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Anderson

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[54] **SYSTEM AND METHOD FOR GENERATING A CONTRAST OVERLAY AS A FOCUS ASSIST FOR AN IMAGING DEVICE**

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[51] **Int. Cl.**[6] **H04N 5/20**; H04N 5/52

[52] **U.S. Cl.** **348/255**; 348/256; 348/678; 348/679

[58] **Field of Search** 348/29, 255, 256, 348/673, 678, 679, 687; 358/174; H01N 5/53, 5/52, 5/20

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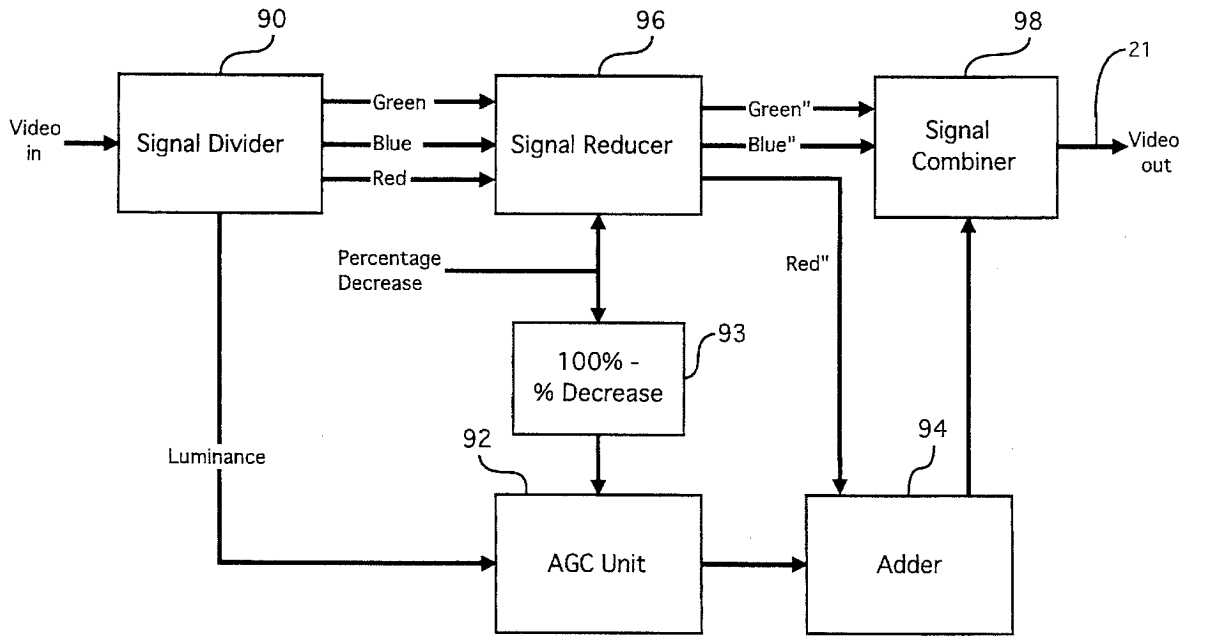
[57] **ABSTRACT**

A system for generating and displaying a contrast false color overlay as a focus assist includes a signal divider, an automatic gain control unit, an adder, a signal reducer and a signal combiner. The signal divider receives a signal representing an image and divides the signal into a red channel signal, a green channel signal and a blue channel signal. The red, green and blue channel signals are input to the signal reducer and respectfully reduced by a percentage value. The reduced Green and Blue channel signals are input to the signal combiner and combined with the output of the adder. A luminance signal is also input or generated from the channel signals and is fed to the automatic gain control unit which produces a contrast signal whose brightness is proportional to the contrast in the image. The contrast signal is input to the adder along with a reduced version of the red channel signal where the two signals are added together, and the output of the adder is provided to the combiner. The output of the combiner is then provided to the output device for display of the image. The present invention also comprises a method for adjusting the display to provide a false color contrast overlay as a focus assist, the method comprising the steps of: receiving a signal representing an image; separating the signal into channels; receiving or generating a luminance signal; producing a contrast signal with an amplitude that varies with the contrast in the image from the luminance signal; reducing the contrast signal; reducing the channel signals; combining the reduced contrast signal with one of the reduced channel signals; and generating an image on the output device using the combined signal and the reduced channel signals.

