(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 December 2010 (23.12.2010)

PCT

(10) International Publication Number
WO 2010/145968 A1

(51) International Patent Classification:
G06T 5/00 (2006.01)

(21) International Application Number:
PCT/EP2010/057967

(22) International Filing Date:
8 June 2010 (08.06.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0954109 18 June 2009 (18.06.2009) FR

(71) Applicant *(for all designated States except US)*: **THOMSON LICENSING** [FR/FR]; 1-5 rue Jeanne d'Arc, F-92130 Issy-Les-Moulineaux (FR).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **GUERMOUD, Hassane** [DZ/FR]; 5 Rue Adolphe Touffait, F-35000 Rennes (FR). **KERVEC, Jonathan** [FR/FR]; La Brousse du Gué, F-35830 Paimpont (FR). **JOLLY, Emmanuel** [FR/FR]; 1 rue Coutanceau, F-35000 Rennes (FR).

(74) Agents: **LE DANTEC, Claude** et al.; 1-5 rue Jeanne d'Arc, F-92130 Issy-Les-Moulineaux (FR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WO 2010/145968 A1

(54) **Title**: IMAGE PROCESSING METHOD

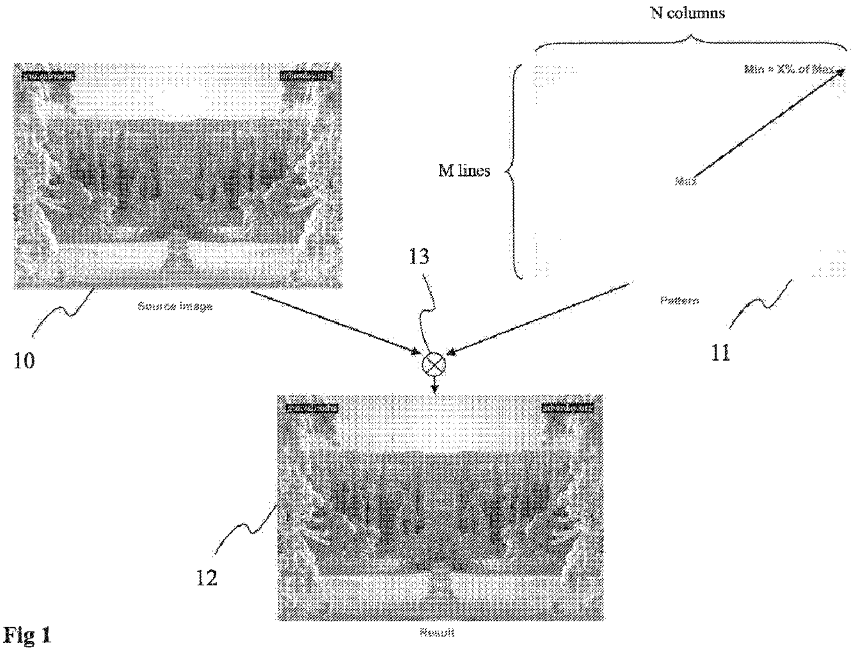


Fig 1

(57) **Abstract**: The invention relates to a method for processing a video image sequence for a display device. In order to reduce the energy consumption of the display device, the method comprises a step of application of a video pattern (11) to each image (10) of the sequence, the pattern (11) being generated in a way to conserve the maximal luminous intensity in at least one area of the image on which the pattern is applied and to attenuate the luminous intensity in the rest of the image, the at least one area comprising at least one pixel.

IMAGE PROCESSING METHOD

1. Scope of the invention

The invention relates to the domain of image or video processing for displaying on any type of display device for which the light source can be modulated pixel by pixel (for example PDP ("Plasma Display Panel") or by region (for example an LCD (“Liquid Crystal Display”) screen with LED (“Light-Emitting Diode”) back-lighting or retro-projection devices).

2. Prior art

According to the prior art, such plasma or LCD screens are recognised for being high energy consumers, the plasma screens being reputed higher energy consumers than the LCD screens. For example, the nominal power of a plasma screen for which the diagonal dimension is 42 inches is of the order of 200 to 250 Watts while the nominal power of an LCD screen with back-lighting at a constant power of the same dimensions is slightly less, for example of the order of 150 Watts.

However, because the operating principles are different for a plasma screen and an LCD screen, the energy consumption of every plasma screen is not always greater than that of LCD screens. In fact, the plasma screens only require the powering of a single plasma cell to illuminate a pixel. To the extent that obscurity is obtained by stopping the arrival of the electrical influx into the plasma pixels, the reproduction of dark scenes on a plasma screen only requires a relatively low quantity of electrical current. In comparison, the LCD screens function at a constant energy level, whether the scene to be reproduced is bright or dark, because of the back-lighting that the screens use permanently at full power, the blanking of the light emitted by the back-lighting being assured by the liquid crystals of the LCD screen for the dark areas of the scene to be reproduced. Studies have thus demonstrated that the annual electrical consumption for a plasma screen for which the diagonal dimension is 37 inches is in the order of 220 to 290 kWh per year and that the annual electrical consumption for an LCD screen of the same diagonal dimension is in the order of 190 to 250 kWh per year.

Moreover, recommendations of the European commission relating to the capping of electrical consumption of flat screens (whether they are of plasma, LCD or retro-projection type) enter into force during 2010. To satisfy these recommendations, the electrical consumption of screens of the prior art must be reduced.

3. Summary of the invention

The purpose of the invention is to overcome at least one of these disadvantages of the prior art.

More specifically, the purpose of the invention is particularly to reduce the electrical consumption of a display device.

The invention relates to a method for processing a video image sequence for a display device. The method comprises a step of application of a video pattern to each image of said sequence, the pattern being generated in a way to conserve the maximum luminous intensity in at least one area of the image on which the pattern is applied and to attenuate the luminous intensity in the rest of the image, the at least one area comprising at least one pixel.

According to a particular characteristic, the attenuation of the luminous intensity of pixels of the rest of the image is directly proportional to the distance of pixels with respect to the at least one area of the image.

Advantageously, the video pattern is of the same dimension as said image.

According to another characteristic, the method comprises steps of:

- decomposing of the pattern into a plurality of blocks, each of the blocks being associated with a plurality of pixels of the video image,
- assigning of a first weighting coefficient to each of the blocks.

Advantageously, the method comprises a step of interpolation, for each pixel associated with a block of the pattern, of the first weighting coefficient into a second weighting coefficient assigned to a pixel associated to the block, for each of the blocks of the pattern.

According to a particular characteristic, the method comprises steps of:

- analysis of the video content of the video image,
- determination of at least one area of interest of the image according to the result of the analysis, the at least one area of the image in which the maximum luminous intensity is conserved being the at least one determined area of interest.

Advantageously, the pattern applied to each image is the same for all the images of the sequence.

According to a particular characteristic, the pattern applied to each image varies temporally.

