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(54) VIDEO COMPRESSION METHOD.

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Description

The present invention relates to a video compression method which is employed in connection with the conditional replenishment transmission and receiving method; in the transmitter according to the said method, those areas which are changed with respect to the previous image are detected and the respective picture information, together with the addresses of the respective areas, is transmitted into the transmission channel, and in the receiver a new image is reconstructed on the basis of the previous image and the addresses of the changed picture areas as well as on the basis of the picture information representing the occurred changes (see e.g. US-A-3 956 580 or EP-A-0 113 514).

A digitized video signal which contains the picture information and is transmitted by means of the pulse code modulation method, requires a transmission channel capacity, the magnitude whereof is defined on the basis of the amount of picture elements and grey scale levels as well as the number of images to be transmitted per second. The information to be transmitted can be decreased without deteriorating the quality of the image by transmitting only the video signal representing the change occurred in between successive images. Therefore it is necessary, in one way or another, to detect the areas in the image which are changed with respect to the previous image, and only these changed areas are then transmitted. The information concerning these transmitted changed picture areas must also be provided with addresses which denote the picture area in question. Thus it is possible to reconstruct every image in a true and accurate fashion.

In the transmitter applying the above explained method, two separate picture memories are needed, the first containing the new image and the second containing an image corresponding to that which was last reconstructed by the receiver. In the receiver, there is needed only one picture memory, which is the display memory.

The object of the present invention is to improve the aforementioned video compression method so that the amount of transmitted information is further decreased.

The method of the invention is characterized in that in connection with the above described prior art method, the conditional replenishment method, there is employed a reference memory both in the transmitter and the receiver; into this reference memory there is stored a so-called reference image according to the transmitted picture information, and the reference memory is used so that whenever a picture area is detected which has changed in the transmitter, it is checked whether this changed picture information corresponds to the information located in the respective place in the reference memory; if the answer is positive, a code word is sent to inform the receiver that the necessary picture information must be picked from the respective location in the reference memory ; if the answer is negative, the picture information representing the change occurred in the picture area is transmitted.

In the transmitter of the apparatus applying the method of the present invention, there are, in addition to the two previously mentioned picture memories, other additional picture memories, i.e. so-called reference memories - in the simplest case, however, only one. The said reference memories are also provided in the receiver.

The method of the invention is designed to be employed in particular, but not exclusively, in connection with the above described prior art method in such cases where the transmitted video signal is created while the camera does not move but remains stably on the same spot. Thus a solid background is seen in the image, and the changes are created while the objects move in front of the background. Consequently, the proceeding front edge of the moving object keeps covering the background, and respectively the back edge of the object keeps revealing the same background. The conditional replenishment method, which was described in the beginning of this specification, recongnizes as changed areas both the moving object as such, and the background which is revealed from behind the moving object.

In the following the invention is explained with reference to the appended drawing, where

Figure 1 illustrates in block diagram a transmitter applying the method of the invention, and

Figure 2 illustrates a corresponding receiver.

In the transmitter of figure 1, the input interface A is connected to the analogue-to-digital (A-to-D) converter 1, which again is connected to the first picture memory 2. The first and second picture memories 2 and 3 are connected to the detector 4 of changed picture areas, which again is connected to the reference circuit 5, where also the reference picture memory 6 is connected. The reference circuit 5 is connected to the coder 7, which is followed by the output interface B. The output of the coder 7 is also connected to the decoder 8 and further both to the replenishment circuit 9 of the reference memory and to the reference picture memory 6 as well as to the switch 10, which is advantageously an electronic switch. The first input a of the switch 10 is connected to the output of the decoder 8, the second input b is connected to the reference memory 6, and the output c is connected

to the second picture memory 3. The switch 10, whereby either of the inputs a, b is connected to the output c, is controlled by the reference circuit 5.

A standard TV video signal is transferred, for instance from a video camera, through the input interface A to the A-to-D converter 1, where the video signal is digitized, and simultaneuously it is transferred into the timing and control circuit (not represented in the drawing), where the timing and control signals required in the transmitter are formed. The digitized video signal is stored into the first picture memory 2, and further into the detector 4 of the changed picture areas, into which detector there is also stored the previously transmitted picture information or corresponding informations from the second picture memory 3.

