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(54) Title: DETECTING SCENE CHANGES

(57) Abstract

Scene changes in a video sequence are detected by generating data representing the amount of information present in each video frame. This information is processed in such a way that significant changes in the information content are identified as positions where scene changes are likely to occur. The amount of information present in each video frame is determined by compressing the video in accordance with a spatial algorithm, such as JPEG. Under such compression techniques, the amount of data present after compression will vary, depending upon the amount of information present in the original scenes. Thus, for each frame, information is available identifying the amount of data present in the compressed video. This information is analysed on a frame-by-frame basis, providing information identifying the presence of scene changes. In a facility for editing the video, or editing audio for synchronisation against a video track, the scene change information may be displayed to an operator. In a security system, the occurence of a scene change may be identified as an intruder entering an area observed by a camera. On detecting an intruder in this way, various measures may be taken, such as activating a video tape recorder.

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DETECTING SCENE CHANGES

FIELD OF THE INVENTION

The present invention relates to methods and apparatus for detecting the position of scene changes in video sequences.

BACKGROUND OF THE INVENTION

In professional television production, it is conventional practice to use a first medium for recording the video pictures and a second medium for recording the sound. Subsequently, editing may be performed separately upon the recorded images and again separately upon the recorded sound, often with additional sounds being added to the sound track recorded during the initial production. Thereafter, the vision and the sound are brought together to produce the final result.

As used herein, pictures recorded or transmitted in electrical form will be referred to as video signals, sound transmitted or recorded in electrical form will be referred to as audio signals and the combination of the two will be referred to as television signals. Thus, as previously described, the final editing step involves the combining of edited video with edited audio to produce a television signal, in which the sound is synchronised with the pictures.

The majority of editing procedures consist of initially editing the video signals and, thereafter, adding the audio

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track to the previously edited video track. This may involve combining audio signals from many different sources and audio mixing facilities for performing this combination of different source material are known. However, a problem with editing an audio track to a previously edited video track is that it can take a significant amount of time to locate positions within the video track at which changes are to occur to the audio track. Usually, these changes take place when the video track cuts between scenes, or when something significant happens to the video pictures.

It is an object of the present invention to provide a method of detecting the position of scene changes in video sequences.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a method of detecting the position of a scene change in a video sequence, characterised by the steps of generating data representing the information content of each video frame; processing said data to locate significant changes in said information content and identifying the position of said significant changes, so as to identify the position of likely scene changes.

In a preferred embodiment, information content is determined by compressing the video data and assessing how much data is present after compression. Compression may be performed in accordance with the JPEG standard for spatial

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compression, wherein, the amount of data resulting for each frame (after compression has taken place) will vary, in dependence upon the information content of the initial source frame.

In a preferred embodiment, the method is used to identify scene changes in a previously edited video sequence, allowing an audio track to be edited to said video sequence.

In a second preferred embodiment, scene changes are detected in un-edited video, to facilitate the editing of the video material. Preferably, the editing of source video material is performed together with the editing of source audio material, thereby removing the constraint of having to edit either the audio material of the video material first.

The previously described preferred embodiments relate to using the inventive technique on recorded video. In a preferred third embodiment, the method is used on live video, possibly produced by a video camera. Thus, the method may be employed in security systems, in which a significant change in the information content of the scene may be interpreted as an intruder entering into an area subject to video surveillance. Thus, on detecting the presence of such an intruder, further measures may be taken, such as raising an alarm, activating additional

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circuits, switching on a recording device or improving the

quality of recordings made by a recording device.

The invention will now be described by way of example

only, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a system for editing audio signals, to

create an audio track for a previously edited video track,

including an audio display, a video display and a

processing unit;

Figure 2 shows a typical display, displayed on the

video display unit shown in Figure 1, with a scene change

indicator over the video source material;

Figure 3 details the processing unit shown in Figure 1,

including a video compression circuit and a processor;

Figure 4 details the video compression circuit shown in

Figure 3;

Figure 5, 6 and 7 detail the operation of the processor

device shown in Figure 3; and

Figure 8 shows a security system having a scene change

detection circuit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The first embodiment is a digital edit suite, arranged

to edit digital audio signals, for combination with a

previously edited video track.

The system includes a processing unit 15, a first video

display unit (VDU) 16 for displaying information relating

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to the audio signals and a second VDU 17, for displaying information relating to the video signals. In addition, control devices are provided in the form of an audio control panel 18 and a video control device 19,the latter having a digitising tablet and a pressure sensitive stylus.

Full bandwidth RGB video signals are supplied to the processing unit 15, via an input video port 20. Similarly, audio signals are supplied to the processing unit 15 via an audio input port 21. An output RGB video signal is available at an output port 22 and its associated mixed audio signal is supplied to an output port 23.

For the purposes of editing the audio signals to the video signals, the audio signals are spatially compressed, allowing them to be stored on conventional computer disk drives and facilitating substantially random access during the editing procedures. Thus, the output video signal at port 22 is not used as the final video result, but does provide time code which in turn may be used to synchronise the edited audio signal supplied on output port 23 to the original full bandwidth edited video signal.

Video data supplied to port 20 is compressed by the processing circuit 15 and written to disk, whereafter, it may be accessed by operation of the stylus and touch tablet combination 19 and displayed on the video VDU 17. An example of the sort of display displayed on the video VDU

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17 is shown in Figure 2. In this example, the original
video source consists of a man walking in front of a tree
and on instructing the system to play, the video clip is
displayed on the monitor 17. As is well known in the art,
a cursor 25 is shown as part of the display and this
responds to manual operation of the stylus. In addition,
particular operations may be selected by placing the stylus
into pressure upon the touch tablet. Thus, symbols 26 are
also overlaid over the screen, which allow the stylus to be
used to advance, reverse and stop the video clip. A clock
27 overlaid over the image shows the position of the video
frame being displayed, with reference to the overall video
source. The size of video source is dependent upon the
storage provided and a typical system would allow one hour
of recorded video to be stored and manipulated.