4. List of figures

The invention will be better understood, and other specific features and advantages will emerge upon reading the following description, the description making reference to the annexed drawings wherein:

- figure 1 shows the application of a video pattern to a source image in a processing unit of figures 2, 3 and 5, according to an embodiment of the invention,
- figures 2 and 3 diagrammatically show the structure of a processing unit of a display device, according to two particular embodiments of the invention,
- figure 4 shows an association of weighting coefficients to the pixels of the image processed in the processing unit of figure 3, according to an embodiment of the invention,
- figure 5 diagrammatically shows the structure of a processing unit of a display device, according to a particular embodiment of the invention,
- figure 6 shows a method for processing video images implemented in a processing unit of figures 2, 3 or 5, according to a particular embodiment of the invention, and
- figure 7 shows a method for processing video images implemented in a processing unit of figure 5, according to a particular embodiment of the invention.

5. Detailed description of embodiments of the invention

Figure 1 shows the processing of a source video image 10 to which is applied a video pattern 11. The result of the application of the pattern 11 to the image 10 is represented by the resulting video image 12. The pattern 11 has the same dimensions as the source image to which it is applied. Advantageously, the pattern 11 is a matrix of dimensions M*N (M lines by N columns) with a number of elements equal to the number of pixels of images 10 and 12. To each element on the matrix M*N representative of the pattern 11 is thus associated a pixel of the source image 10. The pattern 11 is determined in a way such that the video level takes a maximal value

Max at the centre of the pattern, for example equal to 255, and takes a minimal value Min in the corners of the pattern, that is to say in the areas of the pattern furthest from the centre of the pattern. The minimal value corresponds to a percentage of the maximal value Max and is for example equal to 60, 70, 80 or 90 % of the maximal value Max. In other words, the element placed in the centre of the matrix representative of the pattern 11 has as a value the maximal value Max of video level, for example 255, and the elements placed in the four corners of the matrix have as a value the minimal value Min of the video level. The video level associated with each of the elements of the matrix representative of the pattern 11 is for example obtained using a Gaussian or bilinear type function represented by the multiplier 13.

According to a variant, the elements of the matrix M*N representative of the pattern 11 take weighting coefficients as a value. The element placed in the centre of the matrix advantageously takes as a value a maximal weighting coefficient equal to 1 and the elements furthest from the element of the centre, that is to say the elements positioned in the corners of the matrix, take as a value a same minimal weighting coefficient corresponding to X % of the maximal weighting coefficient, X having for example a value of 60, 70, 80 or 90 %.

Advantageously, the centre of the pattern having as a value the video level maximal value or the maximal weighting coefficient corresponds to an element of the matrix M*N, namely the element placed at the intersection of the middle line and the middle column. According to a variant, the centre of the pattern corresponds to a set of elements of the matrix, for example a circle centred on the element of the centre of the matrix having as a radius R elements (R being for example equal to 5, 10, 20, 50 or 100 elements), a square centred on the element of the centre of the matrix having sides of length L elements (L being for example equal to 5, 10, 20, 50 or 100 elements), a rectangle centred on the element of the centre of the matrix having sides of length L elements and of width l elements, or any other geometric form centred on the central element of the matrix.

Figure 2 diagrammatically shows a first hardware embodiment of a processing unit 2 of a display device. The processing unit 2 takes for example the form of a programmable logical circuit of type FPGA (Field-

Programmable Gate Array) for example, ASIC (Application-Specific Integrated Circuit) or a DSP (Digital Signal Processor).

The processing unit comprises the following elements:

- a processor 21,
- a memory 23,
- a synchronization unit 22,
- a multiplier 25,
- a normalization unit 24,
- data buses 200, 201, 202, 203.

The processor 21 contains a function enabling the pattern to be generated according to the criteria entered via for example an MMI (Man Machine Interface) interface not shown. The criteria correspond for example to the area of the pattern for which the video level is maximal, to the desired maximal value, to the minimal value corresponding to a percentage X of the maximal value. The processor 21 generates a pattern represented by a matrix comprising as many elements as pixels contained in the image to be processed. If the image to be processed 26 is an image comprising M lines and N columns, the matrix representing the pattern will also comprise M lines and N columns of elements. The matrix generated is transmitted to the memory (for example a memory of RAM (Random Access Memory) type or of flash type 23 via a bus 200 connecting the processor 21 to the memory 23. The content of the memory 23 is applied to the input signal RGB 26 representative of a video sequence comprising several images by the intermediary of a multiplier 25. The memory 23 and the multiplier 25 are connected together via a 16 bit data bus. The input signal 26 is transmitted to the multiplier 25 via a data bus of for example 32 bits (the number of bits to be transmitted in parallel being 30 effective bits, each RGB (Red, Green, Blue) component being coded on 10 bits). The bus 201 dimensioned for 16 bits as a single element coded on 10 bits of the matrix contained in the memory 23 is to be applied to the three RGB components defining each pixel of the input image 26.The bus 201 must therefore be able to transmit 10 bits in parallel, a 16 bits bus is placed between the memory 23 and the multiplier 25. The application of an element of the matrix contained in the memory 23 to the associated pixel of the image, the coordinates of the element in the matrix being identical to the coordinates of the associated pixel in the input image 26, is synchronized by a synchronization unit 22 receiving at input signals of vertical synchronization (Vsync), of horizontal synchronization

(Hsync) and a signal (RGB_en) corresponding to the active pixels of the source image 26. A normalization unit 24 is placed at the output of the multiplier 25 to return on 30 bits the signal from the multiplication of the RGB input signal 26 coded on 30 bits and the signal representative of elements of the pattern coded on 10 bits, the signal at output from the normalization unit 24 being the RGB_processed output signal 27 representative of video images to be displayed on the display device: the dynamic of the output signal RGB_processed 27 must be identical to the dynamic of the input signal RGB 26. The output image 27 corresponds to the input image 26 to which was applied a pattern 11. In the case where the pattern presents a maximal video level at its centre and a minimal video level in the areas furthest from the centre of the pattern, the output image 27 will have an identical luminous intensity to that of the input image at the centre of the image and a reduced luminous intensity in the areas of the image far from the centre of the image. The reduction in the luminous intensity of pixels of the image falls progressively from the centre of the image towards the periphery of the image according to the function used (for example Gaussian type function or bilinear interpolation type function) to generate the pattern 11 in the processor 21. The energy required to display the output image is thus less than the energy that would be necessary to display the input image not processed by the processing unit 2.

According to a variant, the memory 23 is placed outside of the processing unit 2. In fact, the memory 23 contains as many elements coded on 10 bits as there are pixels in the input image 26. For an image of resolution 1920x1080 (containing therefore 2073600 pixels), the memory must have a storage capacity of approximately 2.6 MB. A RAM or flash memory with such a storage capacity is generally not integrated into a processing unit of FGPA or ASIC type.

Figure 3 diagrammatically shows a second hardware embodiment of a processing unit 3 of a display device. The processing unit 3 takes for example the form of a programmable logical circuit of type FPGA (Field-Programmable Gate Array) for example, ASIC (Application-Specific Integrated Circuit) or a DSP (Digital Signal Processor).

The processing unit 3 comprises the following elements:

- a processor 31,
- a memory 33,

- a synchronization unit 32,
- a multiplier 35,
- a normalization unit 34,
- an interpolation unit 38, and
- data buses 300, 301, 302, 303.

