCA module (7) to be processed (6). The results and image will be then pushed into a result analyzer (8). The result analyzer will determine whether to trigger an alert (12). If an alert is triggered, a record is made in the metadata (13); finally the event metadata is stored in a non-volatile storage (14), preferably a hard disk.

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Examples of potential events are in the form of unattended baggage and/or unusual behavior. Other possible events include, but are not limited to; intrusion detection, crossing of specifically defined line, crowd detection and against crowd flow detection (where one person walks in a different direction
20 from the rest).

This system utilizes a VCA module (7) which is a module for determining a potential event and a MJPEG encoder and decoder for compressing the images into a high quality format. The VCA module (7) analyzes the image
25 and based on the rules set, returns a result which determines the quality of images recorded.

While images that are taken from the camera are being processed for potential events, there is a concurrent and continuous compression of images using the MPEG format.

- 5 The present invention also provides the retrieval and playback of stored data comprising the steps of returning of event metadata (24), listing event found in metadata (25), selecting of event to playback (32), playback of event image(s) (27), synchronization with MPEG video (33), comparing of event metadata against MPEG data to determine corresponding MPEG video (29), selecting
10 of MPEG video to playback (34) and playback of MPEG video (31).

The present invention further provides a method of storing both the MPEG and MJPEG compressed images on a non-volatile storage by capturing the image and converting it into a RAW image (1), transferring of captured image to the
15 MPEG compressor (18, 19), making record in metadata for MPEG (22) and finally storing the MPEG data into a non-volatile storage (23).

The indexing of events of the MPEG video enables the user of this system to navigate to the desired event easily.

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The system that utilizes this method of the present invention comprises a:

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- a. motherboard,
 - b. graphic card,
 - c. frame capture card,
 - d. video compression card,
 - e. video compression software,

- f. secondary storage such as a hard disk,
- g. main memory and
- h. CPU

5 Other formats that may be used in the method and system are as follows:

Still images oriented compression format or motion image oriented compression format suitable for high quality image storage	Video oriented compression format that have higher storage efficiency over quality of a single frame
JPEG JPEG2000 Lossless JPEG JBIG JBIG2 PNG WBMP BMP ICER ILBM PCX PGF TGA TIFF JPEG XR MJPEG MJPEG2000 (MJ2) Pixlet	MPEG-1 MPEG-2 MPEG-4 ASP MPEG-4/AVC H.261 H.262 H.263 H.264 AVS Bink Dirac Indeo RealVideo Theora VC-1 VP6 VP7 WMV

It is to be understood that the present invention may be embodied in other specific forms and is not limited to the sole embodiment described above.

10 Modification and equivalents of the disclosed concepts such as those which

readily occur to one skilled in the art are intended to be included within the scope of the claims which are appended thereto.

For example, changes may be made with respect to the hardware or software
5 of the invention. Due to technological advances in the future, the hardware of the entire system may be simplified or extended by adding or removing components, while still maintaining the gist of the invention, which is a method of recording quality images when a potential event is detected.

What is claimed is:

1. A method of recording quality images when a potential event is detected comprising the steps of,
 - 5 a. copying of image to an event buffer (15) when an alert is triggered from the VCA Result Analyzer (11,12);
 - b. converting of image(s) to a high quality image(s) compression format;
 - 10 c. copying of high quality image(s) to a non-volatile storage (16) and;
 - d. storing of event images(s) in a non-volatile storage (17).
2. A method of detecting potential events comprising the steps of,
 - 15 a. capturing the image and converting it to a RAW image (1);
 - b. transferring the RAW image to a RAW image buffer (3) when required (2);
 - c. copying the RAW image into an analyzer buffer (9, 10);
 - d. copying the RAW image (4);
 - 20 e. converting the RAW image to an image format required by the VCA module (5, 7);
 - f. transferring the converted image to the VCA module (6, 7);
 - g. pushing of the VCA results to a result analyzer (8);
 - h. determining of whether an alert is triggered in the VCA Result
 - 25 Analyzer (12);
 - i. making a record in metadata when an alert is triggered (13);
 - j. storing of event metadata in a non-volatile storage (14).

3. A system for recording quality images when a potential event is detected, comprising, a VCA module (7) and VCA Result Analyzer (12) for determining a potential event, a high quality image(s) compression format encoder and decoder, and non-volatile secondary storage for storing and retrieving images of the potential event.
4. A system for recording quality images when a potential event is detected of claim 3, further comprising a method of concurrent continuous compression of images using a high quality video compression format.
5. A system for recording quality images when a potential event is detected of claim 3, further comprising a method of storing both the high quality video compression formatted image(s) and high quality image(s) compression formatted image(s) on a non-volatile storage comprising the steps of
- a. capturing the image and converting it into a RAW image (1);
 - b. transferring of captured image to the high quality video compressor (18, 19);
 - c. making record in metadata for the resulting high quality video compression formatted image(s) (22) and
 - d. storing the high quality video compression formatted image(s) data into a non-volatile storage (23).

6. A system for recording quality images when a potential event is detected of claim 3, further comprising the steps of retrieval and playback of stored data comprising the steps of

- 5 a. returning of event metadata (24);
- b. listing of event found in metadata (25);
- c. selecting of event to playback (32);
- d. playback of image(s) (27);
- e. synchronization with high quality video (33);
- 10 f. comparing of event metadata against high quality compression
 video metadata to determine corresponding high quality
 compression formatted video (29);
- g. selecting of high quality compression formatted video to playback
 (34) and
- 15 h. playback of high quality compression formatted video (31).

7. A system of recording quality images when a potential event is detected of claim 3, further comprising a:

- 20 a. motherboard,
- b. graphic card,
- c. frame capture card,
- d. video compression card,
- e. secondary storage,
- 25 f. main memory and
- g. CPU

8. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is MJPEG (Motion JPEG).
- 5 9. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is JPEG2000.
- 10 10. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is Lossless JPEG.
- 15 11. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is JBIG.
- 20 12. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is JBIG2.
- 25 13. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is PNG.
14. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is WBMP.

15. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is BMP.

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16. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is ICER.

10 17. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is ILBM.

15 18. A method of recording quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is PCX.

19. A method of recording high quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is PGF.

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20. A method of recording high quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is TGA.

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21. A method of recording high quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is TIFF.
- 5 22. A method of recording high quality images when a potential event is detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is JPEG XR.
23. A method of recording high quality images when a potential event is
10 detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is MJPEG2000 (MJ2).
24. A method of recording high quality images when a potential event is
15 detected of anyone of claims 1 to 7, wherein the high quality image(s) compression format is Pixlet.