19 Claims, 11 Drawing Sheets



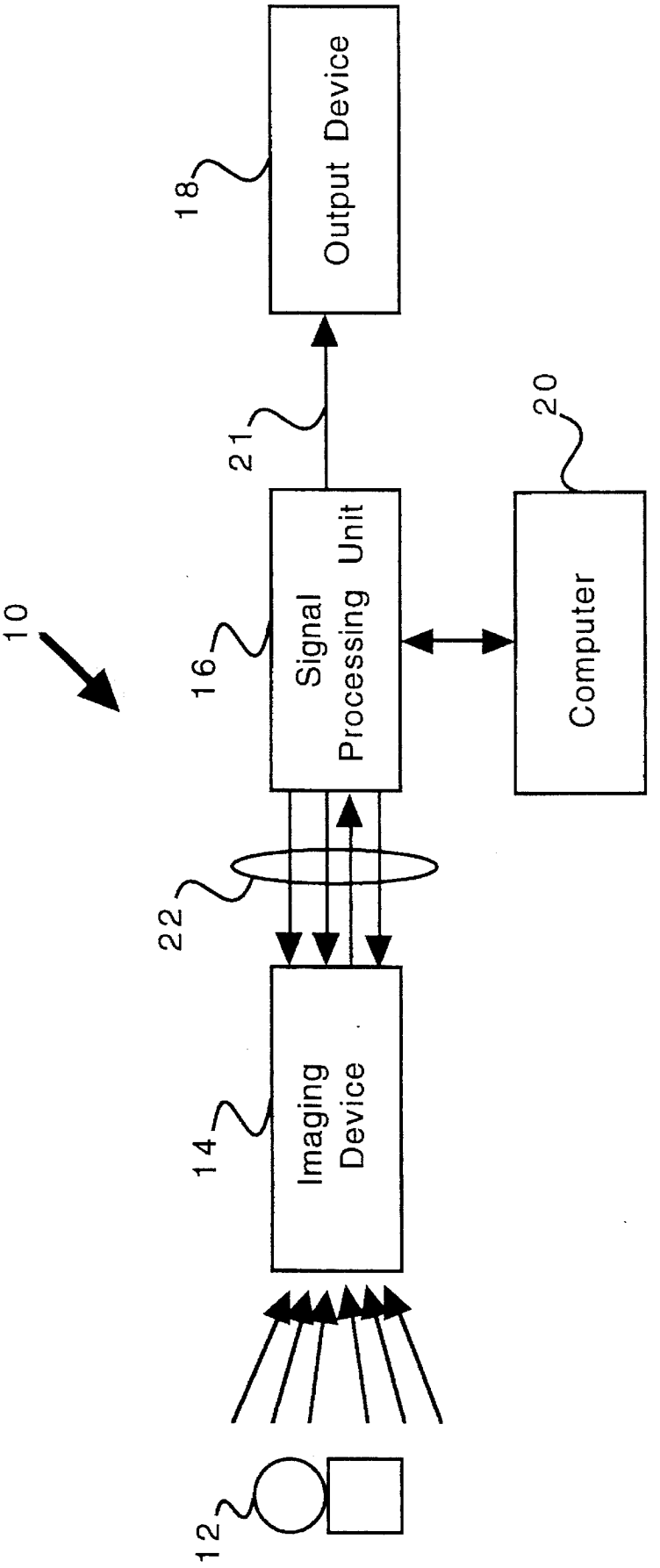

10
12
14
Imaging Device
16
Signal Processing Unit
18
Output Device
20
Computer
21
22