The processor 31, the memory 33, the synchronization unit 32, the multiplier 35, the normalization init 34 and the data buses 300 to 303 assure the same functions as respectively the processor 21, the memory 23, the synchronization unit 22, the multiplier 25, the normalization unit 24 and the data buses 200 to 203 described with respect to figure 2 and will not be further described in detail hereafter. The processor 31 contains a function enabling a pattern to be generated according to the criteria enter via for example an MMI interface. The function assures here the generation of weighting coefficients that will be applied to the input images to conserve the luminous intensity at its input level in one or several image areas and to reduce the luminous intensity of the input image in the rest of the image. Contrary to the function described with respect to figure 2, the function described here generates weighting coefficients that will each be associated with several pixels of the input image, that is to say with blocks of pixels each containing for example 50, 100, 500 or 1000 pixels. The number of coefficient generated by the processor 31 and stored in the memory 33 is thus a lot higher than the number of elements (video level or weighting coefficient) generated by the function contained in the processor 21. Such an embodiment offers the advantage of reducing the memory requirements. The memory 33 is thus advantageously of reduced size and integrated into the processing unit 33. Before being applied to the pixels of the input image 36 via the intermediary of the multiplier 35, the weighting coefficients stored in the memory are transmitted in an interpolation unit 38 placed between the memory 33 and the multiplier 35. The function assured by the interpolation unit 38 is to interpolate the value of a weighting coefficient associated with a block of pixels of the input image into as many weighting coefficient values as there are pixels in the associated block. At the output of the interpolation unit 38 there is a weighting coefficient associated with a pixel of the image. This method is detailed in figure 4.

Figure 4 shows an interpolation method of a weighting coefficient associated with a block of pixels of an input image into several weighting coefficients each associated with a pixel of the block of pixels, according to an embodiment of the invention. The pattern generated by the processor 31 is broken down into a plurality of blocks 41, 42, 43, 44, 4n and a weighting coefficient C1, C2, C3 C4, Cn and respectively associated with each of the blocks 41 to 4n of the pattern 4. Each block 41 to 4n of the pattern 4 is also respectively associated with a block of pixels 401, 402, 403, 404, 40n of the input image. Before being applied to the first block of pixels of the input image, the first coefficient C1 associated with this block is transmitted to the interpolation unit 38 that interpolates the value of the first weighting coefficient C1 into as many weighting coefficient values C1', C2', C3', C4', Cn' as there are pixels in the first block of pixels of the input image, according to any method known to those skilled in the art, for example by bilinear interpolation. Each weighting coefficient interpolated C1' to Cn' is associated with a pixel Pix1 4001, Pix2 4002, Pix3 4003, Pix4 4004, Pixn 400n. The method described with respect to the fist block 41 associated with a block of pixels 401 is reiterated for each of the blocks 41 to 4n of the pattern 4. Each coefficient interpolated C1' to Cn' of each of the blocks is then applied to the pixel of the input image that itself is associated by the intermediary of the multiplier 35 to weigh the luminous intensity of the input image 26 and generate an output image 27 for which the luminous intensity is identical to that of the input image 26 in the area or areas where the weighting coefficient is equal to 1 and for which the luminous intensity is less than that of the input image 26 in the areas of the images where the weighting coefficient applied is less than 1. The reduction of luminous intensity in a part of the output image enables reduction of the electrical consumption required for the display of the processed video image. The same method is reiterated for each image of a video sequence to be displayed on the display device.

Figure 5 diagrammatically shows a third hardware embodiment of a processing unit 5 of a display device. The processing unit 5 takes for example the form of a programmable logical circuit of type FPGA (Field-Programmable Gate Array) for example, ASIC (Application-Specific Integrated Circuit) or a DSP (Digital Signal Processor).

The processing unit 5 comprises the following elements:

- a processor 51,
- a memory 53,
- a synchronization unit 52,
- a multiplier 55,

- a normalization unit 54,
- an interpolation unit 58,
- an image analyzer 59, and
- data buses 500, 501, 502, 503.

The processor 51, the memory 53, the synchronization unit 52, the multiplier 55, the normalization unit 54 and the data buses 500 to 503 assure the same functions as respectively the processor 21, the memory 23, the synchronization unit 22, the multiplier 25, the normalization unit 24 and the data buses 200 to 203 described with respect to figure 2 and will not be further described in detail hereafter. The interpolation unit 58 assures the same functions and the interpolation unit 38 described with respect to figures 3 and 4 and will not be further described hereafter. Advantageously, the pattern applied to the input images 26, 36 in the embodiments of figure 2 and 3 is identical for all the images of a video sequence and is predefined according to criteria selected by a user for example. The area or areas of the image for which the luminous intensity will be conserved at it maximal level is/are (respectively) selected according to criteria defined and do not depend on the image content. The association of a pattern with the images of a video sequence is static. In the embodiment of figure 5, the content of the input image is analyzed to determine what is (or what are) the centre(s) of interest of the image. Advantageously, the analysis of content of the input image 56 is based on the detection of motion, the centre or centres of interest being that or those for which the motion is most significant. According to a variant, the centres of interest are those for which the quantity of motion is greater than a threshold value (for example a movement of 15 pixels per image for a high definition video). According to another variant, the analysis of the image is based on the detection of differences in colour or on the detection of areas of high frequency. According to another variant, the analysis of the image is based on the detection of salience areas of the image, according to any method known to those skilled in the art. The European patent EP1695288 filed in the name of Thomson Licensing SA and published June 30, 2005 described a method for detecting salience areas in an image. The European patent application EP1836682 filed in the name of Thomson Licensing SA and published July 13, 2006 describes a method for detecting areas of salience in a video sequence. The weighting coefficients of the maximal value, for example equal to 1, are applied to the pixels belonging to the areas corresponding to the centre of interest and the weighting coefficients attenuating the luminous intensity of the input image, that is to say the coefficients less than 1, are applied to the other pixels of the image according to the pattern generated by the processor 51 and the coefficients associated with the matrix representative of this pattern. According to this embodiment, a new pattern is generated for each image of the input video sequence according to the content of each image. The association of a pattern with an image is dynamic. According to a variant, a same pattern is applied to several consecutive images of a video sequence, for example when the difference in the quantity of motion between temporally consecutive images is null or close to zero. Advantageously, the salience of each pixel of images of the video sequence is determined according to any method known to those skilled in the art and the weighting coefficients calculated by the function stored in the processor are associated with the pixels of the image according to the salience of each of the pixels. The attenuation of the luminous intensity of the pixels of the output image processed by the video pattern is advantageously proportional to the salience of pixels of the input video image.

Figure 6 shows a method for processing video images implemented in a processing unit 2, 3 or 5, according to a non-restrictive particularly advantageous embodiment of the invention.

During an initialisation step 60, the different parameters of the processing unit are updated.

Then, during a step 61, a video pattern is generated. The video pattern is generated in a way to conserve a luminous intensity of minimal value in one or more areas of the image on which the video pattern would have been applied and in a way to attenuate the luminous intensity in the rest of the image. The area for which the luminous intensity conserves a maximal value corresponds advantageously to the centre of the image, that is to say for example to the pixel situated in the centre of the image or equally to the pixels distributed around the central pixel of the image. The area thus defined corresponds for example to a pixel, to a circle having a radius of several pixels and centred on the pixel of the centre of the image or to any geometric form centred on the pixel of the centre of the image. According to a variant, the areas for which the luminous intensity conserves a maximal value are two in number, for example each situated on a lateral side of the image, at the middle of the image. According to another variant, the areas for which the luminous intensity conserves a maximal value are three in number, with for example an area located at the centre of the image, the two others being located on the lateral sides of the image at the middle of the image.

