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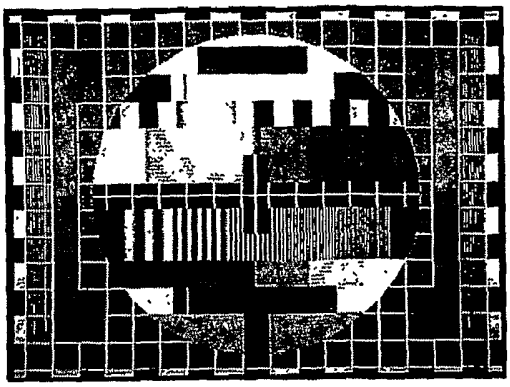
(54) Title: NON-LINEAR ASPECT RATIO CONVERSION



(57) Abstract: Apparatus (10) formats an incoming image from a first aspect ratio to a second aspect ratio by first establishing a central region (200) within the image via an image separator (14). A first pixel interpolator (16) interpolates the pixels within the central region using a constant ratio to minimize pixel size variation. A second pixel interpolator (18) interpolates pixels in each of the border regions (240 and 260) surrounding the central region. The second pixel interpolator employs a non-linear ratio to achieve much more aggressive filtering the closer the pixels are to the image edges. In this, pixel distortion within the central region where most of the action occurs and where most character faces appear is minimized.

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NON-LINEAR ASPECT RATIO CONVERSION

TECHNICAL FIELD

This invention relates to a technique for formatting an image from a first aspect ratio to a second aspect ratio.

BACKGROUND ART

Historically, the National Television Systems Committee (NTSC) in the United States adopted an aspect ratio of 4:3 for television images because the motion picture industry had earlier adopted the same aspect ratio for movies after determining that viewers preferred a rectangular image that had a greater width than height. Television standards organizations throughout the rest of the world have also adopted the 4:3 aspect ratio. With the advent of high definition television, such as the High Definition terrestrial broadcast system proposed by the Grand Alliance and described in the 1994 Proceedings of the National Association of Broadcasters, 48th Annual Broadcast Engineering Conference Proceedings, March 20-24, 1994, content providers now offer high definition television programming having a 16:9 aspect ratio for display on wide screen television display devices.

While the market for high definition wide screen television display devices continues to grow, there remains a large embedded base of standard television display devices that can only display images having a 4:3 aspect ratio. Accordingly, a large amount of television content remains formatted in a 4:3 aspect ratio. When a non-16:9-formatted image (i.e., a 4:3 image) is displayed on a widescreen television the image can be displayed in one of three ways. For example, the image can be displayed in its the native format, for example with a 4:3 aspect ratio, thus giving rise to large vertical bars on both sides of the image as depicted in FIGURE 1. Another approach is to evenly

stretch a 4:3 aspect ratio image to fill the screen to obtain a 16:9 aspect ratio as depicted in FIGURE 2. Unfortunately, evenly stretching the image causes objects to appear wider than intended. Yet another approach is to fill the screen with the 4:3 aspect ratio image without stretching. The resultant 16:9 aspect ratio image will suffer truncations of the top and bottom portions of the image as depicted in FIGURE 3.

Thus, a need exists for a technique for formatting an image to change the aspect ratio to minimize distortion.

BRIEF SUMMARY OF THE INVENTION

Briefly, in accordance with a preferred embodiment, there is provided a method for formatting an image to change the aspect ratio from a first value to a second value. The method commences by first establishing within the image a central region separated on each of its sides from a corresponding image side by an associated border region. Pixels within the central region of the image are interpolated using a constant ratio to effect change in the aspect ratio with minimal stretching. Pixels within each border region are interpolated using a non-linear ratio that changes as a function of the distance from the side of the image such that greater stretching occurs closer to the sides of the image where such stretching appears less noticeable.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 depicts a native format screen display with vertical bars in accordance with the prior art;

FIGURE 2 depicts a screen display with uniform stretching as is done in accordance with the prior art;

FIGURE 3 depicts a screen display that has undergone resizing in accordance with the prior art, resulting in a loss of content;

FIGURE 4 depicts a block schematic diagram of a system in accordance with the present principles for formatting an image having a first aspect ratio to yield a second aspect ratio; and

FIGURE 5 depicts a graphical screen display showing the manner in which the system of FIG. 4 accomplishes such image formatting.

DETAILED DESCRIPTION

FIGURE 4 depicts an image formatting apparatus 10 in accordance with the present principles for formatting an incoming image having a first aspect ratio to fill a display screen 12 with an image having a second aspect ratio. In practice, the image formatting apparatus 10 includes at least one combination image filter means that interpolates pixels within the incoming image in accordance with their location to minimize stretching within the central portion of he image. Rather than display the image formatted by the image formatter 10, a storage device 13 could store the device for subsequent display.