FIG. 1

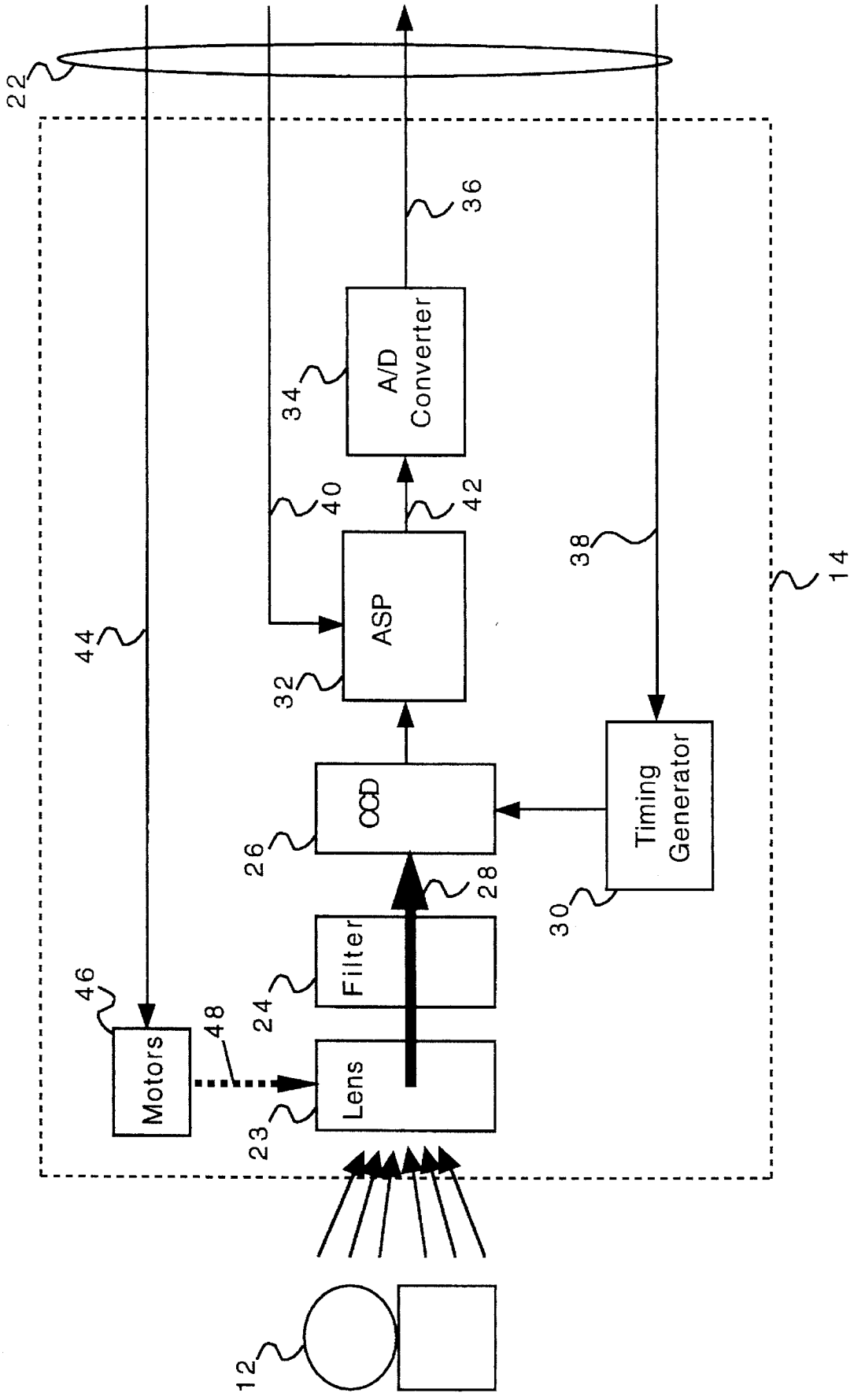

22
36
A/D Converter
34
40
42
ASP
32
38
14
44
CCD
26
28
Timing Generator
30
46
48
Filter
24
Motors
Lens
23
12