The editing of an audio track to the previously edited
video is done with reference to a script, specifying the
audio signals to be recorded at specific instances within
the video. The video will include time code and the actual
numerical value of the time code for the frame being
displayed is also displayed, in the top right hand corner,
above the control icons 26. However, it is unlikely that
editing instructions will have been recorded with reference
to this time code, which would be a laborious process.
Thus, instructions usually take the form of specifying
changes to be made to the audio sound track in response to

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particular actions taking place in the video scene.   In particular, a significant change in the audio score usually takes place when a significant change occurs to the image, particularly, when the video image cuts to a different scene.

In order to facilitate the detection of these scene changes, a display 28 is also overlaid which consists substantially of a solid horizontal line, the length of which is proportional to the number of elapsed frames. This line represents the average amount of data present in the video in frames and, when said amount of data changes abruptly, perturbations are made to the line, such as those indicated by reference 29.   The polarity of the perturbations is not particularly relevant but their presence indicates that something significant has happened to the scene at that particular point.

Above the scene change display, a position pointer 30 is provided which indicates the position of the frame being displayed with reference to the scene change display. In addition, cursor 25 may be moved to the position of pointer 30 and on placing the stylus into pressure, the pointer 30 may be moved by further operation of the stylus, thereby forwarding or reversing the position of the displayed video. Thus, by operation of the stylus upon the touch tablet, so as to manipulate the position of displayed pointer 30, an editor may quickly move the position of the

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video, substantially instantaneously, to the position of a specific scene change. Once a scene change has been identified, the editor may quickly determine whether this scene change is the one that he is actually looking for, with reference to the original score. Thus, after the man has walked in front of the tree, the scene may cut to the man getting into his car. This scene change would usually result in a significant change to the information content of the displayed image, resulting in a perturbation being displayed on the scene change detector line. Thus, if an editor is required to make an audio change at this position, he can quickly move to the position at which a scene change occurs and, with reference to the original script, quickly identify the particular scene change in which a cut is made from the man walking in front of the tree to the man getting in his car. Thus, after the man has got into his car he may slam the car door, the sound of which may have not been recorded. Thus, after quickly locating the point at which the scene changes, an audio editor can introduce the sound of a door closing, thereby completing the audio score.

The processing unit 15 is detailed in Figure 3. A full bandwidth video signal is supplied to the unit as RGB components on input lines 31. The RGB components are supplied to a frame first in first out (FIFO) memory unit 32 via respective interface circuits 33. The frame FIFO 32

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assembles the video data into a form suitable for being
supplied to a compression chip 34 which, typically, is a C-
Cube CL550 chip, supplied by C-Cube Microsystems of
Milpitas, California, USA.   The compression chip 34 is
arranged to compress frames of video in accordance with the
compression standard established by the Joint Photographic
Expert Group (JPEG) of the United States and the full
operation of this chip is described in the data book
supplied by C-Cube Microsystems.

The compression circuit 34 compresses the video frames
and, whereas input frames each have an equivalent amount of
data, in the region of 300 kilobytes, output frames, after
compression, will have an amount of data which is dependent
upon the actual information content of the frame.

Output compressed frames are supplied to a two kilobyte
FIFO 35, configured from fast static RAM, and are
thereafter supplied to a four megabyte dynamic random
access memory device (DRAM) 36, which cyclically loads the
data frames into the four megabytes of memory. The cyclic
nature of the four megabyte RAM is indicated by circle 36A
and frame spacings are indicated by points 36B on the
circle.   Thus, it should be noted that the space occupied
by individual frames varies, given that the data content of
individual frames differs, depending upon the information
content of the original video.

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Data written to the cyclic DRAM 36 is thereafter written to magnetic disk thus, FIFO 35 and the DRAM 36 provide a buffer between the compression circuit 34 and the disk storage devices.

The disk storage devices themselves consist of three magnetic disk drives 37 each capable of storing one gigabyte of data. Thus, it will be appreciated, that the overall storage capacity of the system is very large, the intention being that it should be capable of storing up to one hour of compressed video.

The writing of data to the disk drives 37 is controlled by a central processing unit 38, typically a Motorola 68030 processor, having eight megabytes of onboard memory and a floating point arithmetic unit. The CPU 38 communicates with the compression circuit 34, a timing circuit 39 and interface circuits 40, via a multiplexed 16 bit bus 41. The timing circuit 39 supplies timing signals to the frame FIFO 32, the compression circuit 34 and the static RAM FIFO 35. Circuits 40 operate in accordance with the small computer standard interface (SCSI) and interface the 1.3 gigabyte drives 37 to the cyclic dynamic RAM 36. The timing circuit 39, the compression circuit 34 and SCSI interfaces 40 are themselves interfaced to the CPU bus 41 via interface circuits 42.

As previously stated, as video data compression takes place, the actual amount of data generated for each frame

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varies, in dependence upon the actual information content of the original frame. Thus, in order for the compressed data to be written to a drive 37, under CPU control, it is necessary for the CPU to be provided with information concerning the actual amount of data to be written. Thus, the compression circuit 34 provides information, on a frame-by-frame basis, via its interface circuit 42, to the CPU 38, identifying the amount of data present within a particular frame.   In response to receiving this information, the CPU 38 provides information to a SCSI interface 40, facilitating the transfer of this information to disks 37; it being noted that a delay will be present, due to the cycling of data through the dynamic RAM 36.

CPU 38 is provided with its own local mass storage device 43, again in the form of a magnetic disk, arranged to supply programs and data to the CPU 38. In addition, the data generated by the compression circuit 34 and supplied to the CPU over interface circuit 42 and bus 41, indicative of the amount of data present for each frame after compression, is also written to disk 43. Thus, at any time, the processing unit 38 has access to information identifying the actual amount of compressed data stored for any particular frame.

The procedure for playback is substantially similar to that for recording data.   In response to an operators command, the CPU 38 instructs an SCSI interface 40 to

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transfer data from a disk drive 37 to the four megabyte
DRAM cyclic buffer 36. As data is being written to buffer
36 data is also read from said buffer 36 and supplied to
the static FIFO 35. On the other side of the static FIFO
35, compressed data is supplied to the compression circuit
34, which in turn supplies de-compressed data to the frame
FIFO 32. From said frame FIFO 32, RGB components are read
and supplied to RGB outputs 31 via respective interface
circuits 33. Thus, a majority of transmission paths within
the processing units shown in Figure 3 are by directional
and what were used as input ports 31 during the recording
process, become output ports during the playback process.