As will become better understood hereinafter by reference to FIG. 5, the image formatter 10 of FIG. 4 operates to format the image by first establishing a central region within the image via separator means 14. A first pixel interpolation mechanism 16 within the image formatter 10 formats the pixels that lie in the central region established by the separator means 14 with a less aggressive filtering coefficient nearer to 1:1 to minimize stretching. In practice, the central portion of the image established by the separator means encompasses the area where most of the action occurs and where most of the charter faces appear. Thus, interpolating the pixels within central region using a constant ratio will reduce the degree of distortion in the displayed picture that appears on the display device 12.

A second pixel interpolation mechanism 18 interpolates the pixels within the incoming image that lie outside the central region established by the separator means 14. Unlike the first pixel interpolation mechanism 16, the

second pixel interpolation mechanism 18 performs pixel interpolation using filtering coefficients that fit a non-linear, rectilinear, or a linear curve. In particular, the pixel interpolation mechanism 18 more aggressively filters (i.e., stretches) the pixels outside the central region in accordance with distance of the pixel from the central region, in order to fully utilize the viewing screen. In other words, the closer the pixel lies to the outermost sides of the image, the more aggressive the filtering of the pixel, and the greater the degree of stretching. Thus, the pixels closest to the sides of the image undergo greater stretching than the pixels in the central region. Pixel stretching occurring within the regions closest to the sides of the image appears less noticeable than if such stretching occurred in the central portion of the image.

While the separation means 14, first pixel interpolation means 16 and second pixel interpolation means appear in FIG. 4 as separate elements, these functions could be performed by single device, typically a microprocessor or other programmable device, such as a Digital Signal Processor (DSP), or a hard-wired circuit, such as a FPGA, PLA, custom integrated circuit, or the like, or a combination of such devices. Further, the constant ratio used by the first pixel interpolation means, while typically pre-set, can be adjusted by a user through a keyboard 20 liked to the image formatter 10. The user can also change the coefficient for the central and outside regions through a remote control 24, such as an Infrared or a radio frequency device, having a corresponding detector 26 linked to the image formatter 10.

To better understand the image formatting technique of the present principles, refer to FIGURE 5 that depicts a graphical screen display of an image 200 having a first aspect ratio. To format the incoming image 200 to fill a screen to achieve a second aspect ratio different than the first aspect ratio, the original image must undergo stretching. To minimize image distortion when accomplishing such formatting, a central region 220 is established within the image 200 and pixels within that region under interpolation (filtering) using a low distortion filter. Within each of border regions 240 and 260 of FIG. 5 at

the each of the sides of the image 200 of FIG. 5, the pixels undergo interpolation (filtering) using a non-linear, rectilinear, or linear ratio. Indeed the pixels within each of the border regions 240 and 260 undergo a much more aggressive filtering such that the pixels closer to the sides of the image 200 undergo greater stretching than those closer to the central region 220. Filtering the pixels more aggressively the closer their location to the sides of the image limits the more objectionable stretching to locations away from the central region 220, thus minimizing distortion of the image in the central region where most of the action occurs.

In illustrated embodiment, the pixel interpolation undertaken to format one aspect ratio image to yield another aspect ratio image will cause stretching to expand the picture width to fully utilize the viewing area. Depending on the aspect ratio of the incoming and output images, stretching could also occur to expand or contract the picture height as well as the picture width. Indeed, if the output image has a smaller aspect ratio, then pixel shrinkage must occur.

The foregoing describes a technique for formatting an image having a first aspect ratio to yield a second aspect ratio.

CLAIMS

1. A method for formatting an image to change the aspect ratio from a first value to a second value, comprising the steps of:

establishing within the image a central region separated on each of its sides from a corresponding image edge by an associated border region;

interpolating pixels of the image within the central region using a constant ratio to effect change in the aspect ratio with minimal pixel size variation; and

interpolating pixels of the image within each border region using a non-linear ratio that changes as a function of the distance from the central to effect a change in the aspect ratio such that greater variation in pixel size occurs within each border region than in said central region.

2. The method of formatting an image as recited in claim 1, further comprising the step of adjusting the constant ratio used to interpolate the pixels in the central region.

3. The method of formatting an image as recited in claim 1 wherein the step of adjusting the constant ratio includes the step of receiving a command to change said constant ratio from a user viewing said image.

4. The method for formatting an image as recited in claims 3 further comprising the step of receiving the command via a remote control.

5. The method according to claim 1 wherein greater pixel stretching occurs within the border region than the central region when the second aspect ratio exceeds the first aspect ratio.

