(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 787 262 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
03.10.2012 Bulletin 2012/40

(21) Application number: **05772314.0**

(22) Date of filing: **09.08.2005**

(51) Int Cl.:
H04N 7/26 (2006.01) *H04N 7/36* (2006.01)

(86) International application number:
PCT/FI2005/050289

(87) International publication number:
WO 2006/016007 (16.02.2006 Gazette 2006/07)

(54) VIDEO PRE-PROCESSING BEFORE ENCODING AND CORRESPONDING POST-PROCESSING AFTER DECODING

VIDEOVORVERARBEITUNG VOR ENKODIERUNG UND ENTSPRECHENDE NACHVERARBEITUNG NACH DEKODIERUNG

PRE-TRAITEMENT VIDEO AVANT ENCODAGE ET POST-TRAITEMENT CORRESPONDANT APRÈS DÉCODAGE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **12.08.2004 FI 20045290**

(43) Date of publication of application:
23.05.2007 Bulletin 2007/21

(60) Divisional application:
12170519.8 / 2 498 223

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Printed by Jouve, 75001 PARIS (FR)

Description

FIELD OF THE INVENTION

[0001] The present invention relates to processing of a video image such that after compressing the video image the size of data to be stored on a storage medium, or alternatively the size of data to be further transmitted over a communications network, can be minimized.

DESCRIPTION OF THE PRIOR ART

[0002] Previously there are known video image coders, such as DivX, MPEG4 etc, which are able to compress a video image such that the file size reduces considerably compared with what the file size would be if the video image had been stored directly in the format from the video camera. For instance, the MPEG compression utilizes a solution, in which all video frames are not directly forwarded from the coder as image frames, but only in given situations a single image frame is forwarded from the coder. Frames subsequent to the image frame are not forwarded, but only the changed frame parts are retrieved and they are forwarded from the coder. In this way there will be no need to send continuously information on an unchanged background, for instance. In connection with reproduction, a single frame is displayed, whereafter change information collected from subsequent frames is utilized to change said single image frame at the same rate with the original video image. Thus, the viewer will see an almost identical video image as the one the camera originally shot.

[0003] The coders utilizing the above-described known compression algorithms have a drawback, however, that more often than necessary they interpret the video image having changed to the extent that it necessitates transmission of a whole new image frame. Frequent forwarding of a whole frame from the coder leads to a large file size, however.

[0004] For instance from WO publication 86/03922 there is also previously known a solution, in which memories of a video image transmitter and receiver maintain the same earlier shot reference image and in which, as the image changes, it is first checked whether the changed areas have changed to correspond to the respective blocks in the stored reference image. If yes, a code word is sent from the transmitter to the receiver, on the basis of which code word the receiver can retrieve from the reference image in its memory the changed movement blocks. Whereas, if the changed movement blocks do not correspond to the respective blocks in the reference image, the changed movement blocks are transmitted from the transmitter to the receiver. The solution known from WO publication 86/03922 has a drawback, however, that it works effectively only when the background of the frame remains unchanged, in other words, in practice the camera should stay still. In addition, a solution based on code word transmission is not compatible with known coders, and consequently compression algorithms of the known coders that have been found effective cannot be utilized.

[0005] Previously there is also known from US - A - 6 160 848 a solution, where macroblocks of a frame are classified into moving or stationary. Only moving macroblocks are coded and the stationary are defined as "not-coded", such that they do not contain any DCT coefficient data or motion vector data. A drawback with such a solution is that the solution is applicable only with specific coders and decoders that have been designed to work with signals containing such information. Previously there is also known from WO 01/57803 A1 a solution where a frame is examined for changes by utilizing Markov modelling. However, such a solution is not optimal regarding efficiency and quality of the subsequently regenerated video image.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to solve the above problems associated with the known solutions by providing a solution for processing a video image in a novel manner which enables minimization of the amount of data to be forwarded or stored and in connection of which it is possible to use coders utilizing prior art compression algorithms for video image compression. Another object of the invention is to provide a solution by which a video image processed in accordance with the invention can be reproduced. These objectives are achieved by a processor of independent claim 1, a reproduction device of independent claim 7, a method of independent claim 9, computer software of independent claim 12, a method of independent claim 13 and computer software of independent claim 15.

[0007] In the present invention it has been found that further transmission or storage of whole frames can be avoided completely when only the changed movement blocks are forwarded or stored in the original format. In order for the solution to be effectively utilized in connection with the known video coder compression algorithms the invention always forwards or stores all the movement blocks of the whole frame. The colour values of the pixels in the unchanged movement blocks are changed, however, to correspond to the values of a predetermined colour. With this procedure the prior art coders are able to compress the video image into a very compact format. Practice has shown that the obtained file size is reduced to less than a tenth of what it would be without the processing of the invention. The most considerable advantage of the solution according to the invention is thus substantial reduction in the size of a file to be stored or the amount of video data to be forwarded.

[0008] Preferred embodiments of the processor, the reproduction device and the methods of the invention are disclosed in the attached dependent claims 2 to 6, 8, 10 to 11 and 14.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the following the invention will be described in greater detail, by way of example, with reference to the accompanying drawings, in which

Figure 1 is a block diagram of a first preferred embodiment of a processor in accordance with the invention;
Figure 2 is a flow chart of a first preferred embodiment of a processing method in accordance with the invention;
Figure 3 is a block diagram of a first preferred embodiment of a reproduction device in accordance with the invention;
Figure 4 illustrates production of a video image with the reproduction device, and
Figure 5 is a flow chart of a first preferred embodiment of a reproduction method in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Operations set forth in the blocks of a processor 1 of the block diagram in Figure 1 can be implemented by software, circuit solutions or combinations thereof. Operationally the blocks can be implemented in the presented manner or alternatively the operations of one or more blocks can be integrated.

[0011] In practice the processor 1 can be integrated with the camera with which the video image is shot. This camera may be, for instance, a conventional video camera, a control camera or a mobile station with an integrated camera. It is advantageous that the processor processes video image directly from the camera, i.e. prior to storing it in a file or transmitting it further over a communications network, because in that case it will be possible to minimize the noise appearing in the image at the time of processing. This kind of noise increases the size of the file to be stored or forwarded.

[0012] In the exemplary case of Figure 1 the processor 1 receives a video signal 3 produced by a video camera. On the basis of the processed video signal the processor 1 generates and further supplies a signal 4. The latest frame received from the camera 2, i.e. the frame under process, is stored in a memory 5. A second memory 6 stores the previous processed frame. A comparison block 7 compares the contents of the memories 5 and 6 one movement block at a time and detects the changed movement blocks on the basis of colour changes in the pixels of the movement blocks.

[0013] A modification block 8 modifies the frame under process on the basis of the comparison performed by the comparison block 7. Modification is performed on the movement blocks stored in the memory 5 which are unchanged as compared with the frame stored in the memory 6. In the modification the colour values of the unchanged movement block pixels are set to correspond to the values of a specific colour. The colour values of the pixels are advantageously set to define the pixel colour as black.

[0014] The modification block 8 also modifies the frame stored in the memory 6. This is done by copying the pixels of all changed movement blocks from the memory 5 and said pixels are stored on the corresponding movement blocks of the frame in the memory 6. Said changed frame in the memory 6 is then used as a reference frame for a subsequent frame to be received from the camera 2 so as to detect changed movement blocks.

[0015] The processor 1 utilizes the changed and unchanged movement blocks of the frame stored in the memory 5 for generating a signal 4 to be further transmitted. Said signal is supplied to a coder 9, which may be a prior art coder that compresses the received video image into a compact format (for instance MPEG4 or Div X). After the compression by the coder 9 the obtained video file is stored, for instance, on a computer hard disc 10 or another storage medium readable with an image reproduction device. Alternatively, another option is that instead of storing the obtained image file is forwarded from the coder 9 over a communications network to an image reproduction device.