Advantageously, the video pattern is represented by a two dimensional matrix M*N comprising M x N elements. According to a variant, the number of elements of the matrix representative of the video pattern comprise as many elements as there are pixels in the images to be processed (for example 2073600 elements for a high definition resolution image 1920*1080). The video pattern is then of the same dimensions as the images to be processed. According to another particularly advantageous variant, the video pattern is of dimensions (or size) less than that of the images to be processed, that is to say it comprises a number of elements less than the number of pixels contained in the images to be processed.

The function used to generate the video pattern and the elements that comprise it is advantageously of Gaussian type, with for example as a formula:

$$f(x,y) = K.\exp(-\left[\frac{(x-x_0)^2}{2\sigma_x^2} + \frac{(y-y_0)^2}{2\sigma_y^2}\right])$$

where K is a determined coefficient, for example 255 corresponding to the maximal video level, x and y corresponding respectively to the abscissa and ordinate of an element of the video pattern, x_0 and y_0 corresponding respectively to the coordinates of the centre of the area in which the luminous intensity is conserved at it maximal value, σ_x and σ_y corresponding respectively to the variance in x and the variance in y of the Gaussian.

According to variant, the function used to generate the video pattern is of bilinear type. The attenuation of the luminous intensity applied to the pixels of the image to be processed is even more significant as the pixel is far from the pixel or pixels of the area for which the luminous intensity is maximal and is proportional to the distance of the maximal luminous intensity area.

Then, during a step 62, the video pattern is applied to each image of the video sequence, image by image. The pattern is applied to a source image at input to the processing unit and the resulting image has a luminous intensity equal to that of the source image in the area or areas in which the pattern presents a maximal video level and presents a reduced luminous intensity in the rest of the image, the reduction of luminous intensity with respect to the source image being linked to the values of elements comprised in the video pattern and applied to the pixels of the source image.

Figure 7 shows a method for processing video images implemented in a processing unit 5, according to a non-restrictive particularly advantageous embodiment of the invention.

During an initialisation step 70, the different parameters of the processing unit are updated.

Then, during a step 71, a video pattern is generated, the generation of the pattern starting with a decomposition of the pattern into elementary blocks, each block being assigned to a group of pixels (for example 50, 100, 500 or 1000 pixels) of the image to be processed. A Gaussian or bilinear type function such as described with respect to figure 6 then generates weighting coefficients.

Then, during a step 72, the content of the image is analysed. Advantageously the analysis is based on the detection of motion. According to a variant, the analysis is based on the detection and areas of salience, for example by the recognition of faces or persons.

During a step 73, one or more areas of interest are determined using the result of the analysis of the content of the image. If the analysis is based on the detection of motion, the areas of interest advantageously correspond to the areas for which the quantity of motion detected between two consecutive images is highest. According to a variant, the areas of interest are those for which the quantity of motion exceeds a threshold value. If the analysis is based on the detection of areas of salience in the image to be processed, the areas of interest correspond to detected areas of salience.

During a step 74, the weighting coefficients generated by the function during step 71, known as first weighting coefficients, are assigned to the pattern blocks according to determined areas of interest, that is to say the first weighting coefficients of maximal value are assigned to the blocks corresponding to the position of areas of interest. Thus, the areas of interest corresponding to the areas of the image to be processed for which the luminous intensity will remain maximal after processing of the image by the pattern.

Then, during a step 75, each first weighting coefficient is interpolated into a plurality of second weighting coefficients, each second weighting coefficient being then assigned to a pixel of the image belonging to the block of pixels of the image associated with the block of the pattern.

Finally, during a step 76, the video pattern is applied to an image of a video sequence at the input of the processing unit, that is to say each second weighting coefficient interpolated is applied to the pixel corresponding to an input image or source image. The resulting image presents a luminous intensity equal to that of the source image in the area or areas of interest for which the pattern presents a maximal video level and presents a reduce luminous intensity in the rest of the image, the reduction in luminous intensity with respect to the source image being a function of the weighting coefficients interpolated and applied to the pixels of the source image.

According to a variant, the analysis of the image and the determination of areas of interest precede the step of generation of the pattern. The function then generating the pattern, knowing the area or areas of interest of the image, generates the weighting coefficients and assigns them directly to the blocks of the pattern corresponding to the areas of interest and to the other areas of the image. The steps of interpolation and application of the video pattern follow then the step of generation of the pattern.

According to another variant, the function generating the pattern generates a video level value for each element of the pattern (represented for example by a matrix comprising as many elements as there are pixels in the image to be processed) in the place of weighting coefficients associated with blocks of the image. According to this variant, the pattern is not broken down into elementary blocks and there is no step of interpolation, the application of elements of the pattern to the input image being made directly and in a synchronised way at the arrival of pixel data of the corresponding image.

Advantageously, a new pattern is generated for each image according to the analysis of the content of the image and the determination of the areas of interest.

Naturally, the invention is not limited to the embodiments previously described.

In particular, the invention is not restricted to a method for processing images but extends to the processing unit implementing such a method and to the display device comprising a processing unit implementing the image processing method.

According to an advantageous embodiment, the memory, the multiplier, the interpolation unit and the normalisation unit are for example replaced by a LUT (Look-Up Table) correspondence table stored in the memory. The correspondence table is addressed with the position of the pixel of the image to be processed and with the RGB data of the pixel and provides directly at output an RGB value of the pixel, associated with the position of the pixel and its input RGB value, to be displayed in the output image. Such an embodiment enables the hardware implementation of the processing unit to be simplified and enables the image processing to be accelerated.

According to a variant and particularly in the case of a plasma display screen, with each red, green and blue cell of a pixel is associated a corrector element (weighting coefficient or video level) of a pattern to be applied to the image. Thus the luminous intensity of each cell of each pixel of a screen is weighted by the pattern, the response of each colour (red, green and blue) to a reduction of luminous intensity being different. This embodiment presents the advantage of refining the display of colours while reducing the electrical consumption.

According to another variant, the weighting coefficients applied to the pixels of areas of interest of the video image have a value greater than 1 which enables the luminous intensity of the output image processed at the level of the determined area or areas of interest of the image to be increased to highlight the area or areas of interest of the video image.

CLAIMS

1. Method for processing a sequence of video images for a display device, said method comprising a step (62, 76) of application of a video pattern (11) to each image (10) of said sequence, said pattern being generated (61, 71) in a way to conserve a maximal luminous intensity in at least one area of said image on which said pattern is applied and to attenuate the luminous intensity in the rest of said image, said at least one area comprising at least one pixel,
characterized in that said method further comprises the steps of:
 - analysis (72) of the video content of said video image,
 - determination (73) of at least one area of interest of said image according to the result of the analysis,
 said at least one area of the image in which the maximal luminous intensity is conserved being said at least one determined area of interest.

2. Method according to claim 1, characterized in that the attenuation of the luminous intensity of pixels of the rest of the image is directly proportional to the distance of said pixels with respect to said at least one area of the image.