6. The method according to claim 1 wherein the constant ratio equals 1:1 when the first and second aspect ratios each have a common width.

7. Apparatus for formatting an image to change the aspect ratio from a first value to a second value, comprising:

an image separator for establishing within the image a central region separated on each of its sides from a corresponding image edge by an associated border region;

a first pixel interpolator for interpolating the pixels of the image within the central region using a constant ratio to effect change in the aspect ratio with minimal pixel size variation; and

a second pixel interpolator for interpolating pixels of the image within each border region using a non-linear ratio that changes as a function of the distance from the central to effect a change in the aspect ratio such that greater variation in pixel size occurs within each border region than in said central region.

8. The apparatus as recited in claim 7, further comprising means for adjusting the constant ratio used to interpolate the pixels in the central region.

9. The apparatus according to claim 8 wherein said adjusting means comprises a keyboard for receiving a command to change said constant ratio from a user viewing said image.

10. The apparatus according to claim 8 wherein said adjusting means comprises a detector for receiving a command received from a remote control to change said constant ratio by a user viewing said image.

11. The apparatus according to claim 7 wherein the first second pixel interpolator causes greater pixel stretching to occur within the border region than the central region when the second aspect ratio exceeds the first aspect ratio.

12. The apparatus according to claim 7 wherein the constant ratio equals 1:1 when the first and second aspect ratios each have a common width.