During playback, data will tend to be written to the
static RAM 35 at a substantially constant rate and will,
therefore, be made available to the de-compression circuit
34 at a substantially constant rate. However, the rate at
which the de-compression circuit 34 is able to receive this
data varies, given that frames having a large amount of
data will require additional processing on the part of the
de-compression circuit 34, to produce displayable video
signals. Thus, static FIFO 35 provides an important
buffering facility and the rate at which data is read from
said FIFO to the compression circuit will vary, in
dependence upon the amount of data processing required.

The decompressed video data generated by the
decompression circuit 34 is not precisely in the form

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suitable for supplying directly to a display monitor. In particular, the RGB components are not in the required order and their rate of production is not in the required synchronisation. Thus, the decompressed video signals generated by the decompression circuit 34 are supplied to frame FIFO 32, thereafter, RGB signals may be read out to produce signals of the required type, by means of interface circuits 33.

In addition to providing an output at port 31, which may be directed to output port 22 of Figure 1, the decompressed RGB video signals also supplied to circuitry arranged to generate the video display on monitor 17.

In particular, the decompressed RGB video signals are supplied to a video mixer 45, which receives a second signal from a frame store 46. Thus, the decompressed RGB video signal is combined with a video signal read from a frame store 46 to provide a combined video signal which is supplied to a digital to analogue convertor 47. Thereafter, the output from the digital to analogue convertor 47 is supplied to the display monitor 17.

The decompressed RGB video signal supplied to the video mixer 45 provides the background image of the recorded video, such as the man walking in front of a tree in Figure 2. The overlaid images, in the form of a clock 27, the icons 26 and the scene change detection display 28, are assembled in the frame store 46 and the video mixer 45 is

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arranged to overlay signals supplied from the frame store 46 over the decompressed video image, supplied by interfaces 33. Thus, the signals supplied to the digital to analogue convertor 47, consist of the decompressed video image (the man walking in front of the tree) with the icons and displays overlaid, as shown in Figure 2, for display on the monitor 17.

The overlaid images, assembled in the frame store 46, are generated by the processing unit 38, in response to program control and in response to data supplied from the compression circuitry and stored in storage device 43. Thus, the processing unit 38 is arranged to analyse and process the numbers generated for each frame which represent the amount of compressed data present in that frame. The processing of this information in turn generates the data required to display the scene change display element 28, as shown in Figure 2.

A schematic representation of the compression and decompression circuit 34 is shown in Figure 4. Operation of the circuit will be described with reference to compression and it should be appreciated that the decompression procedure is substantially similar but performed in reverse.

Full bandwidth RGB video is supplied to a matrix convertor 51, arranged to convert the RGB signal into a YUV signal, consisting of luminance plus colour difference, as

used in broadcast television. This conversion provides a
degree of compression and introduces a level of loss.

After conversion to YUV, the image frame is divided
into a number of blocks, typically consisting of eight by
eight pixels or sixteen by sixteen pixels. Subsequent
processing is performed for each individual block and, in
some situations, it may be necessary to take additional
measures to ensure that these blocks do not become visible
in the final output image.

The output from circuit 52, arranged to divide the
picture into a plurality of blocks, is supplied to a
discrete cosine transform (DCT) circuit 53, which analyses
each block and produces a plurality of frequency bands,
describing the nature of the picture within a block. This
process does not significantly compress the image and is
substantially lossless.   However it does facilitate
subsequent compression.

After conversion in DCT circuit 53, the frequency bands
are truncated by a truncating circuit 54 and thereafter,
the data generated by truncating circuit 34 is Hoffman
coded by a codec 55. The Hoffman codec 55 takes advantage
of the inherent redundancy of a typical video signal, in
that, values generated by truncation circuit 54 which occur
often are given codes consisting of fewer bits, while,
conversely, signals which occur less often are given more

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bits, resulting in a significant level of compression with very little loss.

The data generated by the Hoffman circuit 26, for a plurality of bands derived from a plurality of blocks, are combined, resulting in a serial stream of data which is written to the disk drives 37, via the buffering described with reference to Figure 3.

The nature of the process described above is such that, whenever possible, the amount of data actually stored is minimised. This data reduction is very much dependent upon the inherent redundancy of the original data. As the actual information content of the original image increases, the amount of data required to be stored after compression also increases. Thus, the amount of data required to be stored is directly related to the information content of the original frame. As previously stated, it is necessary for this information defining the amount of data present to be transferred to the processing unit 38, so that said processing unit is in a position to instruct the interface circuits, concerning the amount of data required to be written to the disks 37 for a particular frame.

When an abrupt change occurs to the amount of data generated after compression, this is indicative of a change in the nature of the original video input signal. More often than not, this change will be due to a change in the nature of the scene being recorded in the first place,

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which will often be due to a scene change in the story line, usually resulting in a cut from one recording position to another recording position.

The operations performed by the processing unit 38, in response to receiving data from the compression circuit 34, are shown in Figure 5. The compression process does not change the number of frames present in the clip, therefore frames can be given unique numbers, defined by the time code, which relate to a compressed frame or it's equivalent non-compressed frame. For the purposes of the present disclosure, the frame presently being processed will be referred to as frame n, with the previous frame being referred to as frame n-1, the frame previous to that being frame n-2.

The amount of data generated after compression is identified in Figure 5 by the value X. Thus, the amount of data produced by compressing frame n is identified in Figure 5 as X(n) and, similarly, the amount of information produced by compression of the previous frame is identified as X(n-1).

The processing unit 38 processes numbers X in order to produce a display element 28, identifying the position of scene changes. As part of this process, the value X(n) is stored for the present frame along with values for the three previous frames.

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At step 56, the stored values of X are shifted, such that the old value for X(n) becomes X(n-1), X(n-1) becomes X(n-2) and X(n-2) becomes X(n-3), making space available for a new X(n) to be received.