[0016] In Figure 1 the coder 9 is depicted by way of example as a separate part from the processor. Alternatively, another option is that the coder 9 is integrated with the processor, and consequently the processor and the coder can be implemented by one microcircuit, for instance.

[0017] Figure 2 is a flow chart of a first preferred embodiment of the processing method in accordance with the invention. Figure 2 reveals in greater detail the operation of the processor in Figure 1.

[0018] To initiate processing there are first performed preparatory operations. Raw video material to be captured from the camera is set unchanged in format RGB. Movement blocks are defined to be equal-sized squares having equal width (MBW) and height (MBH), i.e. 4 pixels. The size of the movement block (MBSIZE) is calculated by multiplying the width of the movement block (MBW) by its height (MBH), (MBW * MBH) = MBSIZE.

[0019] The width (FW) and the height (FH) of a video frame (FRAME) are set to be divisible by the width (MBW) and the height (MBH) of the movement block (MB). The number of fixed movement blocks (MB) is calculated by multiplying the frame width (FW) by the frame height (FH) and the product is divided by the size of the movement block (MBSIZE), i.e. (((FH * FW) = FRAMESIZE / MBSIZE) = MBCOUNT.

[0020] A matrix (MBMATRIX) is created according to the number (MBCOUNT) of the movement blocks (MB) for instance such that a frame is divided into sections (4x4) starting from the upper left corner ending to the lower right corner. For each (MBCOUNT) movement block (MB) in the frame there are calculated corner coordinates X and Y of the square, P1, P2, P3, P4, which are placed in the matrix in accordance with the order number (MBINDEX) of the movement block. The corner coordinates of the movement block are disposed as follows: P1 is the upper left corner, P2 is the upper right corner, P3 is the lower right corner and P4 is the lower left corner.

[0021] There are created a video frame buffer (FRAMEBUFFER) and a last frame buffer (LASTFRAMEBUFFER) that are equal in size. The size to be reserved for the buffers (FRAMEBUFFERSIZE, LASTFRAMEBUFFERSIZE) is calculated by multiplying the frame width (FW), the frame height (FH) and the colour depth (COLORDEPTH) in bytes, i.e. (FH * FW * COLORDEPTH) = FRAMEBUFFERSIZE = LASTFRAMEBUFFERSIZE.

[0022] For pixel changes there is created a common colour sensitivity value (COLORSENSITIVITY), which defines the pixel change. The higher the value, the greater the colour change in the compared pixels must be in order for the current pixel to be found changed.

[0023] A common trigger value (MBTRIGGERVALUE) is created for the changes in the movement blocks, which value defines a change in the movement block. The higher the value, the larger number of pixels must change, in order for the current movement block to have changed.

[0024] A counter value of changed pixels (CHANGECOUNTER) is created, which value indicates the number of changed pixels in the current movement block.

[0025] A list (CHANGEDLIST) on changed movement blocks is created, which list indicates an index of the changed movement blocks.

[0026] After these preparatory operations reception of a video signal from a camera starts in block A. The video image arriving from the camera or camera module is copied in the FRAMEBUFFER memory. The last frame buffer (LASTFRAMEBUFFER) memory is zeroed, if it has not been used at all. To zero the memory denotes that the value of each byte is set to zero. The list on the changed movement blocks (CHANGEDLIST) is reset. The value of the colour sensitivity of the movement block (COLORSENSITIVITY) is set, for instance, to have a value within the range of 4096 to 8192. The value can be set more sensitive (e.g. 2048 to 4096) if the target of the image is in the dark, or correspondingly, higher (e.g. 8192 to 16384) if the target is better lit than normal. The trigger value of a change in the movement blocks (MBTRIGGERVALUE) is set to be 4 to 8, for instance. The value can also be set lower (e.g. 2 to 4) if the target is more remote, or higher (e.g. 8 to 16) if there is a lot of noise or interference in the target.

[0027] Block C starts movement-block-specific comparison with the corresponding movement blocks in the preceding frame. Operations of blocks D to G are performed on each movement block.

[0028] Block D finds out whether the current movement block includes at least a given number of pixels whose colour value change exceed a predetermined threshold. This can be carried out in the following manner:

[0029] First the counter of changes in the movement block pixels (CHANGECOUNTER) is set to zero. A subloop is created where each (MBSIZE) pixel of the movement block (MB) to be processed (MBINDEX) is examined in accordance with the matrix (MBMATRIX) starting from the coordinates P1 through to the coordinates P4, however in square-shape form not to go over the coordinates P2, nor to go under the coordinates P3. The following operations are performed on each pixel:

[0030] RGB values of pixels indicated by the coordinates are picked up from the frame under process (FRAMEBUFFER) and the preceding frame (LASTFRAMEBUFFER).

[0031] RG values (PIXELRG) of a pixel in the frame under process (FRAMEBUFFER) are compared with the RG values (LASTPIXELRG) of the pixel in the preceding frame (LASTFRAMEBUFFER) so as to obtain a change in the absolute value of colour components red (RED) and green (GREEN), i.e. an absolute (ABS) change (ABSRGDIFFERENCE). Counting is performed such that the difference between the RG values of pixels in the frame under process (FRAMEBUFFER) and the preceding frame (LASTFRAMEBUFFER) is placed in an ABS function, i.e. ABS(PIXELRG - LASTPIXELRG) = ABSRGDIFFERENCE. If the absolute change (ABSRGDIFFERENCE) in the colour components red (RED) and green (GREEN) is greater than colour sensitivity (COLORSENSITIVITY) of the movement blocks, the value of the pixel change counter (CHANGECOUNTER) is raised by one.

[0032] If the change in pixels was not detected in the colour components red (RED) and green (GREEN), then the colour components of green (GREEN) and blue (BLUE) are compared in the same manner as described above for the RG values. The GB values (PIXELGB) of the pixel in the frame under process (FRAMEBUFFER) are in that case compared with the GB values (LASTPIXELGB) of the pixel in the preceding frame (LASTFRAMEBUFFER) so as to obtain an absolute (ABS) change (ABSGBDIFFERENCE) in the colour components green (GREEN) and blue (BLUE). Counting is performed such that the difference between the GB values of pixels in the frame under process (FRAMEBUFFER) and the preceding frame (LASTFRAMEBUFFER) are placed in an ABS function, i.e. ABS(PIXELGB - LASTPIXELGB) = ABSGBDIFFERENCE. If the absolute change (ABSGBDIFFERENCE) in the colour components green (GREEN) and blue (BLUE) is greater than colour sensitivity (COLORSENSITIVITY) of the movement blocks, the value of the pixel change counter (CHANGECOUNTER) is raised by one.

[0033] When all pixels in the movement block have been examined in the above manner, the pixel change counter is checked. If the value of the pixel change counter (CHANGECOUNTER) is higher than the trigger value of a movement block change (MBTRIGGERVALUE), the movement block is detected changed, whereby the process proceeds to block F, where a movement block index (MBINDEX) is set on.a list of changed items

(CHANGEDLIST). Whereas, if the value of the pixel change counter is lower than the trigger of the movement block change, the predetermined threshold was not exceeded, whereby the movement block is detected unchanged and the process proceeds to block E.

[0034] In block G it is checked whether all the movement blocks of the frame to be processed have been examined. If not, the process returns to block C, from which the processing of the following movement block starts.

[0035] In block H colour values of pixels in the movement blocks detected unchanged are set to a predetermined value. In accordance with the invention it is advantageous to set the colour values to indicate the movement block pixels being black, because experiments have shown that prior art compression algorithms of a video image are then capable of processing these movement blocks quickly, and additionally, the file size of the produced compressed video image is small. However, it is possible to set the colour values to correspond to another colour that enables achievement of corresponding advantages with the compression algorithm used.