A digitized TV image is composed of n lines, each of which lines is divided into m elements, i.e. the image is a raster formed by n x m picture elements (n and m are integers). The picture area in turn consists of a block containing a chosen number of picture elements. The digitized video signal is formed of the address of the block and of the information concerning this block (for instance grey scale levels).

When a certain picture area is detected as changed in the detector 4, the reference circuit 5 checks whether the changed picture information corresponds to the information located in the respective location in the reference memory 6. This is the case for example when the camera is stationary and the information of a stable background is stored into the reference memory 6, and the changed picture area in question is a background area which has been revealed from behind a moving object. Now, instead of picture information, a code word is sent via the output interface B to the transmission channel. The code word is formed of the address of the picture area and of the code word proper, which may be very short. The code word informs the receiver that the required picture information must be picked from the corresponding reference memory. The content of the second picture memory 3 must be modified in similar fashion. Under control of the reference circuit 5, the second input b of the switch 10 is connected to its output c, and the corresponding picture information is read from the reference picture memory 6 into the second picture memory 3.

The situation is different when the detector 4 recognizes that a certain picture area has changed but a check by the reference circuit 5 shows that the picture information is different from the information stored in the corresponding location in the reference memory 6. Now the picture information representing the change in the picture area is sent in a currently known fashion from the transmitter through the coder 7 and the output interface B into the transmission channel. The content of the second picture memory 3 is modified so as to correspond to the transmitted picture information. Under control of the reference circuit 5, the first input a of the switch 10 is connected to its output c, and the transmitted picture information is read into the second picture memory 3 through the decoder 8.

In the receiver according to figure 2, the input interface C is connected to the decoder 11 and to the code word identifier 12. The decoder 11 is connected to the replenishment circuit 13 of the reference memory and further to the reference picture memory 14. The first input a of the switch 15 is connected to the output of the decoder 11, and the second input b to the output of the reference picture memory 14. The output c of the switch 15 is connected to the display memory 16. The switch 15, which connects either of the inputs a, b to the output c, is controlled by the code word identifier 12. The display memory 16 is connected to the monitor 18 via the digital-to-analogue (D-to-A) converter 17.

When the transmitter sends a code word, instead of picture information, to the transmission channel, and the said code word is received by the receiver, the code word is then identified by means of the code word identifier 12, which connects the reference picture memory 14 to the display memory 16 via the switch 15. Now the required picture information is picked at the corresponding location in the reference memory 14 and is placed in the corresponding location in the display memory 16. The address of the picture area, indicated by the code word, is read into the reference memory 14 for instance via the decoder 11 and the replenishment circuit 13 of the reference memory. Thus the amount of transmitted information can be decreased, because the said code word can be much shorter than the picture information it replaces.

If the transmitter sends the picture information representing the change in the picture area, it is normally received in the receiver, decoded and stored into the display memory 16. Now the switch 15 is in a position where it connects the decoder 11 to the display memory 16. From the display memory 16, the picture information is fed, via the D-to-A converter 17, to be seen on the screen of the monitor 18.

The reference image of the transmitted picture information is stored into the reference memory 6 by means of the replenishment circuit 9 of the reference memory. The storage of the reference image is advantageously carried out so that the new image is integrated into the reference memory at a long time constant. This can be illustrated as the formula 1 as follows:

(1) $P_{ijr} = k \cdot P_{ij\,(r-1)} + (1-k) \cdot P_{ij}$

where P_{ij} = the new picture information connected to the picture area ij;

P_{ijr} =

the new picture information connected to a certain picture area ij, which information replaces the old information $P_{ij\,(r-1)}$ stored in the reference memory;

$P_{ij(r-1)}$ =

the picture information connected to the corresponding picture area ij, which information is store in the reference memory;

k =

constant; $0 < k < 1$

i, j =

integrals

When k ~ 1, the time constant is long. In that case the picture information stored in the reference memory changes very slowly, and is unaffected by rapid changes in the camera image or parts thereof.