FIG. 2

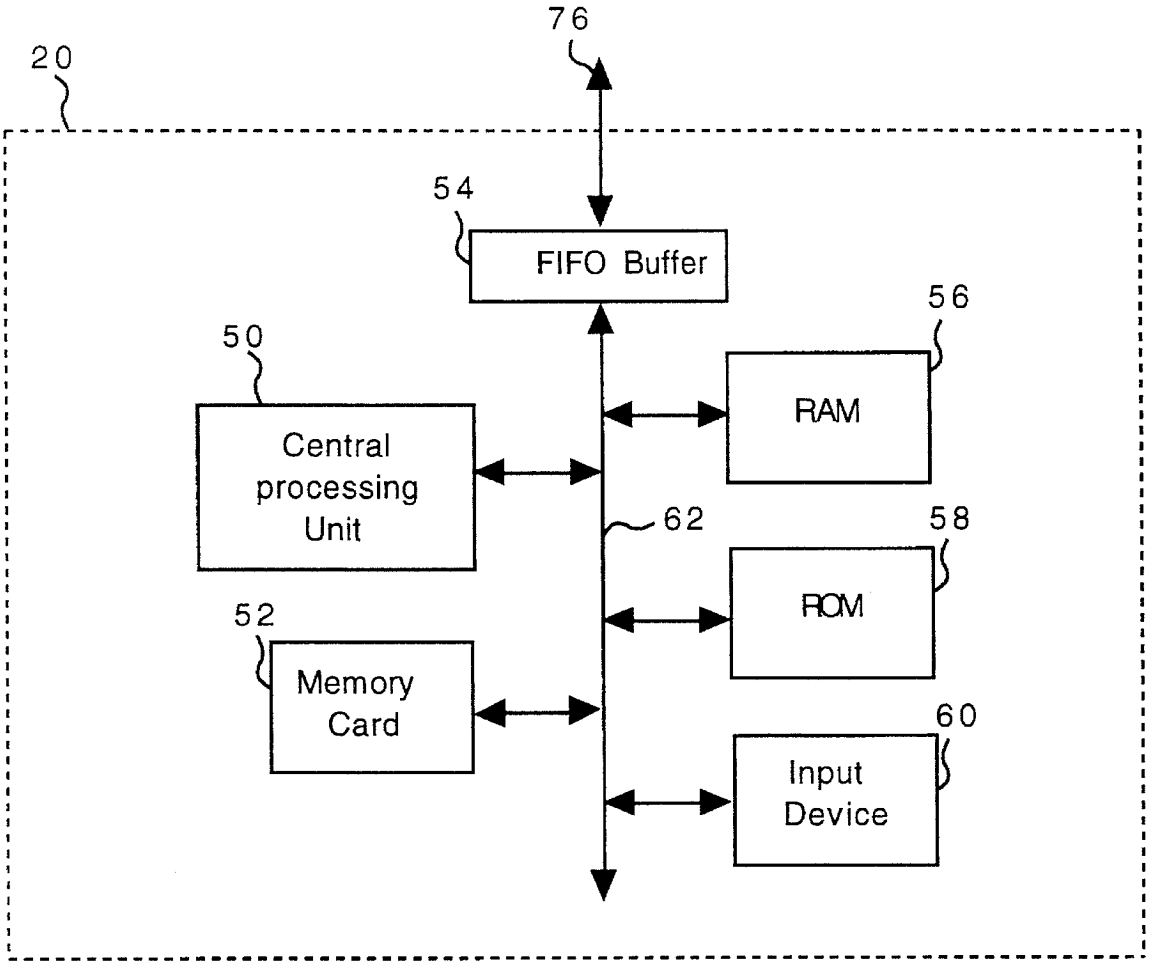

76
20
54
FIFO Buffer
56
50
RAM
Central processing Unit
62
58
ROM
52
Memory Card
60
Input Device