[0036] The setting of colour values can be implemented, for instance, by creating a loop, in which all changed movement blocks (CHANGEDLIST) are examined. In the loop there are examined the movement blocks that do not appear on the list of changed items (CHANGEDLIST). Each pixel of these unchanged movement blocks are set black in the frame buffer (FRAMEBUFFER).

[0037] In block I the pixels of the changed movement blocks are copied to the preceding frame in the corresponding movement blocks. This can be implemented by examining in the loop the movement blocks that appear on the list of changed items (CHANGEDLIST). Each pixel of these movement blocks is copied unchanged to the same location in the preceding frame buffer (LASTFRAMEBUFFER).

[0038] In block J a signal is generated on the basis of the information (FRAMEBUFFER) on the changed and unchanged movement blocks. The signal thus conveys a preprocessed image that can subsequently be compressed by means of a compression algorithm.

[0039] In block K it is monitored whether more video data is arriving from the camera. In the affirmative, the process returns to block A, from which the processing of a new received frame starts.

[0040] Unlike in the flow chart of Figure 2, after detecting a specific movement block changed it is possible, in connection with block F, to record the movement blocks (8 blocks) surrounding said changed movement block as changed as well, for instance, by adding them to the list of changed items (CHANGEDLIST). Experiments have shown that in some cases there may occur interference in a reproduced video image in these surrounding movement blocks.

[0041] Figure 3 is a block diagram of a first preferred embodiment of a reproduction device in accordance with the invention. Operations set forth in the blocks of the reproduction device 11 presented in the block diagram of Fig- ure 3 can be implemented by computer software, circuit solutions or combinations thereof. Operationally the blocks can be implemented in the presented manner, or alternatively, the operations of one or more blocks can be integrated. In practice the reproduction device 11 may consist of a computer, a television peripheral, a mobile station or any other reproduction device which is capable of reproducing video image.

[0042] In the case of Figure 3, it is assumed, by way of example, that compressed video data is retrieved from a hard disk 10, whereafter a decoder 12 decodes compression (e.g. MPEG 4 or DivX) and supplies to the reproduction device 11 a signal 13 containing image information. The images contained in the signal 13 are stored in a memory 14, from which the reproduction device 11 retrieves and processes them one by one.

[0043] Modification block 15 identifies from the frame stored in the memory 14 the movement blocks comprising at least a given number of pixels whose colour values correspond with a given accuracy to those of a given colour. The modification block 15 identifies these movement blocks as unchanged movement blocks. The modification block 15 identifies all other blocks as changed movement blocks. The modification block 15 copies the pixels of the changed movement blocks from the frame in the memory 14 to the corresponding movement blocks of the preceding frame to be maintained in the memory 16. The reproduction device 11 utilizes the image produced in the memory 16 by including it in a video signal 17 to be applied to a display 18.

[0044] Figure 3 shows, by way of example, that the hard disk 10 (or another storage medium of a video file), the decoder 12 and the display 18 are separate from the reproduction device 11. In practice, however, one or more of these parts can be integrated with the reproduction device. Moreover, it is an option that the video data to be reproduced is not stored on a storage medium at all, but it is received from a communications network from which it is supplied to the decoder 12.

[0045] Figure 4 illustrates production of video image with the reproduction device. On the left in Figure 4 there is a previous, processed and reproduced frame. In the middle there is a frame under process, where unchanged movement blocks are black, whereby only the changed movement blocks are in the original form. When the changed movement blocks of the middle frame are copied to the corresponding locations in the previous frame on the left, the result will be a new, changed frame shown on the right.

[0046] Figure 5 is a flow chart of a first preferred embodiment of a reproduction method in accordance with the invention. At first, some preliminary operations are performed to reproduce video image.

[0047] A decoded video image is received in RGB format. The movement blocks are equal-sized squares whose width (MBW) and height (MBH) are equal, i.e. 4

pixels, for instance. The size of a movement block (MBSIZE) is calculated by multiplying the width (MBW) of the movement block by its height (MBH), (MBW * MBH) = MBSIZE. The width (FW) and the height (FH) of a frame (FRAME) are set to be divisible by the width (MBW) and the height (MBH) of the movement block. The number of fixed movement blocks (MB) is calculated by multiplying the frame width (FW) by the frame height (FH) and the product is divided by the size of the movement block (MBSIZE), i.e. (((FH * FW) = FRAMESIZE / MBSIZE) = MBCOUNT.

[0048] A matrix (MBMATRIX) is created in accordance with the number (MBCOUNT) of the movement blocks (MB) for instance such that a frame is divided in sections (4x4) starting from the upper left corner ending to the lower right corner. For each (MBCOUNT) movement block (MB) in the frame there are calculated corner coordinates X and Y of the square, P1, P2, P3, P4, which are placed in the matrix in accordance with the order number (MBINDEX) of the movement block. The corner coordinates of the movement block are disposed as follows: P1 is the upper left corner, P2 is the upper right corner, P3 is the lower right corner and P4 is the lower left corner.

[0049] There are created a video frame buffer (FRAMEBUFFER) and a buffer of a frame to be interpreted (PREFRAMEBUFFER) that are equal in size. The size to be reserved for the buffers (FRAMEBUFFERSIZE, PREFRAMEBUFFERSIZE) is calculated by multiplying the frame width (FW), the frame height (FH) and the colour depth (COLORDEPTH) in bytes, i.e. (FH * FW * COLORDEPTH) = FRAMEBUFFERSIZE = PREFRAMEBUFFERSIZE.

[0050] There is created a common trigger value (MBTRIGGERVALUE) (for instance 4), which determines a change in the movement block. The higher the value, the more pixels need to change in order for the movement block to be considered changed. There is created a counter value of changed pixels (CHANGECOUNTER), which indicates the number of changed pixels in the movement block to be processed.

[0051] Reception of the signal containing image information starts in block L. The image information contained in the received signal is stored in a memory (PREFRAMEBUFFER). The memory (FRAMEBUFFER) of a completed frame to be reproduced is zeroed, if it has not yet been used at all. To zero the memory denotes that the value of each byte is set to zero.

[0052] In block M the pixels of the frame to be examined are divided into movement blocks. So, the pixels that belong to a subsequent movement block to be examined are searched one movement block at a time.

[0053] In blocks N to O all the movement blocks of the frame are examined one by one so as to find out whether in the movement block there are at least a given number of pixels whose colour values correspond with a given accuracy to those of a given colour. In the affirmative, an unchanged movement block is in question. Otherwise a changed movement block is in question. This can be implemented such, for instance, that the following operations are performed on each movement block:

[0054] The pixel change counter (CHANGECOUNTER) of a movement block is set to zero;

[0055] A sub-loop is created in which each (MBSIZE) pixel of the movement block (MB) to be processed (MBINDEX) is examined in accordance with the matrix (MBMATRIX), starting from the coordinates P1 through to the coordinates P4, however, in square-shape form not to go over the coordinates P2, nor to go under the coordinates P3;

[0056] The pixel colour indicated by the coordinates is established from the interpreted frame (PREFRAMEBUFFER);

[0057] If the unchanged movement blocks are indicated by setting their colour values to correspond to those of black colour, then, if the value of the pixel colour (PIXELCOLOR) of the frame to be interpreted (PREFRAMEBUFFER) exceeds the black sensitivity (BLACKSENSITIVITY) value of the changing pixels (for instance 4096), the value of the pixel change counter (CHANGECOUNTER) is raised by one. (In other words, if the pixel colour is not black, the value of the pixel change counter is raised by one.);

[0058] Whereas, if the unchanged movement blocks have been indicated by setting their colour values to correspond to those of another colour, then:

[0059] If the sum of pixel colour components red (RED) and green (GREEN) differs at most for a predetermined error margin from the sum of the colour components red (RED) and green (GREEN) of a given colour, the value of the pixel change counter (CHANGECOUNTER) will be raised by one.