3. Method according to one of claims 1 to 2, characterized in that said video pattern is the same size as said image.

4. Method according to one of claims 1 to 2, characterized in that it comprises steps of:
 - decomposing (71) of said pattern into a plurality of blocks (41 to 4n), each of said blocks being associated with a plurality of pixels (4001 to 400n) of said video image,
 - assigning (74) of a first weighting coefficient to each of said blocks.

5. Method according to claim 4, characterized in that it comprises a step of interpolation (75), for each pixel associated with a block of the pattern, of the first weighting coefficient into a second weighting coefficient

assigned to a pixel associated with said block, for each of said blocks of said pattern.

6. Method according to one of claims 1 to 5, characterized in that said pattern applied to each image varies temporally.

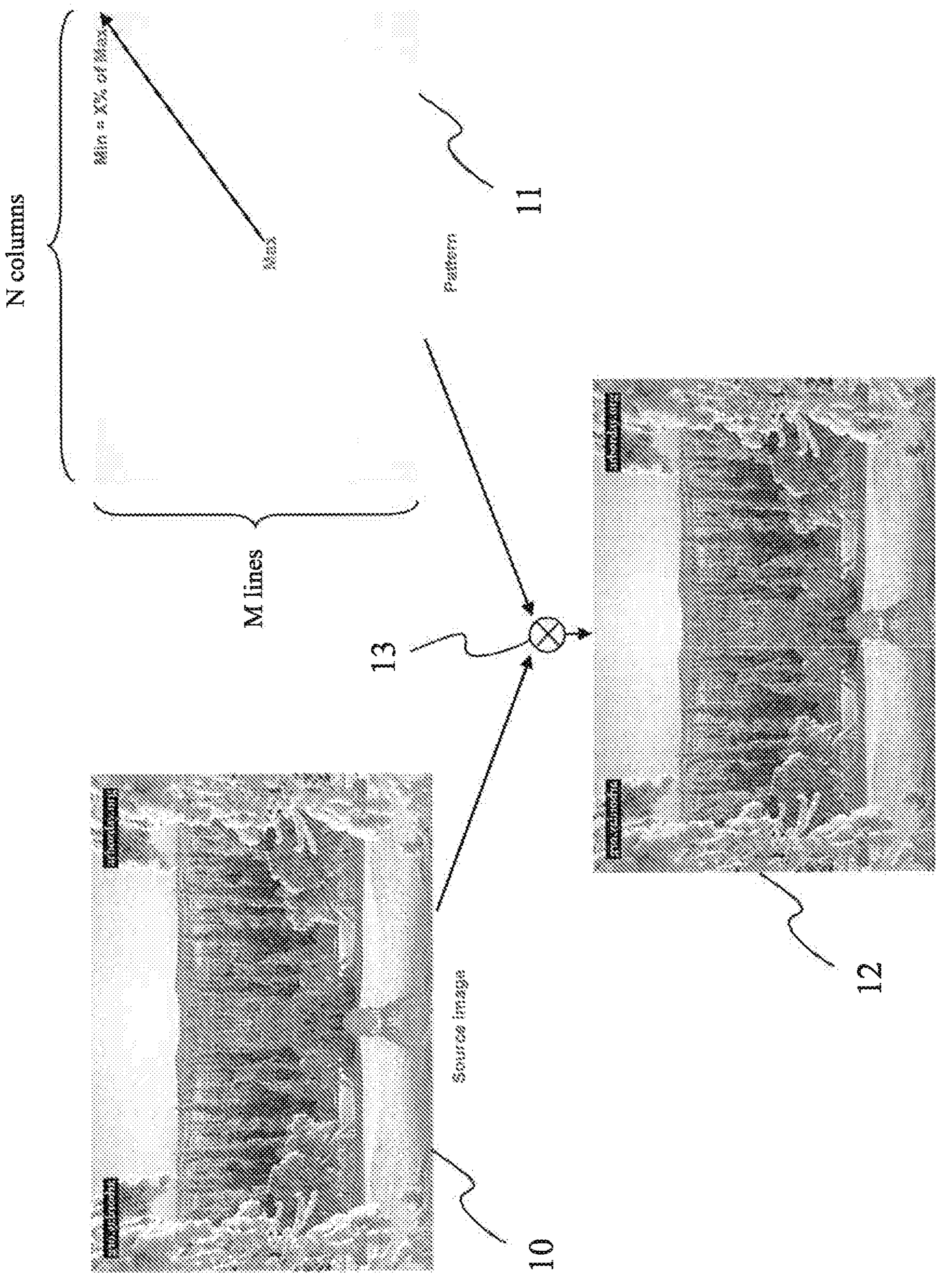

N columns
Min = X% of Max
Max
Pattern
11
M lines
13
Source image
10
Result
12

Fig 1

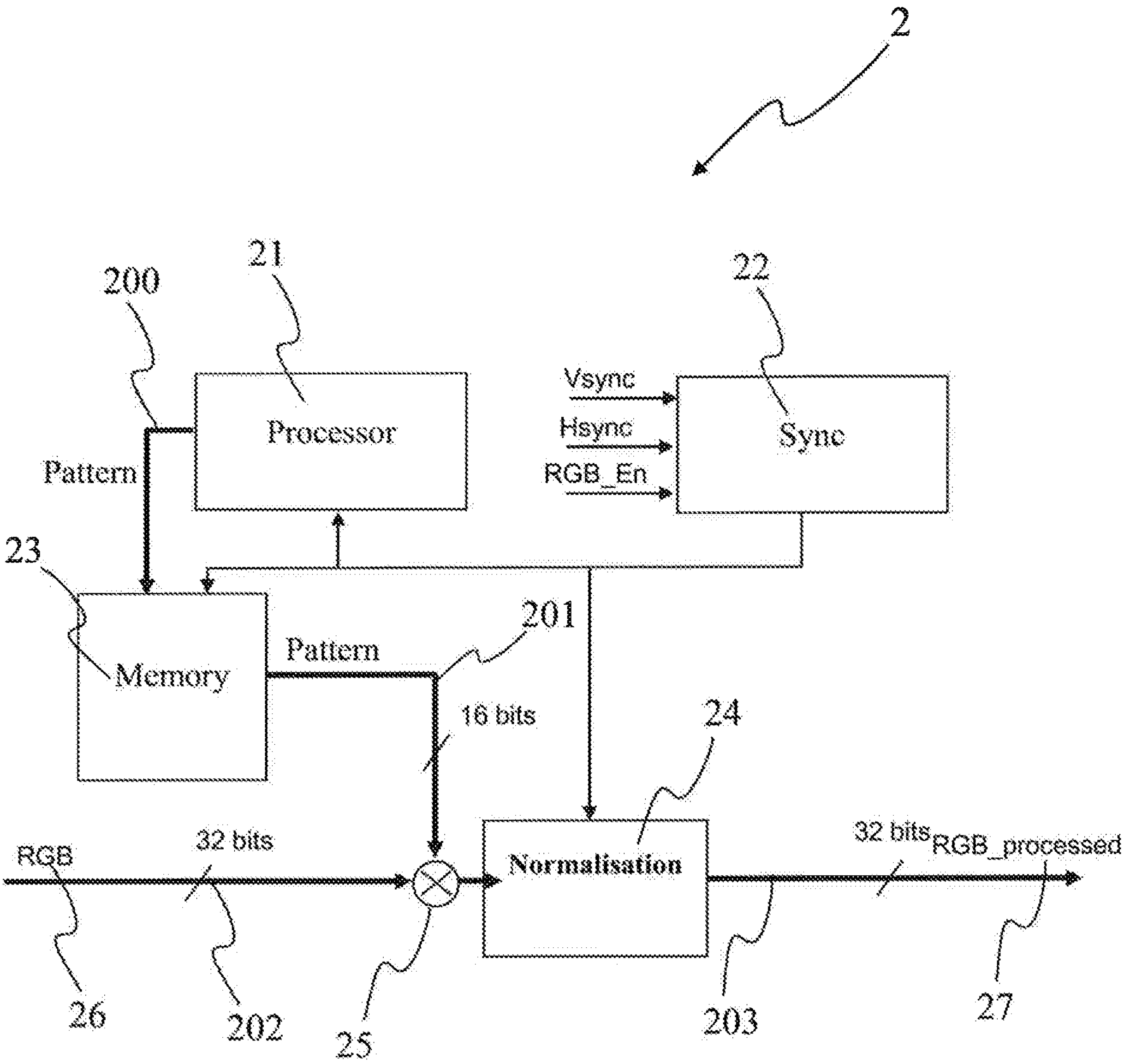

2
21
22
200
Processor
Vsync
Hsync
RGB_En
Sync
Pattern
23
Memory
Pattern
201
16 bits
24
RGB
32 bits
Normalisation
32 bits
RGB_processed
26
202
25
203
27

Fig 2

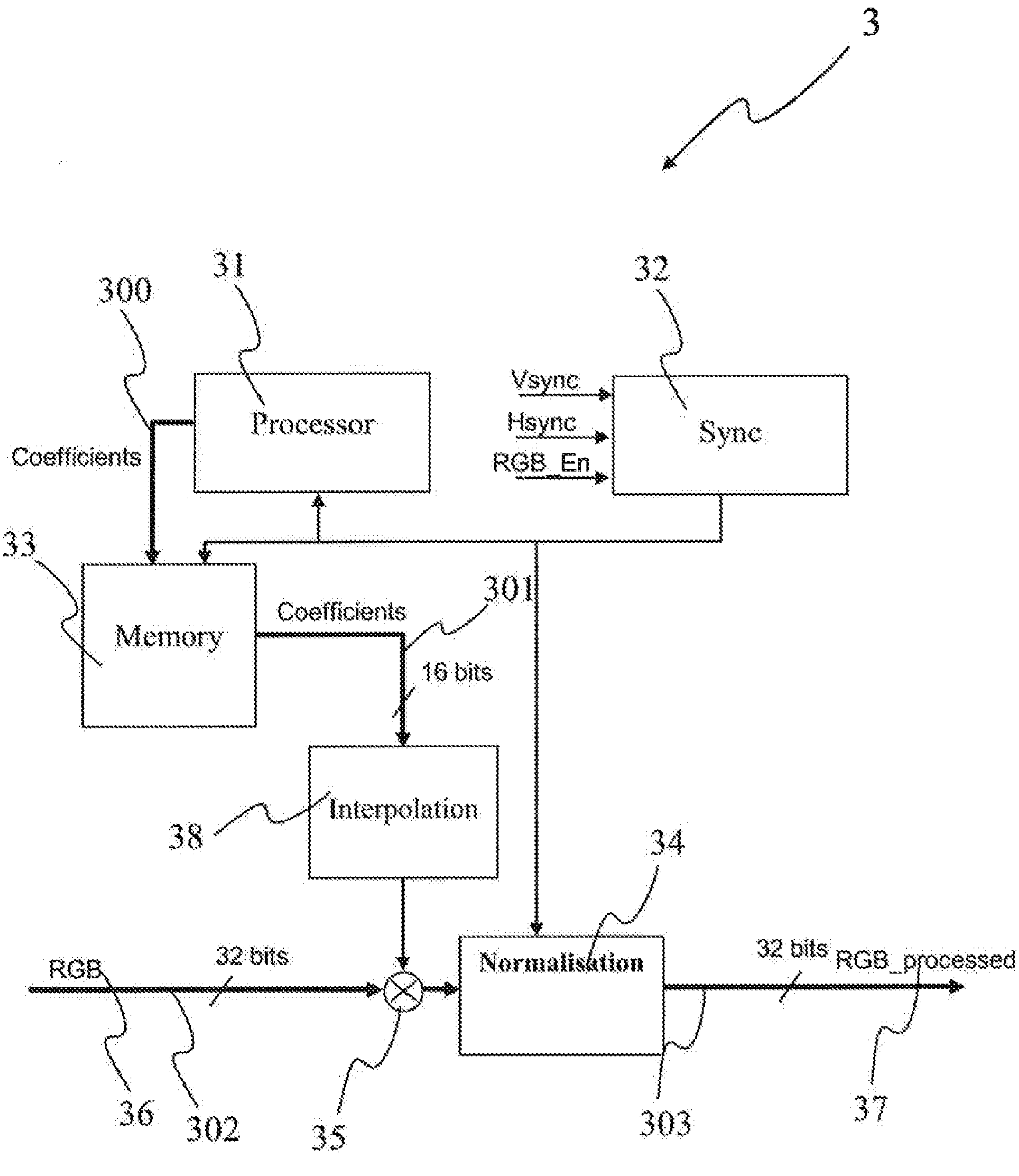
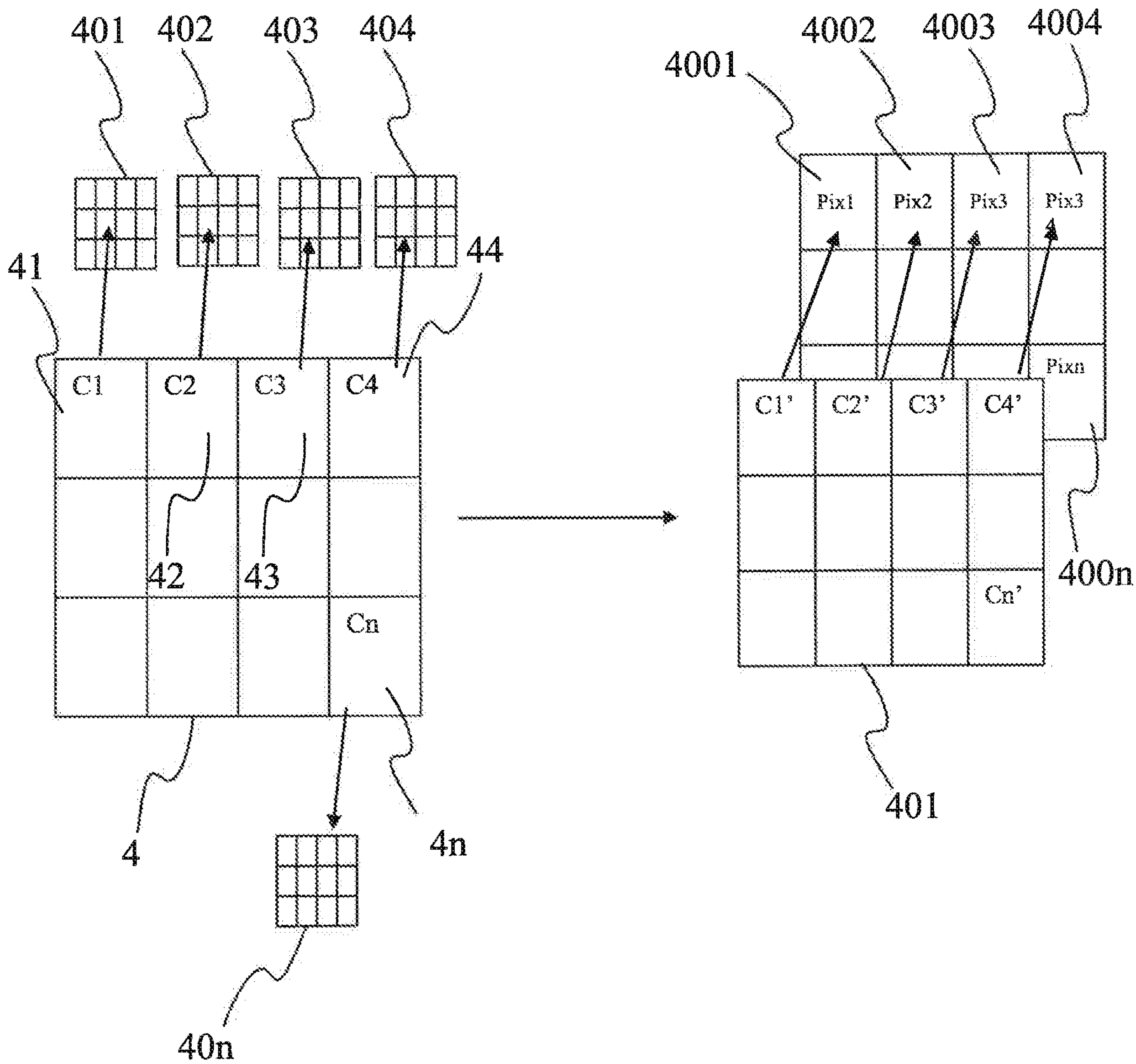