Both in the transmitter and the receiver, several reference memories can be employed, the content whereof is stored from the transmitted picture information in various different ways - it can be for instance integrated at time constants with different lengths (the magnitude of k varies in the formula 1). If only one reference memory is employed, the content stored therein can be the image seen by the camera either at the moment when the camera is switched on, or at any moment ordered by the cameraman. If several reference memories are available, the content stored therein can be the received image or an image corresponding to the received image at certain time intervals. The said information is written into the reference memory by means of the reference memory replenishment circuit.

Claims

1. A video compression method to be employed in connection with the conditional replenishment transmission and receiving method, in the transmitter of which method the picture areas changed with respect to the previous image are detected, and the picture information representing the occurred changes, along with the addresses of the respective areas, is sent to the transmission channel, and in the receiver a new image is reconstructed on the basis of the previous image, the addresses of the changed picture areas and on the basis of the information representing the occurred changes, **characterized** in that both in the transmitter and in the receiver at least one reference memory (6; 14) is employed, into which reference memory there is stored a reference image of the transmitted picture information and which memory is used so that whenever the transmitter recognizes a picture area which has changed, it is checked whether the changed picture information corresponds to the information stored in the respective location in the reference memory; if the answer is positive, the transmitter sends a code word informing the receiver that the required picture information must be taken from the reference memory; if the answer is negative, the new picture information representing the change occurred in the picture area is transmitted.

2. The method of claim 1, **characterized** in that the new reference image is integrated at a long time constant from the transmitted picture information into the reference memory (6; 14).

3. The method of claim 1, **characterized** in that both the transmitter and the receiver use several reference memories, the content whereof is stored on the basis of the transmitted picture information in various different ways, for instance by integrating at time constants with different lengths.

4. The method of claim 1, 2 or 3, **characterized** in that the chosen content of the reference memory is the image seen by the camera either at the moment when the camera is switched on or at any moment ordered by the cameraman.

5. The method of claim 3, **characterized** in that the chosen content of the reference memory is the received image or an image corresponding to the received image at certain time intervals.

Revendications

1. Procédé de compression de signaux vidéo à employer en liaison avec un procédé conditionnel de reconstitution à l'émission et à la réception, dans l'émetteur duquel les régions de l'image modifiées par rapport à l'image précédente sont détectées, et les informations d'image correspondant aux modifications qui se sont produites, avec les adresses des régions correspondantes, sont envoyées sur le canal d'émission, et dans le récepteur duquel une nouvelle image est reconstruite à partir de l'image précédente, des adresses des régions modifiées de l'image et à partir des informations représentant les modifications intervenues, caractérisé en ce qu'il emploie à la fois dans l'émetteur et le récepteur au moins une

mémoire de référence (6 ; 14), dans laquelle mémoire de référence est stockée une image de référence des informations vidéo transmises et laquelle mémoire est utilisée de manière que toutes les fois que l'émetteur reconnaît une région d'image qui a été modifiée, une vérification de la correspondance est effectuée entre les informations de l'image modifiée et les informations stockées à l'emplacement correspondant dans la mémoire de référence ; si le résultat est positif, l'émetteur envoie un mot de code informant le récepteur que les informations d'image nécessaires doivent être prélevées dans la mémoire de référence ; si le résultat est négatif, les nouvelles informations d'image représentant la modification intervenue dans la région de l'image sont transmises.

2. Procédé selon la revendication 1, caractérisé en ce que la nouvelle image de référence est intégrée avec une grande constante de temps à partir des informations d'image transmises vers la mémoire de référence (6 ; 14).

3. Procédé selon la revendication 1, caractérisé en ce que l'émetteur et le récepteur emploient tous deux plusieurs mémoires de référence, dont le contenu est stocké à partir des informations transmises de l'image de différentes façons, par exemple par intégration avec des constantes de temps de différentes durées.

4. Procédé selon l'une des revendications 1, 2 ou 3, caractérisé en ce que le contenu choisi de la mémoire de référence est l'image vue par la caméra soit au moment où la caméra est mise en service, soit à un moment quelconque décidé par l'opérateur.

5. Procédé selon la revendication 3, caractérisé en ce que le contenu choisi de la mémoire de référence est l'image reçue ou une image correspondant à l'image reçue à certains intervalles de temps.