[0060] If the error margin was not exceeded in the comparison of the red (RED) and the green (GREEN) colour components, the green (GREEN) and the blue (BLUE) colour components are also compared. If the sum of the pixel colour components green (GREEN) and blue (BLUE) of the interpreted frame differs at most for a given error margin from the sum of the green (GREEN) and the blue (BLUE) colour components of a given colour, the value of the pixel change counter (CHANGECOUNTER) will be raised by one.

[0061] When all pixels have been examined, the value of the pixel change counter (CHANGECOUNTER) is checked. If the value exceeds the trigger value of the change in the movement block (MBTRIGGERVALUE), a changed movement block is in question, whereby the process proceeds via block P to block Q. Whereas, if the value is not higher than the change trigger value, the process proceeds via block O to block R.

[0062] In block Q the pixels of the changed movement blocks are copied to the preceding frame. This can be done by copying each pixel of the movement block under process unchanged to the same location in the frame buffer (FRAMEBUFFER).

[0063] From block R the process returns to block M to process a subsequent movement block if there are still unexamined movement blocks in the frame under process.

[0064] In block S a video signal is generated on the basis of the modified frame (FRAMEBUFFER).

[0065] If the signal reception goes on, the signal containing more frames to be interpreted, the process returns from block T to block L so as to process the image information of a subsequent frame received.

[0066] It should be understood that the above description and the relating figures are only intended to illustrate the present invention. It is obvious to the person skilled in the art that the invention may be modified and varied in a variety of ways without deviating from the scope of the claims.

Claims

1. A video image processor (1) which is configured to receive a video signal (3) generated by a video camera (2),
to compare (7) an individual frame under process, included in the received video signal (3), with a preceding frame so as to detect changes;
to detect (7) said changes by dividing the pixels of the individual frame into movement blocks of a predetermined size and to detect a given movement block as changed if in said movement block the number of pixels whose colour value has changed as compared with those of the preceding frame exceeds a predetermined threshold, said video image processor (1) being **characterised in that** it is configured
to change (8) in the frame under process the colour values of all other pixels than those of the changed movement blocks by setting the colour values of pixels that are in movement blocks detected as unchanged as compared with the preceding frame to predetermined values, and
to generate a signal (4) which indicates the changes by including in said signal the information on movement blocks detected as changed and also the information on unchanged movement blocks, such that said signal includes all the movement blocks of the frame under process.

2. A processor as claimed in claim 1, wherein if the processor (1) detects a given movement block as changed on the basis of a colour value check of pixels in said movement block, the processor (1) is configured to record also all the movement blocks surrounding said given movement block as changed.

3. A processor as claimed in claim 1 or 2, wherein the processor (1) is configured to analyze a change in colour values by analyzing changes in RGB values such that if the absolute value of a change in RG value or in GB value of a single pixel exceeds said predetermined threshold, the processor (1) finds the colour values of said pixel changed.

4. A processor as claimed in any one of claims 1 to 3, wherein the processor (1) is configured to modify said preceding frame by copying to it, from the frame under process, the pixels of the movement block detected (7) as changed and to use said frame changed in this manner also in the comparison which the processor (1) will perform on a frame subsequent to the frame under process.

5. A processor as claimed in any one of claims 1 to 4, wherein the processor (1) is configured to set the colour values of the pixels in unchanged movement blocks to predetermined values that indicate the pixels being black.

6. A processor as claimed in any one of claims 1 to 5, wherein the processor (1) is configured to feed the generated signal (4) to a video image coder (9) that is integrated with the processor or separate therefrom.

7. A video image reproduction device (11) which is configured
to receive a signal (13) containing image information, to divide the pixels of a single frame to be examined in the received image information into movement blocks of a predetermined size, and
to generate a video signal (17) on the basis of the image information, **characterized in that** for generating a video signal the reproduction device is configured
to detect (15) as unchanged the movement blocks of the examined frame in which there is at least a given number of pixels whose colour values correspond with a given accuracy to those of a given colour and to detect all other movement blocks as changed,
to modify (15) a preceding completed frame in a memory (16) by copying the pixels of the movement blocks detected as changed in said single examined frame to the preceding completed frame in the memory, and
to include said modified frame in the memory (16) in the video signal (17) to be generated.

8. A video image reproduction device as claimed in claim 7, wherein the reproduction device (11) is configured to detect (15) as unchanged the movement blocks of the examined frame in which there is at least a given number of pixels whose colour values with a predetermined accuracy indicate the pixel being black.

9. A method for processing a video signal generated

by a video camera, the method comprising:

receiving (A) a video signal of a video camera, comparing a single frame included in the video signal and being processed with a preceding frame so as to detect changes,
detecting (D) the changes by dividing the pixels in a single frame into movement blocks of a predetermined size and by detecting a given movement block as changed, if the number of pixels whose colour value has changed as compared with the corresponding pixels in the preceding frame exceeds a predetermined threshold, said method being **characterised in that** it comprises the steps of
changing (H) in the frame under process the colour values of all other pixels than those of changed movement blocks by setting the colour values of the pixels in these unchanged movement blocks, as compared with the preceding frame, to a predetermined value, and
generating (J) a signal that indicates the changes by including in the signal the information on the movement blocks detected as changed as well as the information on unchanged movement blocks, such that said signal includes all the movement blocks of the frame under process.

10. A method as claimed in claim 9, wherein the method analyzes changes (D) in colour values by analyzing changes in RGB values and the colour values of a single pixel are detected as changed if the absolute value of the change of the RG value or the absolute value of the change of the GB value of the pixel exceeds said predetermined threshold.

11. A method as claimed in claim 9 or 10, wherein the method modifies (I) said preceding frame by copying to it from the frame under process the pixels of the changed movement blocks and uses the preceding frame modified in this manner for the comparison to be performed on a frame subsequent to the frame under process.

12. Software for controlling a programmable device for implementing any one of the claims 9 to 11.

13. A method for generating a video signal for reproduction, the method comprising:

receiving (L) a signal containing image information,
dividing (M) the pixels of a single frame under process in the received image information into movement blocks of a predetermined size, said method being **characterised in that** it comprises the steps of
detecting (N) as unchanged the movement blocks of the frame under process in which there is at least a given number of pixels whose colour values correspond with a given accuracy the values of a given colour, and detecting all other movement blocks as changed,
modifying (Q) the preceding completed frame in a memory by copying the pixels of the movement blocks detected as changed in said single frame under process to the preceding completed single frame in the memory, and
including (S) said modified frame in the memory in a video signal to be generated.

14. A method as claimed in claim 13, comprising detecting (N) as unchanged the movement blocks of the frame under process in which there are at least a given number of pixels whose colour values with a given accuracy indicate the pixel being black.

15. Software for controlling a programmable device for implementing any one of the claims 13 to 14.

Patentansprüche

1. Ein Videobildprozessor (1), der konfiguriert ist,
ein von einer Videokamera (2) erzeugtes Videosignal zu empfangen,
einen individuellen, verarbeitet werdenden Rahmen, der in dem empfangenen Videosignal (3) enthalten ist, mit einem vorhergehenden Rahmen zu vergleichen (7), um Veränderungen zu erkennen;
besagte Veränderungen zu erkennen (7), indem die Pixel des individuellen Rahmens in Bewegungsblöcke einer im Voraus bestimmten Größe zu teilen und einen gegebenen Bewegungsblock als verändert zu erkennen, falls im besagten Bewegungsblock die Anzahl der Pixel, deren Farbwert sich im Vergleich zum vorhergehenden Rahmen verändert hat, eine im Voraus bestimmte Schwelle überschreitet, wobei der besagte Videobildprozessor (1) **dadurch gekennzeichnet, dass** er konfiguriert ist,
in dem verarbeitet werdenden Rahmen die Farbwerte aller anderen Pixel als diejenigen der veränderten Bewegungsblöcke zu ändern (8), indem die Farbwerte der Pixel, die sich in den als unverändert erkannten Bewegungsblöcken im Vergleich mit dem vorhergehenden Rahmen befinden, auf im Voraus bestimmte Werte eingestellt werden, und
ein Signal (4) zu generieren, das die Veränderungen anzeigt, indem in dem besagten Signal die Information über die als verändert erkannten Bewegungsblöcke und auch die Information über unveränderte Bewegungsblöcke derart einbezogen werden, dass das besagte Signal sämtliche Bewegungsblöcke des verarbeitet werdenden Rahmens beinhaltet.