FIG. 1

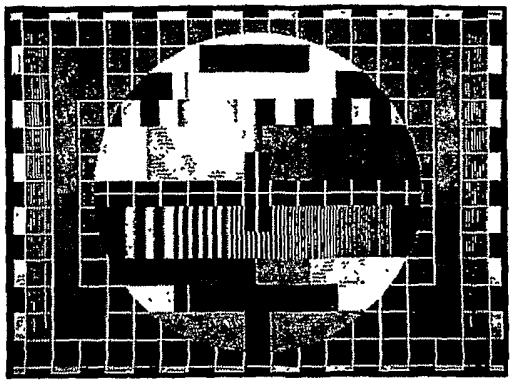


FIG. 2

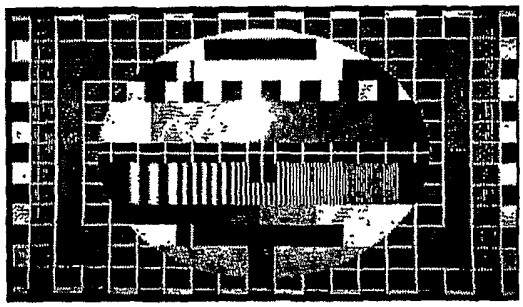


FIG. 3

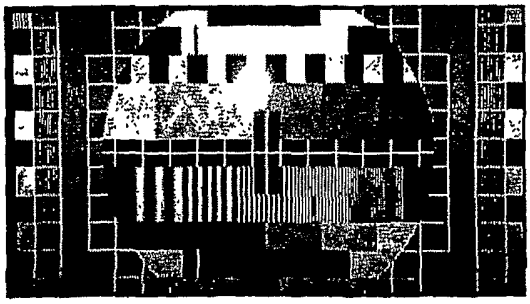


FIG. 4

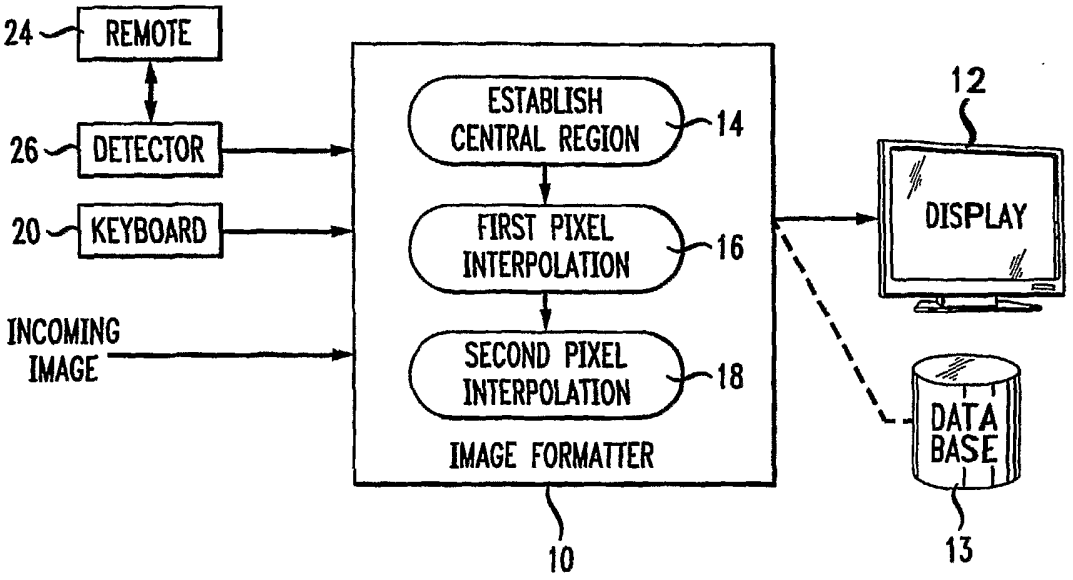
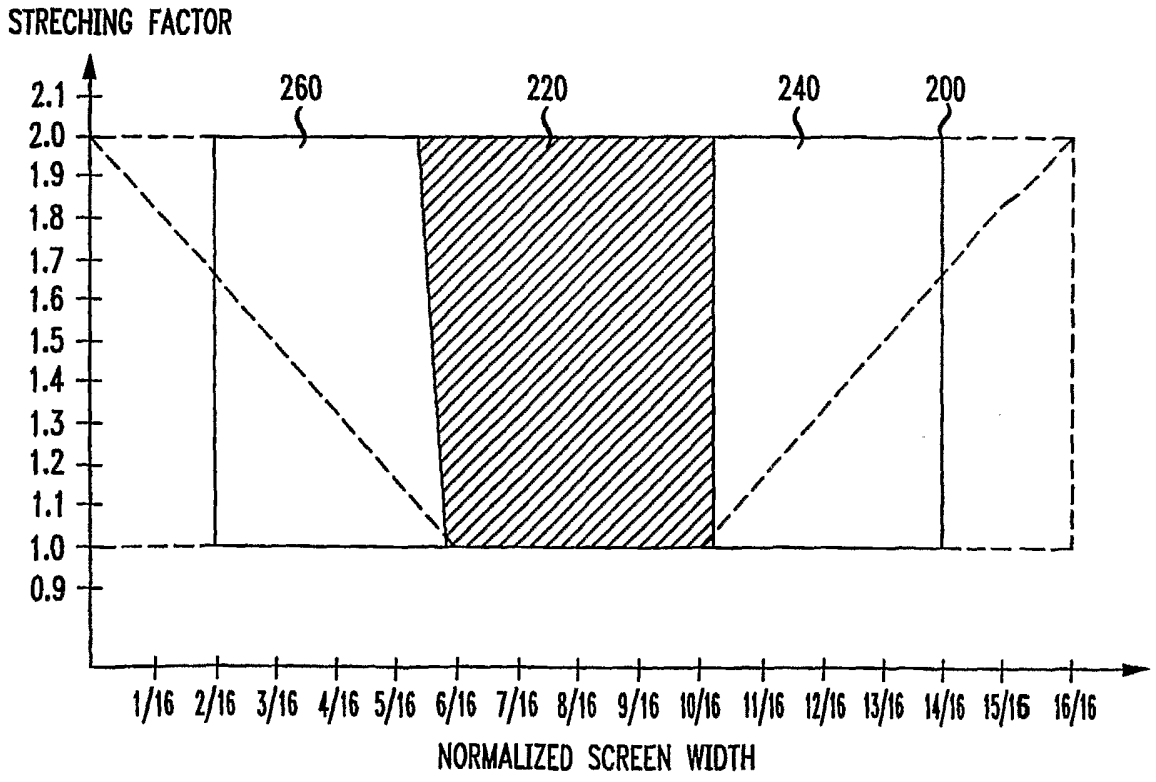

24
REMOTE
26
DETECTOR
20
KEYBOARD
INCOMING IMAGE
ESTABLISH CENTRAL REGION
14
FIRST PIXEL INTERPOLATION
16
SECOND PIXEL INTERPOLATION
18
IMAGE FORMATTER
10
12
DISPLAY
DATA BASE
13

FIG. 5


STRECHING FACTOR
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
260
220
240
200
1/16 2/16 3/16 4/16 5/16 6/16 7/16 8/16 9/16 10/16 11/16 12/16 13/16 14/16 15/16 16/16
NORMALIZED SCREEN WIDTH

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/006070

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N5/44 H04N7/015

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)
IPC 7 H04N 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)

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X	US 2003/117526 A1 (KOZAI KAZUHIRO) 26 June 2003 (2003-06-26) abstract; claim 7; figures 1,2,3b,8,13,14 paragraphs '0004! - '0011!, '0022! - '0029!, '0032!, '0033!, '0164!, '0171!	1,7
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 September 2004	16/09/2004

Name and mailing address of the ISA	Authorized officer
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