At step 57, the next value for X is received and at step 58, stored value for Y(n) is shifted to Y(n-1), making space available for the new Y(n) value to be received.

At step 59, the new value for Y(n) is calculated as:

$$Y(n) = X(n) + X(n-1) + X(n-2) + X(n-3)$$

Thereafter, at step 60, Y(n) is divided by four, thereby producing an average of the four stored values of X.

At step 61, the previous value for Y, noe stored as Y(n-1), is subtracted from the new value, Y(n), to produce an output value, Z(n).

Thus, the effect of this processing is to effectively differentiate the incoming numbers, so as to more accurately locate the position of an actual scene change.

At step 62, a value for C is calculated, which will be equal to zero if no scene change has been detected, or equal to plus one or minus one if a scene change has been detected. Threshold values are set for comparison, which may be adjusted during initial system setting up. Thus, at step 61 Z(n) is compared against T1 and if Z(n) is larger than T1, C(n) is set to plus one. Thereafter, Z(n) is compared against T2 and if Z(n) is smaller than T2, C(n) is

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set to minus one. If Z(n) falls between T1 and T2, C is set to zero, indicating that no scene change has taken place.

The calculation of C, with reference to the threshold values T1 and T2 is shown graphically in Figure 6. Thus, as clearly seen from this graph, C is given a value of minus one if Z is smaller than T2, C is given a value of zero if Z is between T2 and T1, and C is given a value of plus one if Z is larger than T1.

At step 63, the value for C calculated at step 62 is considered. If C is not equal to zero, the previously calculated value for Z(n) is diplayed. Otherwise Z(n) is taken to be zero and small variations, not caused by the result of a scene change, are effectivly gated out of the signal.

The resulting display of Z(n) plotted against n, forming the basis for the display element 28 in Figure 2, is shown in Figure 7. The values for n run horizontally and represent frame position. The number of pixels available for each frame position n is dependent upon the resolution, that is the number of frame positions to be displayed across the width of the image. This resolution value is adjustable, in response to commands from the operator.

In Figure 7, the resolution has been set to show thirty seven frames of the video clip. Within this clip two scene changes occur, which have been detected and have resulted in a plus one peak 71 and a minus one peak 72. The

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audio editor can now quickly locate these frames by operation of the stylus, to determine whether audio editing is required at that position.

In the system shown in Figure 1, the video source material has previously being edited and the system is provided to facilitate the editing and synchronisation of an audio track. However, the technique for identifying scene changes, as described above, could also be used to facilitate the editing of video signals, wherein scene changes may be detected to locate the position of edit points.

A third embodiment is shown in Figure 8, which employs the technique of protecting scene changes within a surveillance system. A surveillance camera 92 is directed at an area, such as a bank vault or a warehouse etc, excluded from public access.

Under normal operating conditions, the image generated by the camera 92 will remain substantially constant and even if the camera 92 is subject to environmental conditions which may cause camera shake, the image will not change significantly. The video images produced by the camera 92 are compressed by a compression circuit 93, substantially similar to the compression circuitry disclosed with reference to Figure 3. Frames of compressed video are supplied to a video tape recorder 94. In addition, information indicative of the amount of data

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present in each compressed frame is supplied to a central
processing unit 95. Under normal conditions, the amount of
data present in each compressed field should remain
substantially constant, given that the view is not
changing. Furthermore, even if the camera 92 experiences
shake, due to atmospheric conditions, the actual amount of
information present in the picture should not change
significantly, resulting in the amount of data present in
the compressed video being substantially the same.

However, is an intruder enters the field of view, the
amount of information in the image will change
significantly, resulting it the amount of compressed video
data changing significantly. This change of data present
in each compressed frame is recognised by the central
processing unit which is then programmed to enter a state
indicating that an intruder has entered the field of view.
Subject to the particular application concerned, this may
result in a control signal being supplied to an alarm 96,
thereby activating said alarm. Furthermore, VTR 94 may
normally be in a non-activate state and an alarm signal
generated by the CPU 95 may activate the VTR 94, causing
frames generated by the camera 92 to be recorded. In this
way, a recording facility is provided without said facility
generating large amounts of unnecessary recorded material.

Alternatively, the operating characteristics of the
VTR 94 may be modified. For example, during normal

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operation, the VTR 94 may record frames in a "slow-scan" fashion, wherein frames are recorded at substantially less than video rate. In addition, further levels of compression may be supplied to the video image, resulting in significant degradation.

However, on detecting the presence of an intruder, the recording characteristics of the VTR 94 may be modified, resulting in high bandwidth video being recorded at full video rate. Thus, the amount of unnecessary recording is reduced, while good quality pictures are obtained of the actual intruder himself.

It will be appreciated that the system for detecting scene changes in a video source may have many further applications beyond the particular embodiments described herein. The invention has particular application in systems where video compression is being employed for other purposes, particularly to reduce storage capacity and access time.

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CLAIMS

1.   A method of detecting the position of a scene
change in a video sequence, characterised by the steps of

generating data representing the amount of information
present in each video frame;

processing said data to locate significant changes in
said information content and

identifying the position of said significant changes,
so as to identify the position of likely scene changes.

2.   A method according to claim 1, wherein the video
signals are interlaced and the amount of information
present in each video frame is determined by determining
the amount of information present in each video field.

3.   A method according to claim 1 or claim 2, wherein
the information content is determined by compressing the
video data and assessing how much data is present after
compression.

4.   A method according to claim 3, wherein the video
data is compressed in accordance with a spatial compression
algorithm.

5.   A method according to claim 4, wherein said
spatial compression algorithm compresses each video field

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or frame and information is generated representing the amount of information present in said field or frame, after compression.

6.   A method according to claim 4, wherein said compression algorithm divides data relating to a field or a frame into a plurality of areas.

7.   A method according to claim 6, wherein said areas are processed to determine the frequency components of signals derived from said areas.

8.   A method according to claim 7, wherein said frequency components are truncated to facilitate further compression.

9.   A method according to claim 8, wherein said truncated frequency components are coded in accordance with a statistically related coding scheme, such as hoffman coding, to provide further data compression.