2. Ein Prozessor gemäß dem Patentanspruch 1, wobei, falls der Prozessor (1) einen gegebenen Bewegungsblock auf der Basis einer Farbwertkontrolle der Pixel in dem besagten Bewegungsblock als verändert erkennt, der Prozessor (1) konfiguriert ist, auch alle Bewegungsblöcke, die den besagten Bewegungsblock umgeben, als verändert zu registrieren.

3. Ein Prozessor gemäß dem Patentanspruch 1 oder 2, wobei der Prozessor (1) konfiguriert ist, eine Veränderung in den Farbwerten zu analysieren, indem die Veränderungen in den RGB-Werten derart analysiert werden, dass, falls der absolute Wert einer Veränderung in dem RG-Wert oder in dem GB-Wert eines einzelnen Pixels den besagten Schwellenwert überschreitet, der Prozessor (1) die Farbwerte des besagten Pixels als verändert erkennt.

4. Ein Prozessor gemäß einem der Patentansprüche 1 bis 3, wobei der Prozessor (1) konfiguriert ist, den besagten vorhergehenden Rahmen zu modifizieren, indem aus dem verarbeitet werdenden Rahmen die Pixel des als verändert erkannten (7) Bewegungsblocks in den Rahmen kopiert werden, und den besagten, in dieser Weise veränderten Rahmen auch in dem Vergleich zu verwenden, den der Prozessor (1) an einem, auf den verarbeitet werdenden Rahmen folgenden Rahmen durchführen wird.

5. Ein Prozessor gemäß einem der Patentansprüche 1 bis 4, wobei der Prozessor (1) konfiguriert ist, die Farbwerte der Pixel in unveränderten Bewegungsblöcken auf im Voraus bestimmte Werte einzustellen, die anzeigen, dass die Pixel schwarz sind.

6. Ein Prozessor gemäß einem der Patentansprüche 1 bis 5, wobei der Prozessor (1) konfiguriert ist, das generierte Signal (4) an einen Videobildkodierer (9) zu speisen, der mit dem Prozessor integriert ist oder von ihm getrennt ist.

7. Ein Videobildreproduktionsgerät (11), das konfiguriert ist,
ein, die Bildinformation enthaltendes Signal (13) zu empfangen,
die Pixel eines individuellen, untersucht zu werdenden Rahmens in der erhaltenen Bildinformation in Bewegungsblöcke einer im Voraus bestimmten Größe zu teilen, und
ein Videosignal (17) auf der Basis der Bildinformation zu generieren, **dadurch gekennzeichnet, dass** zum Generieren eines Videosignals das Reproduktionsgerät konfiguriert ist,
die Bewegungsblöcke des untersuchten Rahmens als unverändert zu erkennen (15), in welchen mindestens eine gegebene Anzahl Pixel vorhanden ist, deren Farbwerte mit einer gegebenen Genauigkeit denen einer gegebenen Farbe entsprechen, und alle anderen Bewegungsblöcke als verändert zu erkennen,
einen vorhergehenden vervollständigten Rahmen in einem Speicher (16) zu modifizieren (15), indem die Pixel des als verändert erkannten Bewegungsblocks in dem besagten einzelnen untersuchten Rahmen in den vorhergehenden, vervollständigten Rahmen in dem Speicher kopiert werden, und
den besagten modifizierten Rahmen in dem Speicher (16) in das zu generierende Videosignal (17) einzubeziehen.

8. Ein Videobildreproduktionsgerät gemäß dem Patentanspruch 7, wobei das Reproduktionsgerät (11) konfiguriert ist, die Bewegungsblöcke des untersuchten Rahmens, in welchen mindestens eine gegebene Anzahl Pixel vorhanden ist, deren Farbwerte mit einer im Voraus bestimmten Genauigkeit anzeigen, dass die Pixel schwarz sind, als unverändert zu erkennen (15).

9. Ein Verfahren zur Verarbeitung eines von einer Videokamera generierten Videosignals, wobei das Verfahren Folgendes aufweist:

ein Videosignal von einer Videokamera empfangen (A),
einen, in dem Videosignal enthaltenen und verarbeitet werdenden einzelnen Rahmen mit einem vorhergehenden Rahmen vergleichen, um Veränderungen zu erkennen,
die Veränderungen erkennen (D), indem die Pixel in einem einzelnen Rahmen in Bewegungsblöcke einer im Voraus bestimmten Größe geteilt werden, und einen Bewegungsblock als verändert erkennen, falls die Anzahl der Pixel, deren Farbwert sich verändert hat im Vergleich mit den entsprechenden Pixeln des vorhergehenden Rahmens, einen im Voraus bestimmten Schwellenwert überschreiten, wobei das Verfahren **dadurch gekennzeichnet ist, dass** es folgende Schritte aufweist
in dem verarbeitet werdenden Rahmen die Farbwerte aller anderen Pixel als diejenigen der veränderten Bewegungsblöcke ändern (H), indem die Farbwerte der Pixel in diesen unveränderten Bewegungsblöcken, im Vergleich zu dem vorhergehenden Rahmen, auf einen im Voraus bestimmten Wert eingestellt werden, und
ein Signal generieren (J), das die Veränderungen anzeigt, indem in das Signal sowohl die Information über die als verändert erkannten Bewegungsblöcke als auch die Information über unveränderte Bewegungsblöcke des verarbeitet werdenden Rahmens derart einbezogen wird, dass das besagte Signal alle Bewegungs-

blöcke des verarbeitet werdenden Rahmens beinhaltet.

10. Ein Verfahren gemäß dem Patentanspruch 9, wobei das Verfahren die Veränderungen in den Farbwerten analysiert (D), indem die Veränderungen in den RGB-Werten analysiert werden und die Farbwerte eines einzelnen Pixels als verändert erkannt werden, falls der absolute Wert der Veränderung des RG-Wertes oder der absolute Wert der Veränderung des GB-Wertes des Pixels den besagten im Voraus bestimmten Schwellenwert überschreitet.

11. Ein Verfahren gemäß dem Patentanspruch 9 oder 10, wobei das Verfahren den besagten vorhergehenden Rahmen modifiziert (I), indem die Pixel aus dem verarbeitet werdenden Rahmen der veränderten Bewegungsblöcke in ihn kopiert werden, und der vorhergehende, in dieser Weise modifizierte Rahmen zum Vergleich verwendet wird, der an einem, auf den verarbeitet werdenden Rahmen folgenden Rahmen durchgeführt werden wird.