3
300
31
32
Processor
Vsync
Hsync
RGB_En
Sync
Coefficients
33
Memory
Coefficients
301
16 bits
Interpolation
38
34
RGB
32 bits
Normalisation
32 bits
RGB_processed
36
302
35
303
37

Fig 3



401
402
403
404
41
44
C1
C2
C3
C4
42
43
Cn
4
4n
40n
4001
4002
4003
4004
Pix1
Pix2
Pix3
Pix3
Pixn
C1'
C2'
C3'
C4'
Cn'
400n
401

Fig 4

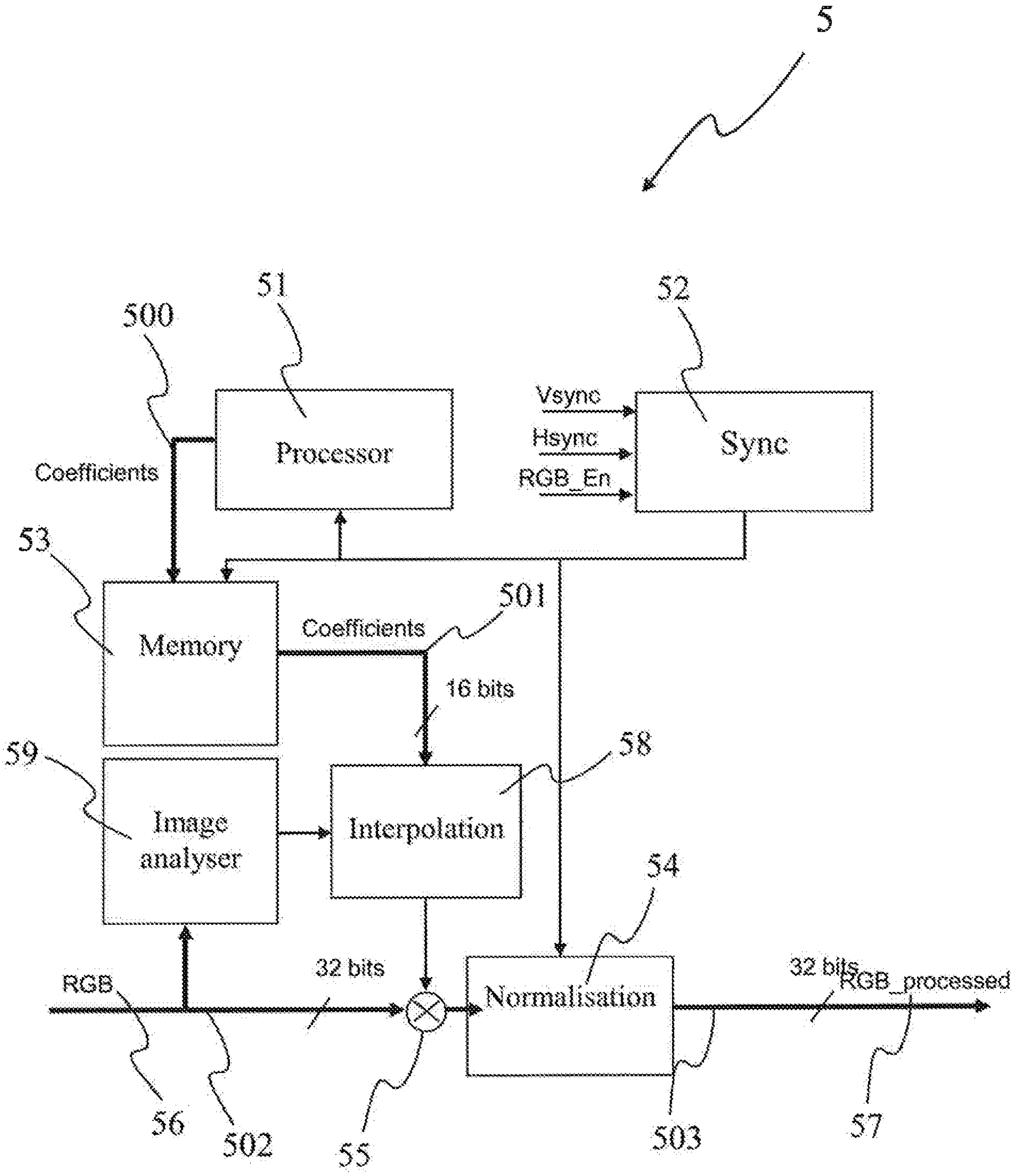

5
51
52
500
Vsync
Hsync
RGB_En
Processor
Sync
Coefficients
53
Memory
Coefficients
501
16 bits
59
Image
analyser
Interpolation
58
54
RGB
32 bits
Normalisation
32 bits
RGB_processed
56
502
55
503
57