10.   A method according to claim 4, wherein JPEG compression is used to compress the data within each field or frame.

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11.   A method according to any preceding claim, wherein numbers (X) are generated representing the amount of information present in each field or frame and said numbers are mathematically differentiated to provide an indication of the presence of a scene change.

12.   A method according to any preceding claim, wherein said video sequence is derived from edited video, and scene changes are detected to facilitate the editing of an audio track.

13.   A method according to any of claims 1 to 11, wherein said video sequence is a source recording, and scene change detection is implemented to facilitate the editing of said video sequence.

14.   A method according to any of claims 1 to 11, wherein said video sequence is derived from a camera and the scene change detection is performed to identify changes to the scene observed by said camera.

15.   A method according to claim 14, wherein a scene change detected by said camera results in measures being taken to identify the existence of an intruder.

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16. A method according to claim 15, wherein a video tape recorder is activated on the detection of said intruder.

17. A method according to claim 16, where the activation of said video tape recorder involves the modification of recording procedures for said video tape recorder, so as to enhance the quality of images recorded thereby.

18. Apparatus for detecting the position of a scene change in a video sequence, characterised by:

means (15;34) for generating data representing the amount of information present in each video frame;

processing means (38) for processing said data to locate significant changes in said information content; and

display means (17) for identifying the position of said significant changes, so as to identify the position of likely scene changes.

19. Apparatus according to claim 18, wherein said means for generating data includes compressing means (34) for compressing the video data.

20. Apparatus according to claim 18 or claim 19, wherein said compression means includes means for

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compressing said video data in accordance with a spatial compression algorithm.

21.   Apparatus according to claim 20 wherein said compression means effects JPEG spatial compression.

22. An edit suite (Figure 1) for editing audio signals to a previously edited video track, including scene change detection apparatus according to any of claims 18 to 21.

23.   An edit suite for editing video clips, including scene change detection apparatus according to any of claims 18 to 21.
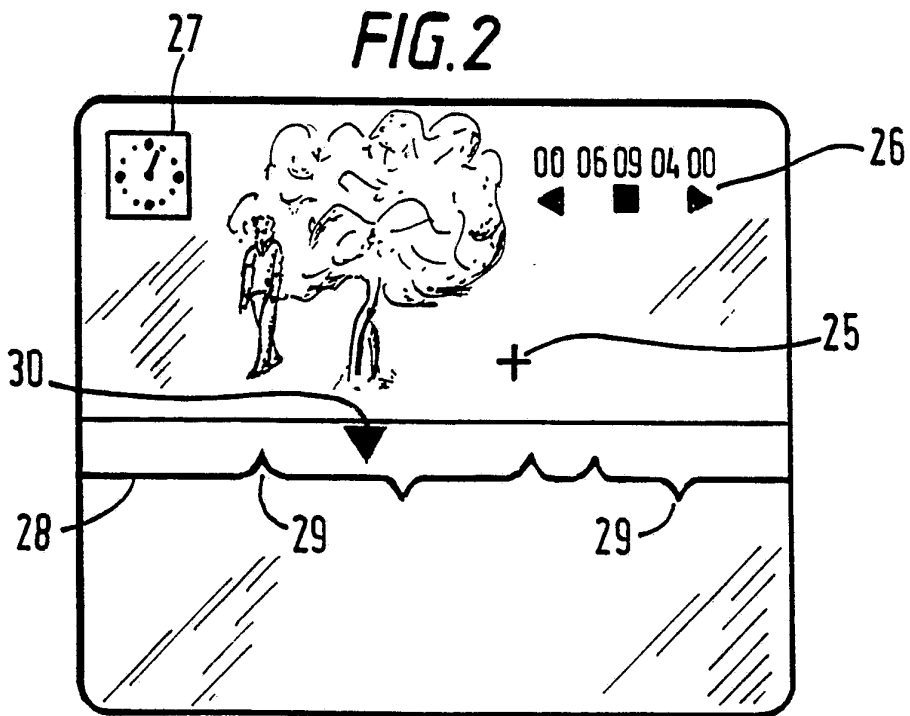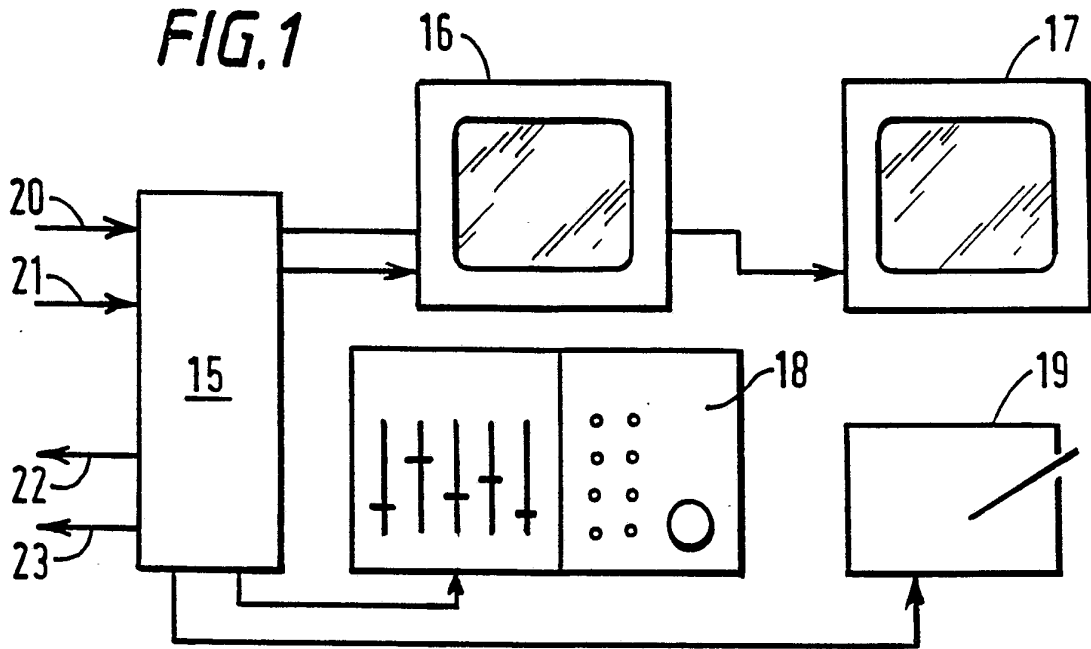

24.   A surveillance system including a camera (92) arranged to observe a scene, scene change detection apparatus (93,95) according to any of claims 18 to 21 and means (95,96) for generating an output signal on detecting a change of scene.