12. Software zur Steuerung eines programmierbaren Gerätes zur Durchführung eines der Patentansprüche 9 bis 11.

13. Ein Verfahren zum Generieren eines Videosignals zur Reproduktion, wobei das Verfahren folgende Schritte aufweist:

ein Signal mit Bildinformation empfangen (L), die Pixel eines einzelnen verarbeitet werdenden Rahmens in der empfangenen Bildinformation in Bewegungsblöcke einer im Voraus bestimmten Größe zu teilen (M), wobei das besagte Verfahren **dadurch gekennzeichnet ist, dass** es folgende Schritte aufweist:

die Bewegungsblöcke des verarbeitet werdenden Rahmens als unverändert erkennen (N), in denen mindestens eine gegebene Anzahl Pixel vorhanden ist, deren Farbwerte mit einer gegebenen Genauigkeit den Werten einer gegebenen Farbe entsprechen, und alle anderen Bewegungsblöcke als verändert erkennen,
den vorhergehenden vervollständigten Rahmen in einem Speicher modifizieren (Q), indem die Pixel des als verändert erkannten Bewegungsblocks in dem besagten einzelnen, verarbeitet werdenden Rahmen in den vorhergehenden vervollständigten einzelnen Rahmen in dem Speicher kopiert werden, und
den besagten modifizierten Rahmen in dem Speicher in das zu generierende Videosignal einzubeziehen (S).

14. Ein Verfahren gemäß dem Patentanspruch 13, wobei diejenigen Bewegungsblöcke des verarbeitet werdenden Rahmens als unverändert erkannt werden (N), in welchen mindestens eine gegebene Anzahl Pixel vorhanden ist, deren Farbwerte mit einer gegebenen Genauigkeit anzeigen, dass das Pixel schwarz ist.

15. Software zur Steuerung eines programmierbaren Gerätes zur Durchführung eines der Patentansprüche 13 bis 14.

Revendications

1. Processeur d'image vidéo (1) qui est configuré pour recevoir un signal vidéo (3) généré par une caméra vidéo (2),
pour comparer (7) une trame individuelle en cours de traitement, incluse dans le signal vidéo (3) reçu, avec une trame précédente de manière à détecter des changements ;
pour détecter (7) lesdits changements en divisant les pixels de la trame individuelle en blocs de mouvement d'une taille prédéterminée et pour détecter qu'un bloc de mouvement donné a changé si, dans ledit bloc de mouvement, le nombre de pixels dont une valeur de couleur a changé comparé à ceux de la trame précédente dépasse un seuil prédéterminé, ledit processeur d'image vidéo (1) étant **caractérisé en ce qu'**il est configuré
pour changer (8) dans la trame en cours de traitement les valeurs de couleur de tous les pixels autres que ceux des blocs de mouvement changés en fixant les valeurs de couleur des pixels qui sont dans les blocs de mouvement détectés comme étant inchangés comparé à la trame précédente à des valeurs prédéterminées, et
pour générer un signal (4) qui indique les changements en incluant dans ledit signal les informations concernant les blocs de mouvement détectés comme étant changés et également les informations concernant les blocs de mouvement inchangés, de sorte que ledit signal comprenne tous les blocs de mouvement de la trame en cours de traitement.

2. Processeur selon la revendication 1, dans lequel, si le processeur (1) détecte qu'un bloc de mouvement donné a changé sur la base d'un contrôle de valeur de couleur de pixels dans ledit bloc de mouvement, le processeur (1) est configuré pour enregistrer également tous les blocs de mouvement entourant ledit bloc de mouvement donné comme étant changés.

3. Processeur selon la revendication 1 ou 2, dans lequel le processeur (1) est configuré pour analyser un changement des valeurs de couleur en analysant des changements de valeurs RVB de sorte que, si la valeur absolue d'un changement de valeur RV ou de valeur VB d'un pixel unique dépasse ledit seuil prédéterminé, le processeur (1) trouve les valeurs de couleur dudit pixel changé.

4. Processeur selon l'une quelconque des revendications 1 à 3, dans lequel le processeur (1) est configuré pour modifier ladite trame précédente en copiant dans celle-ci, à partir de la trame en cours de traitement, les pixels du bloc de mouvement détectés (7) comme étant changés et pour utiliser ladite trame modifiée de cette manière également dans la comparaison que le processeur (1) effectuera sur une trame qui suit la trame en cours de traitement.

5. Processeur selon l'une quelconque des revendications 1 à 4, dans lequel le processeur (1) est configuré pour fixer les valeurs de couleur des pixels dans les blocs de mouvement inchangés à des valeurs prédéterminées qui indiquent que les pixels sont noirs.

6. Processeur selon l'une quelconque des revendications 1 à 5, dans lequel le processeur (1) est configuré pour fournir le signal généré (4) à un encodeur d'image vidéo (9) qui est intégré au processeur ou séparé de celui-ci.

7. Dispositif de reproduction d'image vidéo (11) qui est configuré

pour recevoir un signal (13) contenant des informations d'image,

pour diviser les pixels d'une trame unique à examiner dans les informations d'image reçues en blocs de mouvement d'une taille prédéterminée, et

pour générer un signal vidéo (17) sur la base des informations d'image, **caractérisé en ce que**, pour générer un signal vidéo, le dispositif de reproduction est configuré

pour détecter (15) comme étant inchangés les blocs de mouvement de la trame examinée dans lesquels il existe au moins un nombre donné de pixels dont les valeurs de couleur correspondent avec une précision donnée à celles d'une couleur donnée et pour détecter que tous les autres blocs de mouvement ont changé,

pour modifier (15) une trame achevée précédente en mémoire (16) en copiant les pixels des blocs de mouvement détectés comme étant changés dans ladite trame unique examinée dans la trame achevée précédente en mémoire, et

pour inclure ladite trame modifiée en mémoire (16) dans le signal vidéo (17) à générer.

8. Dispositif de reproduction d'image vidéo selon la revendication 7, dans lequel le dispositif de reproduction (11) est configuré pour détecter (15) comme inchangés les blocs de mouvement de la trame examinée dans lesquels il existe au moins un nombre donné de pixels dont les valeurs de couleur indiquent avec une précision prédéterminée que le pixel est noir.

9. Procédé pour traiter un signal vidéo généré par une caméra vidéo, le procédé comprenant :

la réception (A) d'un signal vidéo d'une caméra vidéo,

la comparaison d'une trame unique incluse dans le signal vidéo et traitée avec une trame précédente de manière à détecter des changements,

la détection (D) des changements en divisant les pixels dans une trame unique en blocs de mouvement d'une taille prédéterminée et en détectant qu'un bloc de mouvement donné a changé, si le nombre de pixels dont une valeur de couleur a changé comparé aux pixels correspondants dans la trame précédente dépasse un seuil prédéterminé, ledit procédé étant **caractérisé en ce qu'**il comprend les étapes de

changement (H) dans la trame en cours de traitement des valeurs de couleur de tous les pixels autres que ceux des blocs de mouvement changés en fixant les valeurs de couleur des pixels dans ces blocs de mouvement inchangés, comparé à la trame précédente, à une valeur prédéterminée, et

génération (J) d'un signal qui indique les changements en incluant dans le signal les informations concernant les blocs de mouvement détectés comme ayant changés ainsi que les informations concernant les blocs de mouvement inchangés, de sorte que ledit signal comprenne tous les blocs de mouvement de la trame en cours de traitement.

10. Procédé selon la revendication 9, dans lequel le procédé analyse des changements (D) des valeurs de couleur en analysant les changements des valeurs RVB et les valeurs de couleur d'un pixel unique sont détectées comme étant changées si la valeur absolue du changement de la valeur RV ou la valeur absolue du changement de la valeur VB du pixel dépasse ledit seuil prédéterminé.

11. Procédé selon la revendication 9 ou 10, dans lequel le procédé modifie (I) ladite trame précédente en copiant dans celle-ci, à partir de la trame en cours de traitement, les pixels des blocs de mouvement changés et utilise la trame précédente modifiée de cette manière pour la comparaison à effectuer sur une trame qui suit la trame en cours de traitement.