Fig 5

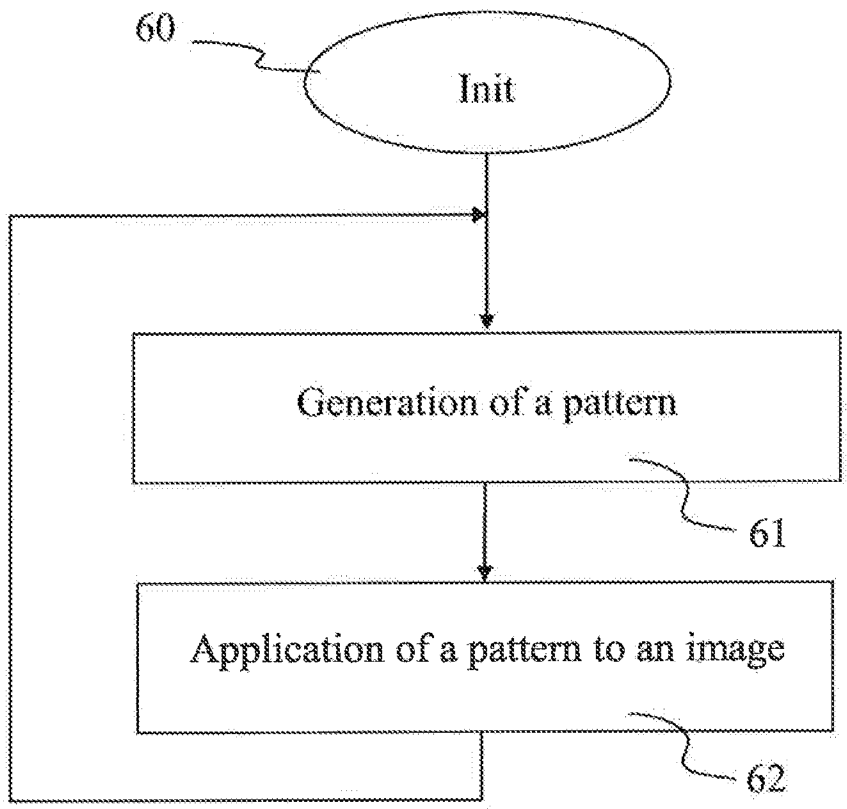

60
Init
Generation of a pattern
61
Application of a pattern to an image
62

Fig 6

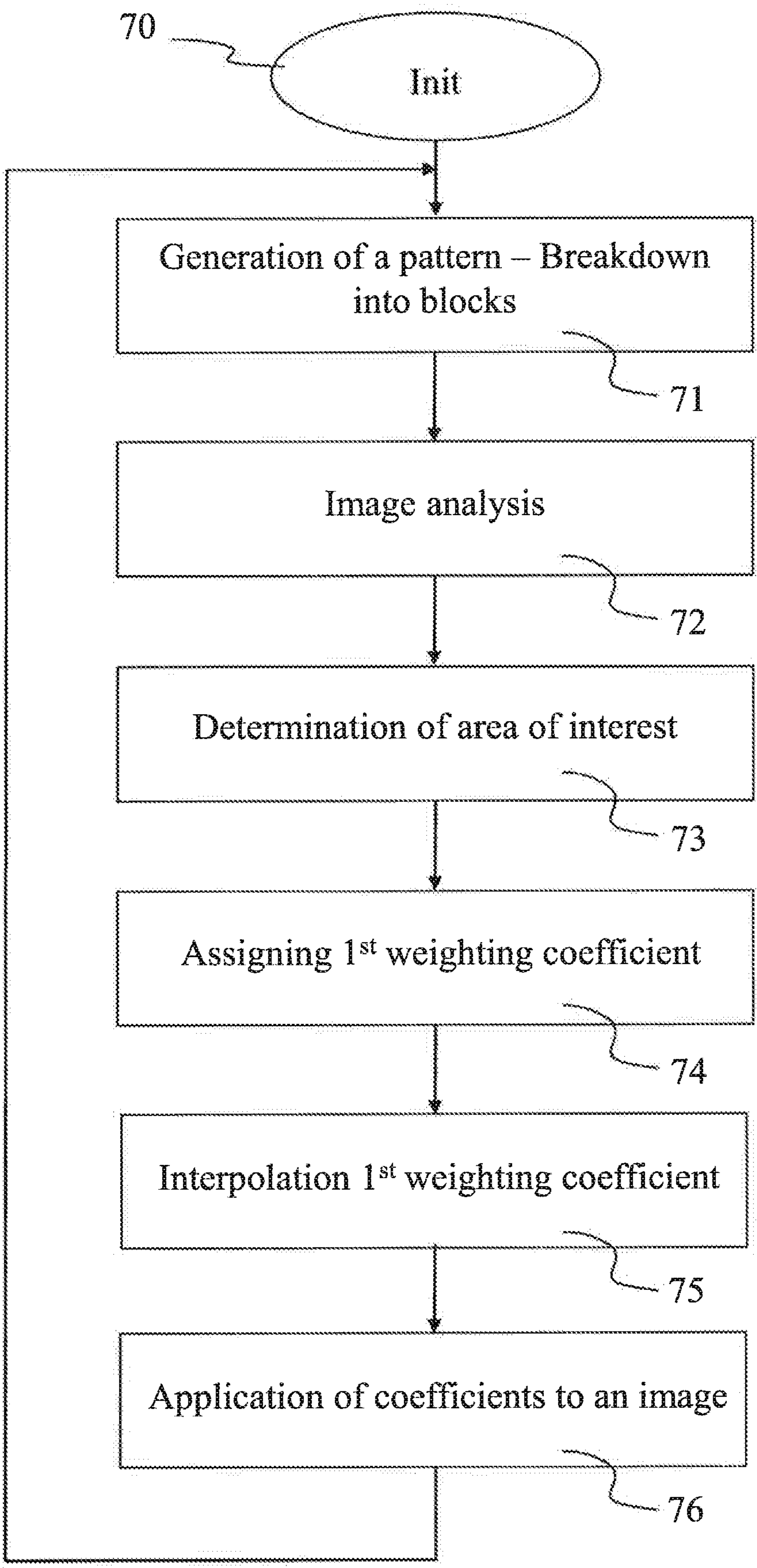

70
Init
Generation of a pattern – Breakdown into blocks
71
Image analysis
72
Determination of area of interest
73
Assigning 1st weighting coefficient
74
Interpolation 1st weighting coefficient
75
Application of coefficients to an image
76

Fig 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/057967

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06T5/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/253825 A1 (KAWAMURA TOMOYUKI [JP] ET AL) 17 November 2005 (2005-11-17) * abstract paragraph [0043] - paragraph [0047] paragraph [0050] figure 4A figure 4B -----	1-6
A	EP 1 237 138 A1 (MATSUSHITA ELECTRIC IND CO LTD [JP]) 4 September 2002 (2002-09-04) * abstract paragraph [0062] - paragraph [0063] paragraph [0111] -----	1-6

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"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 when the document is taken alone

"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

Date of the actual completion of the international search	Date of mailing of the international search report
19 July 2010	28/07/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Millet, Christophe

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/057967

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005253825 A1	17-11-2005	CN 1697002 A	16-11-2005
		GB 2414130 A	16-11-2005
		JP 2005321664 A	17-11-2005
EP 1237138 A1	04-09-2002	WO 0122391 A1	29-03-2001
		TW 501079 B	01-09-2002
		US 6791566 B1	14-09-2004

Form PCT/ISA/210 (patent family annex) (April 2005)