25.   A surveillance system according to claim 24, including a video tape recorder for recording an output from said camera.

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26. A surveillance system according to claim 25, wherein said video tape recorder only records when an intruder is detected.

27. A surveillance system according to claim 25, wherein the operating characteristics of the video recorder are modified, so as to record pictures of improved quality, when an intruder is detected.

FIG.1

FIG.2

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FIG.3

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FIG.4

R ———→ | MATRIX **51** | —Y→ | LOCKS **52** | ⇉ | DCT **53** | ⇉ | TRUNC **54** | ⇉ | CODEC **55** | →

G ———→ (MATRIX 51) —U→

B ———→ (MATRIX 51) —V→

FIG.8

COMPRESS **93** —COMPRESSED VIDEO→ VTR **94**

COMPRESS **93** —AMOUNT OF DATA→ CPU **95**

CPU **95** → ALARM **96**

Camera **92**

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FIG.5


```
SHIFT SUCH THAT :
        X(n-1)  =  X(n)
        X(n-2)  =  X(n-1)        — 56
        X(n-3)  =  X(n-2)
```

INPUT NEW X(n)   — 57

$Y(n-1) = Y(n)$ — 58

$Y(n) = X(n) + X(n-1) + X(n-2) + X(n-3)$ — 59

$Y(n) = Y(n) \div 4$ — 60

$Z(n) = Y(n) - Y(n-1)$ — 61

```
IF    Z(n) > T1    THEN  C = 1

IF    Z(n) < T2    THEN  C = -1        — 62

      ELSE  C = 0
```

```
IF  C ≠ 0  THEN
DISPLAY Z(n) WITH RESPECT TO n        — 63
```
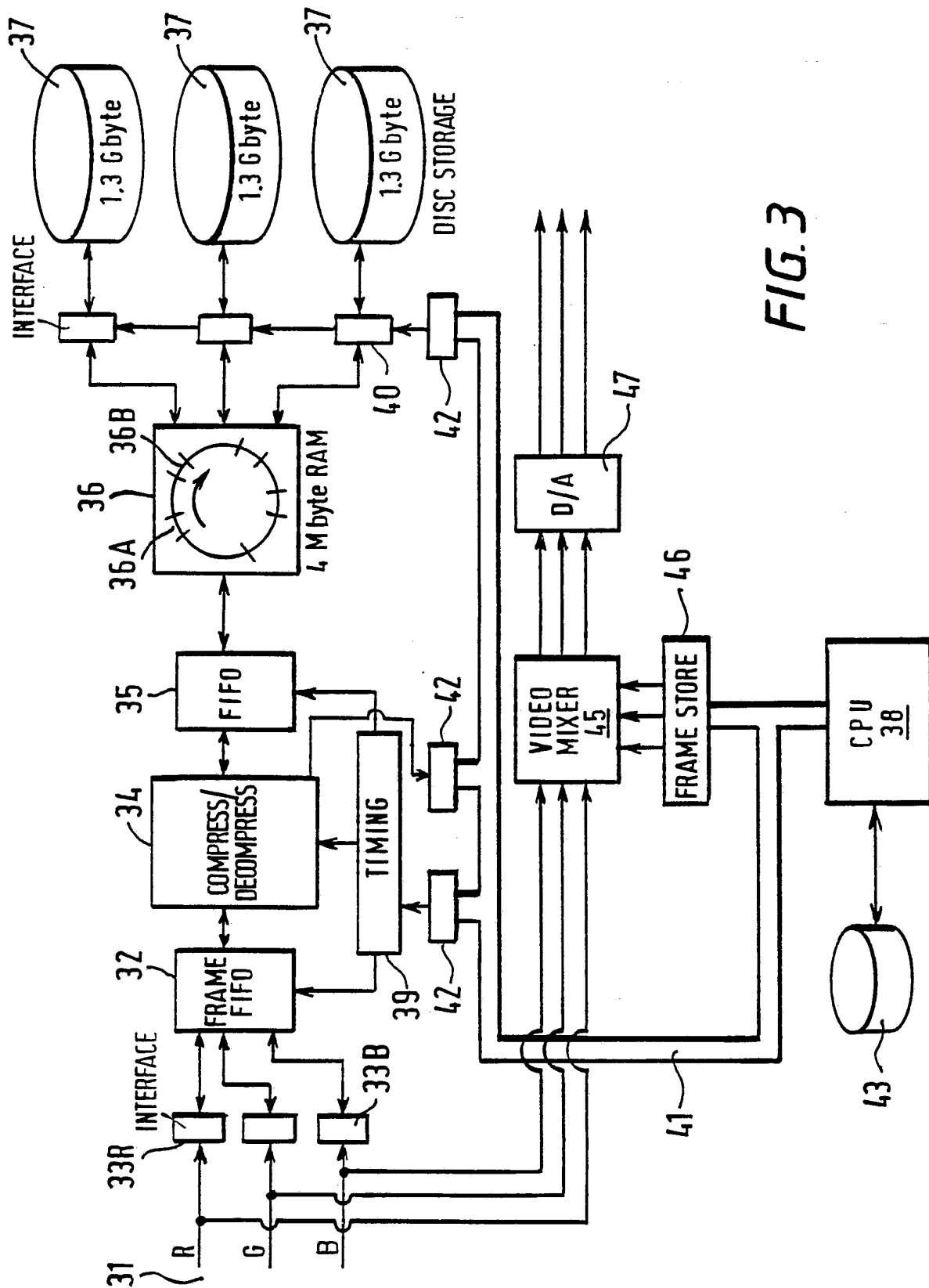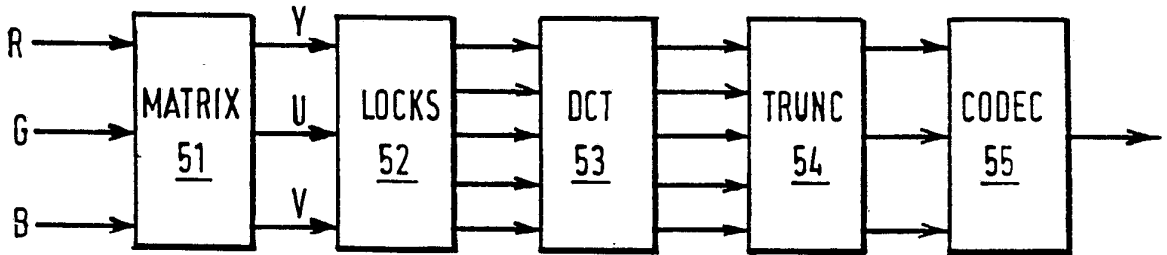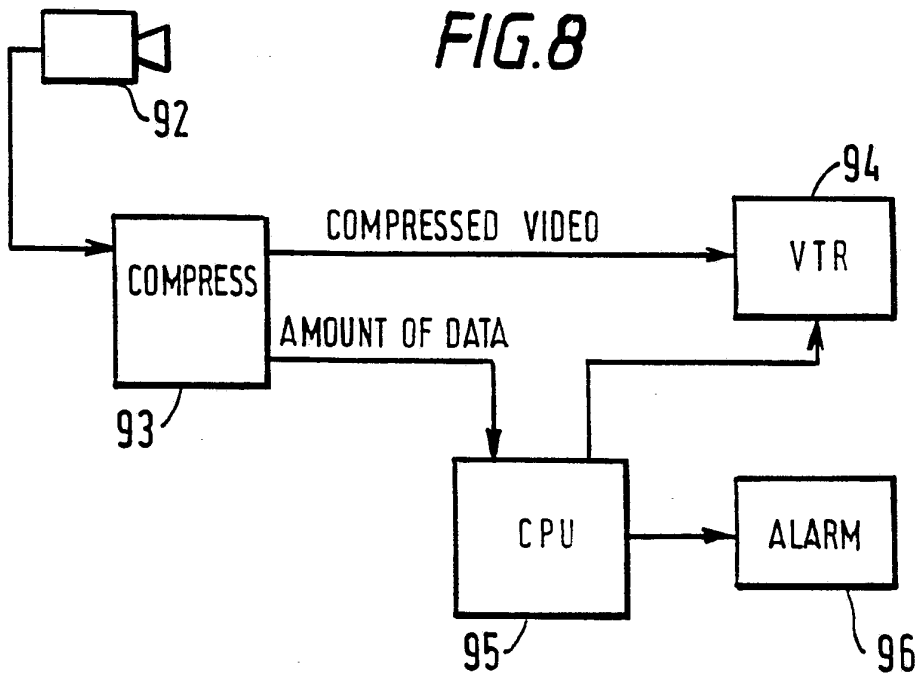
FIG.6