12. Logiciel pour commander un dispositif programmable pour mettre en oeuvre l'une quelconque des revendications 9 à 11.

13. Procédé pour générer un signal vidéo pour une reproduction, le procédé comprenant :

la réception (L) d'un signal contenant des informations d'image,
la division (M) des pixels d'une trame unique en cours de traitement dans les informations d'image reçues en blocs de mouvement d'une taille prédéterminée, ledit procédé étant **caractérisé en ce qu'**il comprend les étapes de
détection (N) comme étant inchangés des blocs de mouvement de la trame en cours de traitement dans lesquels il existe au moins un nombre donné de pixels dont les valeurs de couleur correspondent avec une précision donnée aux valeurs d'une couleur donnée, et détection de tous les autres blocs de mouvement comme étant changés,
modification (Q) de la trame achevée précédente en mémoire en copiant les pixels des blocs de mouvement détectés comme étant changés dans ladite trame unique en cours de traitement dans la trame unique achevée précédente en mémoire, et
inclusion (S) de ladite trame modifiée en mémoire dans un signal vidéo à générer.

14. Procédé selon la revendication 13, comportant la détection (N) comme inchangés des blocs de mouvement de la trame en cours de traitement dans lesquels il existe au moins un nombre donné de pixels dont les valeurs de couleur indiquent avec une précision donnée que le pixel est noir.

15. Logiciel pour commander un dispositif programmable pour mettre en oeuvre l'une quelconque des revendications 13 à 14.