Ansprüche

1. Ein Videoverdichtungsverfahren zur Anwendung in Verbindung mit der bedingten Anreichungsübertragung und Empfangsmethode, wobei entsprechend des Verfahrens im Sender die Bildflächen, die sich im Vergleich zu einem vorherigen Bild verändert haben, festgestellt werden und die Bildinformationen, die den aufgetretenen Veränderungen entsprechen, zusammen mit den Adressen der entsprechenden Flächen dem Übertragungskanal übermittelt werden, und im Empfänger ein neues Bild auf der Basis des ursprünglichen Bildes, der Adressen der geänderten Bildflächen und auf der Basis von Informationen, die den aufgetretenen Veränderungen entsprechen, rekonstruiert wird,
dadurch gekennzeichnet,
daß sowohl im Sender als auch im Empfänger zumindest ein Referenzspeicher (6; 14) eingesetzt wird, indem ein Referenzbild der übermittelten Bildinformationen gespeichert wird und der so eingesetzt wird, daß sobald der Sender erkennt, daß ein Bildbereich sich geändert hat, überprüft wird, ob die veränderte Bildinformation den Informationen entspricht, die an den entsprechenden Stellen des Referenzspeichers gespeichert sind; falls die Antwort positiv ist, wird vom Sender ein Codewort übermittelt, das dem Empfänger mitteilt, daß die verlangte Bildinformation aus dem Referenzspeicher genommen werden muß, und falls die Antwort negativ ist, daß eine neue Bildinformation entsprechend der aufgetretenen Veränderungen in der Bildfläche übermittelt wird.

2. Das Verfahren nach Anspruch 1,
dadurch gekennzeichnet,
daß das neue Referenzbild über eine lange Zeitkonstante von der übermittelten Bildfunktion in den Referenzspeicher (6; 14) integriert wird.

3. Das Verfahren nach Anpruch 1,
dadurch gekennzeichnet,
daß sowohl der Sender als auch der Empfänger mehrere Referenzspeicher einsetzen, wobei der Inhalt von diesen auf der Basis der übermittelten Bildinformation in verschiedenen Arten gespeichert wird, beispielsweise durch Integration mit Zeitkonstanten unterschiedlicher Länge.

4. Das Verfahren nach Anspruch 1, 2 oder 3,
dadurch gekennzeichnet,
daß der ausgewählte Inhalt des Referenzspeichers dem Bild entspricht, daß die Kamera entweder in dem Moment sieht, wenn sie eingeschaltet wird, oder einem vom Kameramann festgelegten Moment.

5. Das Verfahren nach Anspruch 3,
dadurch gekennzeichnet,
daß der ausgewählte Inhalt des Referenzspeichers das empfangene Bild ist oder ein Bild entsprechend zu einem in bestimmten Zeitintervallen empfangenen Bildes.