FIG.7

INTERNATIONAL SEARCH REPORT

International Application No   PCT/GB 93/00634

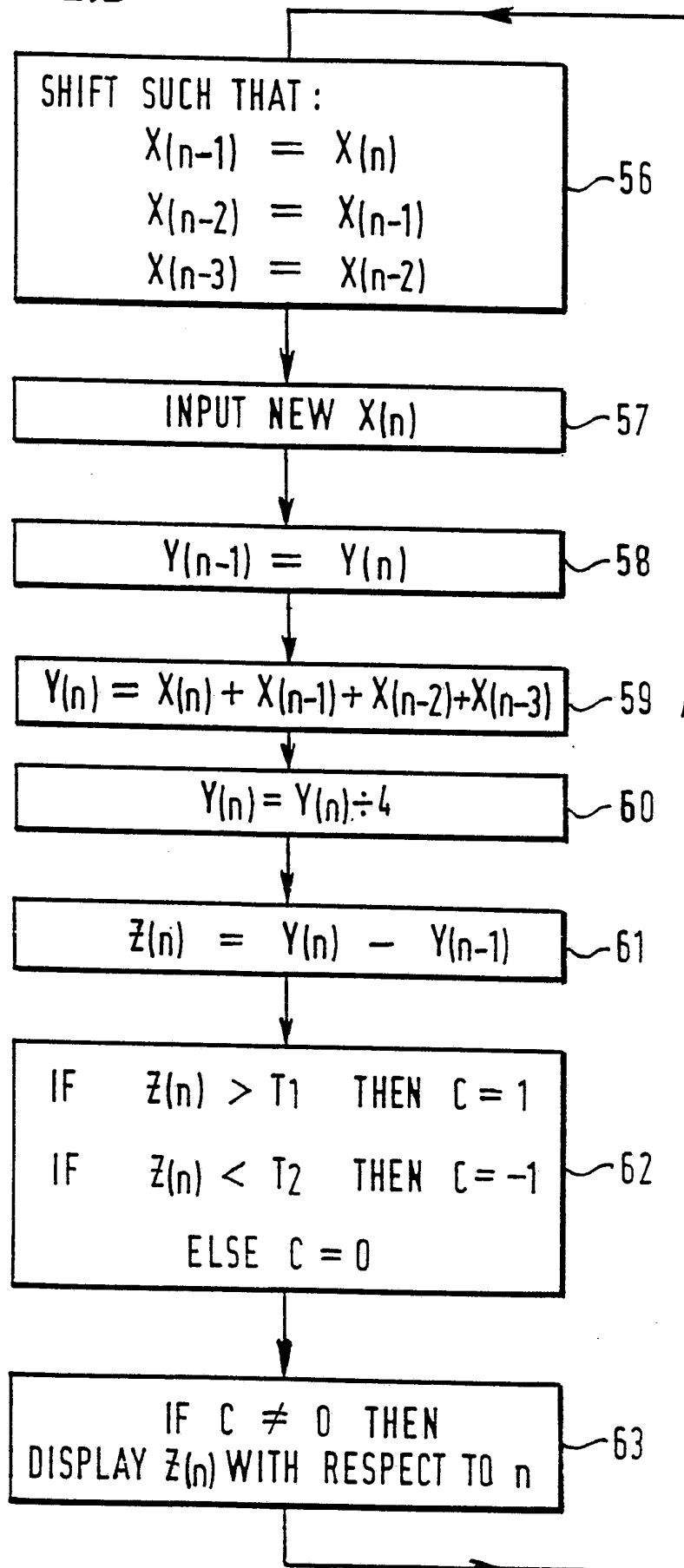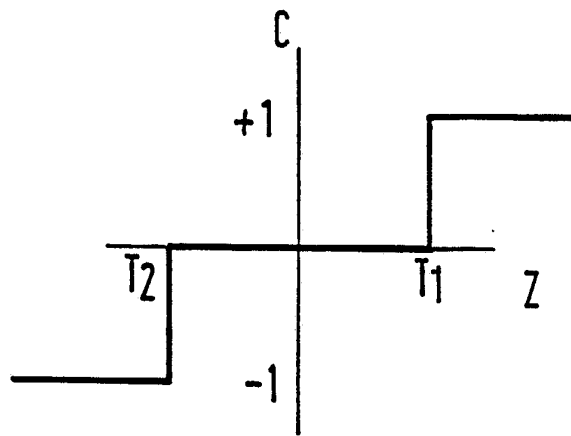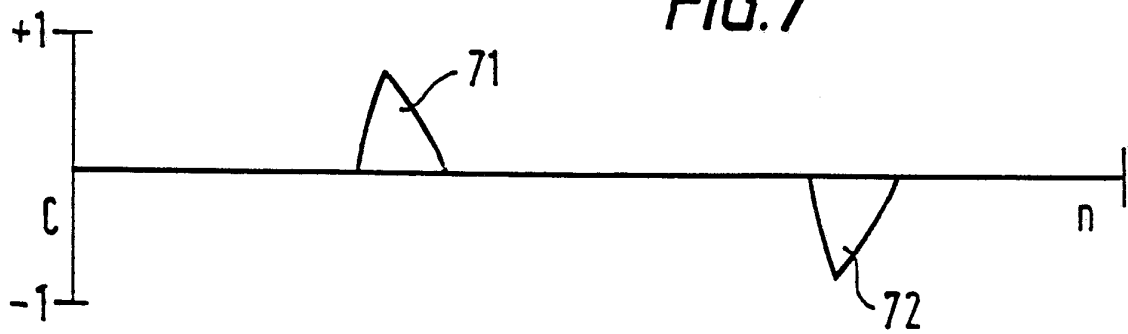| I. CLASSIFICATION OF SUBJECT MATTER   (if several classification symbols apply, indicate all)[6] |
|---|
| According to International Patent Classification (IPC) or to both National Classification and IPC |
| Int.Cl. 5 G11B27/031;   G08B13/196;   H04N5/92 |

II. FIELDS SEARCHED

Minimum Documentation Searched[7]	
Classification System	Classification Symbols
Int.Cl. 5	G11B ; G08B ; H04N

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category[o]	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	US,A,5 099 322 (GOVE) 24 March 1992 see column 1, line 65 - column 2, line 39 see column 2, line 64 - column 8, line 24	1,2, 13-15, 23,24
Y		3-12,16, 19-22

X	US,A,4 774 570 (ARAKI) 27 September 1988 see column 1, line 28 - line 41 see column 2, line 41 - column 4, line 30 see column 6, line 40 - column 12, line 40	24-26
Y		16

Y	US,A,4 774 574 (DALY ET AL.) 27 September 1988 see the whole document	3-11, 19-21

	-/--	

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
22 JULY 1993	3 0. 07. 93
International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	DAALMANS F.J.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category°	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	GB,A,2 195 810 (SONY CORPORATION) 13 April 1988 see page 3, line 24 - line 105; figure 4 ---	12,22
X	GB,A,2 158 324 (LICENTIA PATENT- VERWALTUNGS GMBH.) 6 November 1985 see the whole document ---	1,2, 13-15, 18,23,24