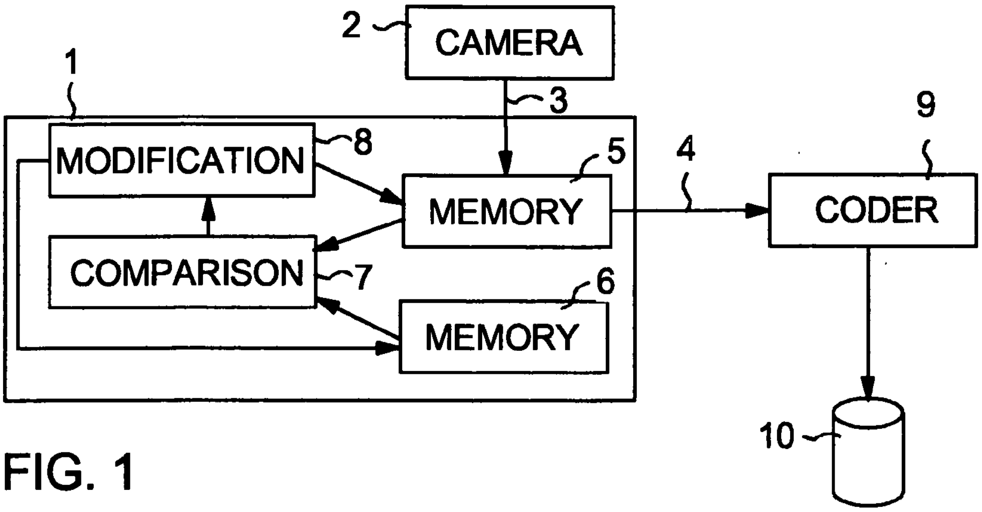

FIG. 1

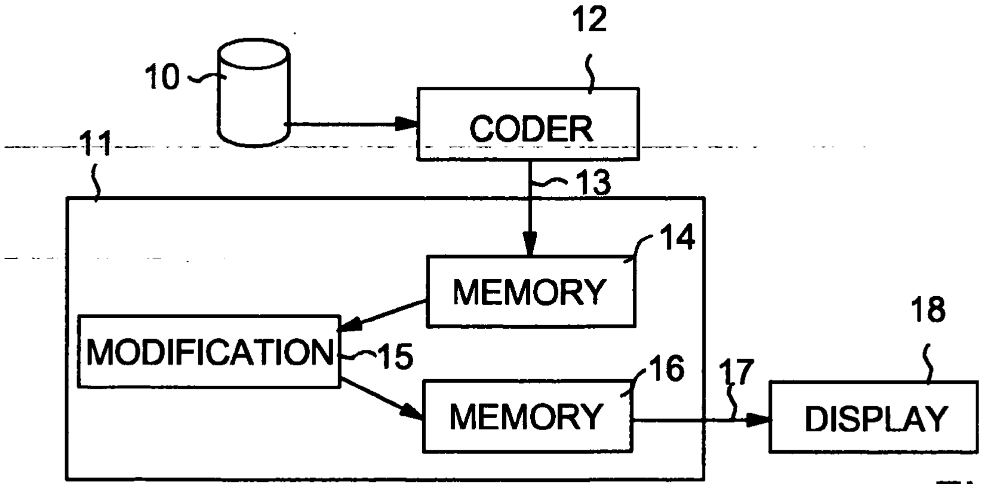

FIG. 3

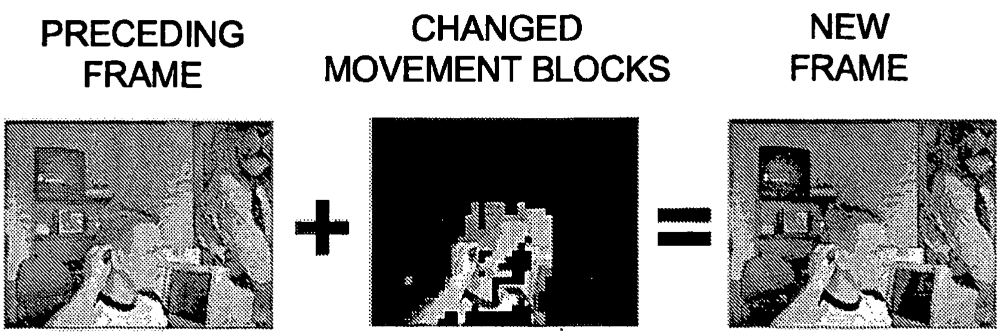

FIG. 4

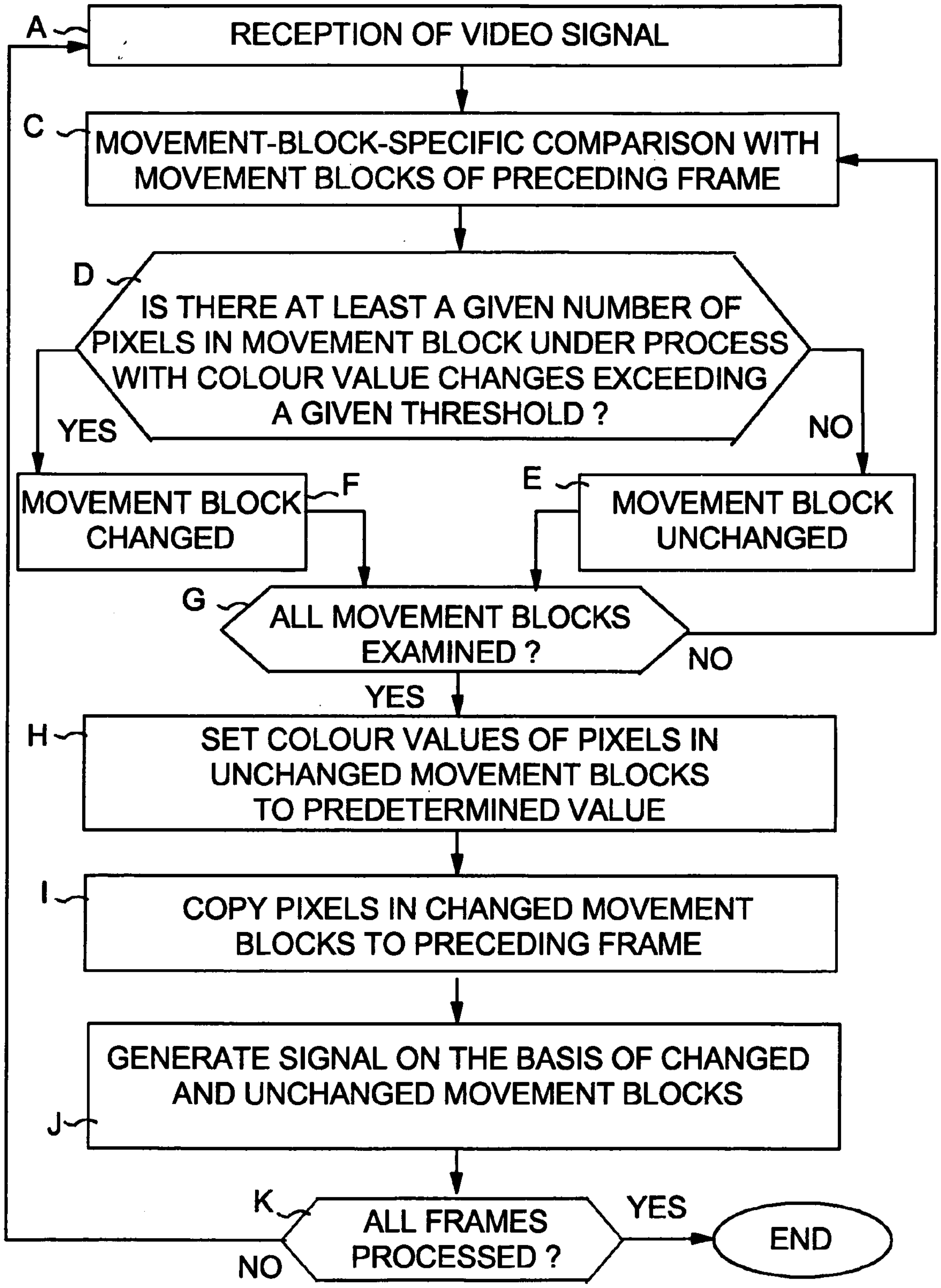
A
RECEPTION OF VIDEO SIGNAL
C
MOVEMENT-BLOCK-SPECIFIC COMPARISON WITH MOVEMENT BLOCKS OF PRECEDING FRAME
D
IS THERE AT LEAST A GIVEN NUMBER OF PIXELS IN MOVEMENT BLOCK UNDER PROCESS WITH COLOUR VALUE CHANGES EXCEEDING A GIVEN THRESHOLD ?
YES
NO
MOVEMENT BLOCK CHANGED
F
E
MOVEMENT BLOCK UNCHANGED
G
ALL MOVEMENT BLOCKS EXAMINED ?
NO
YES
H
SET COLOUR VALUES OF PIXELS IN UNCHANGED MOVEMENT BLOCKS TO PREDETERMINED VALUE
I
COPY PIXELS IN CHANGED MOVEMENT BLOCKS TO PRECEDING FRAME
GENERATE SIGNAL ON THE BASIS OF CHANGED AND UNCHANGED MOVEMENT BLOCKS
J
K
ALL FRAMES PROCESSED ?
YES
NO
END

FIG. 2

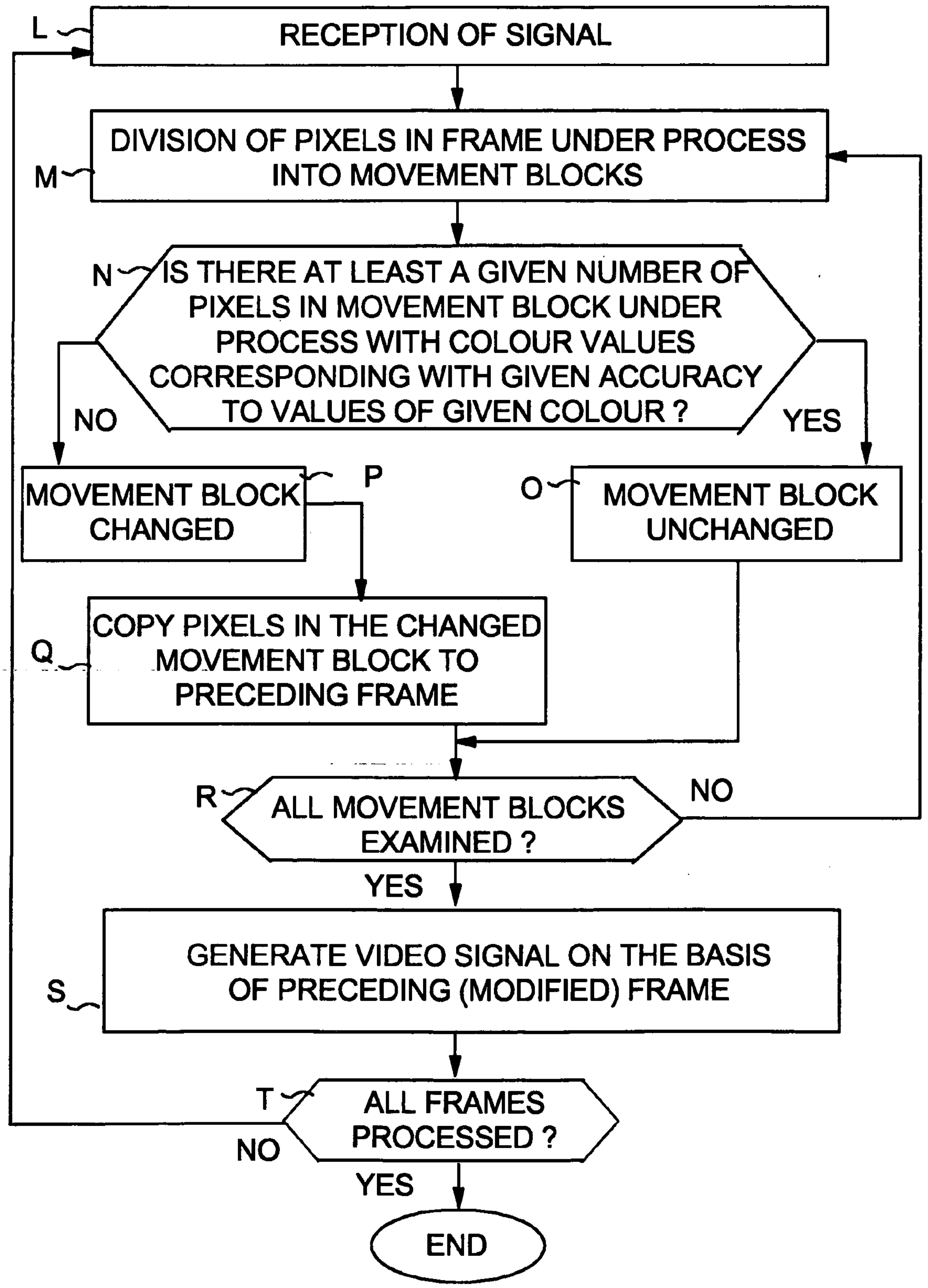
L
RECEPTION OF SIGNAL
M
DIVISION OF PIXELS IN FRAME UNDER PROCESS INTO MOVEMENT BLOCKS
N
IS THERE AT LEAST A GIVEN NUMBER OF PIXELS IN MOVEMENT BLOCK UNDER PROCESS WITH COLOUR VALUES CORRESPONDING WITH GIVEN ACCURACY TO VALUES OF GIVEN COLOUR ?
NO
YES
MOVEMENT BLOCK CHANGED
P
O
MOVEMENT BLOCK UNCHANGED
Q
COPY PIXELS IN THE CHANGED MOVEMENT BLOCK TO PRECEDING FRAME
R
ALL MOVEMENT BLOCKS EXAMINED ?
NO
YES
S
GENERATE VIDEO SIGNAL ON THE BASIS OF PRECEDING (MODIFIED) FRAME
T
ALL FRAMES PROCESSED ?
NO
YES
END

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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- US 6160848 A **[0005]**
- WO 0157803 A1 **[0005]**