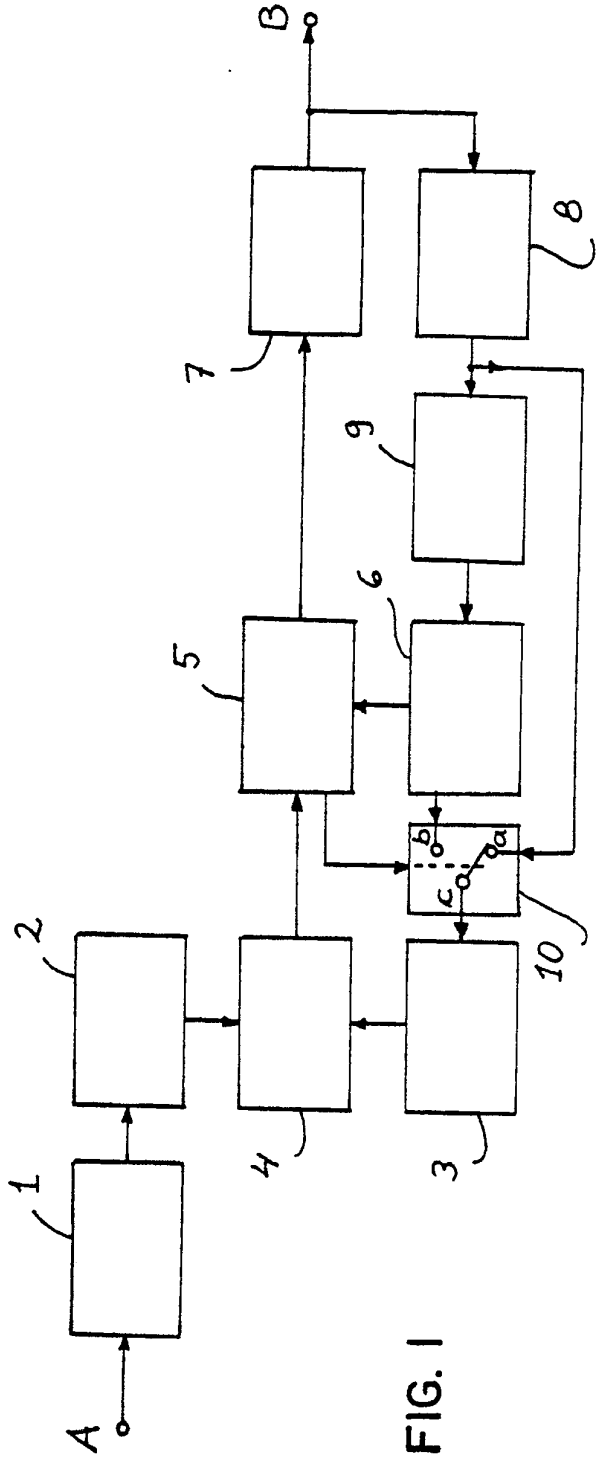

FIG. 1

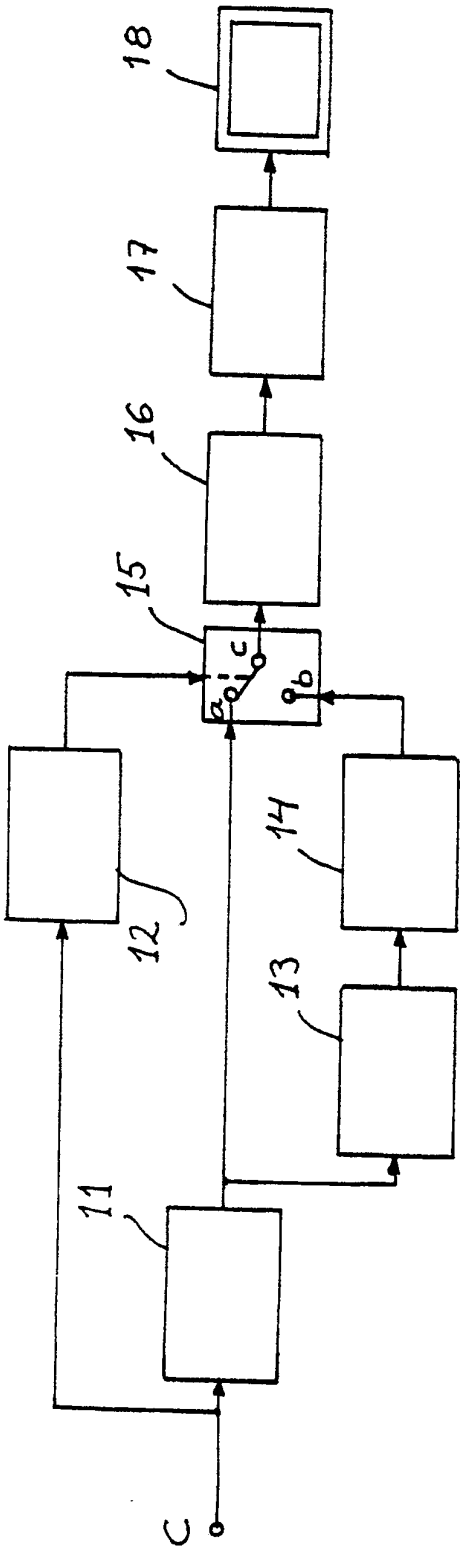

FIG. 2