X	US,A,5 032 905 (KOGA) 16 July 1991 see the whole document ---	1-4,6,7, 14,18-20
X	EP,A,0 378 393 (K.K.TOSHIBA) 18 July 1990 see column 1, line 6 - line 21 see column 1, line 53 - column 2, line 4 see column 2, line 31 - column 4, line 26 see column 5, line 1 - line 27 see claims 1,2,5-9 ---	1,2,11, 13,14, 18,23
X	PATENT ABSTRACTS OF JAPAN vol. 13, no. 285 (E-780)29 June 1989 & JP,A,10 68 084 (NIPPON TELEGRAPH & TELEPH CORP (NTT)) 14 March 1989 see abstract ---	1,2,13, 18,23
X	PATENT ABSTRACTS OF JAPAN vol. 10, no. 8 (E-373)14 January 1986 & JP,A,60 172 892 (TOSHIBA K.K.) 6 September 1985 see abstract ---	1,2,18
P,X	EP,A,0 489 301 (K.K.TOSHIBA) 10 June 1992 see column 2, line 53 - column 7, line 5 see column 7, line 39 - column 9, line 9; claims 1-3 ---	1-4,6,7, 11,13, 14,18, 19,23
A	EP,A,0 268 270 (MATSUSHITA ELECTRIC INDUSTRIAL CO.,LTD.) 25 May 1988 see the whole document ---	1,12,13, 22,23
A	GB,A,2 235 815 (COMPACT VIDEO GROUP INC.) 13 March 1991 see the whole document ---	1,12,13, 22,23
	-/--	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	CD-ROM PROFESSIONAL vol. 4, no. 6, November 1991, USA pages 38 - 40 BONOMI M 'Multimedia and CD-ROM : An Overview of JPEG, MPEG and the future' see the whole document -----	10,21
		Relevant to Claim No.

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.

GB 9300634
SA 73081

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.   22/07/93

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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