FIG. 3

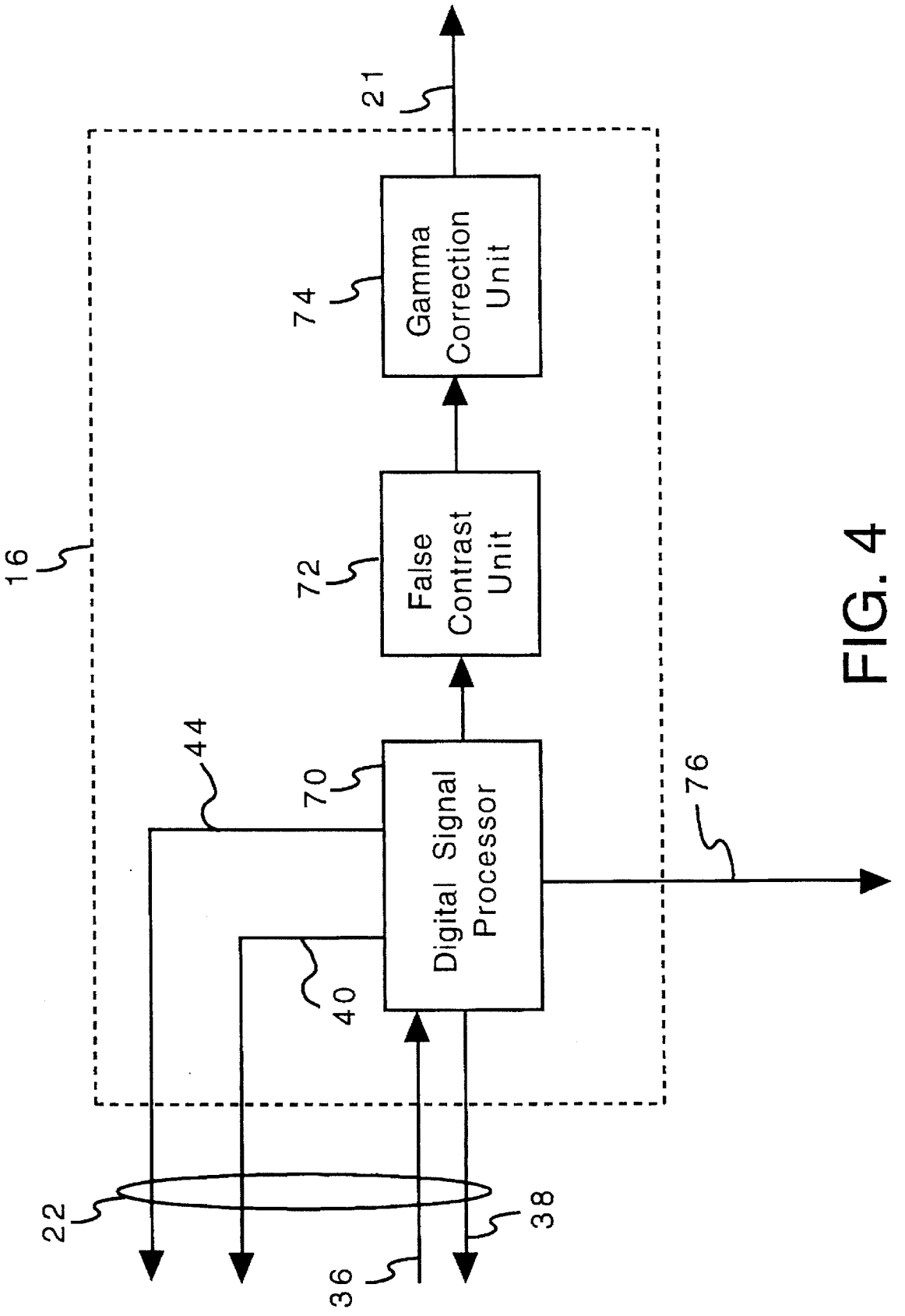

16
21
74
Gamma Correction Unit
72
False Contrast Unit
44
70
Digital Signal Processor
76
40
22
36
38

FIG. 4

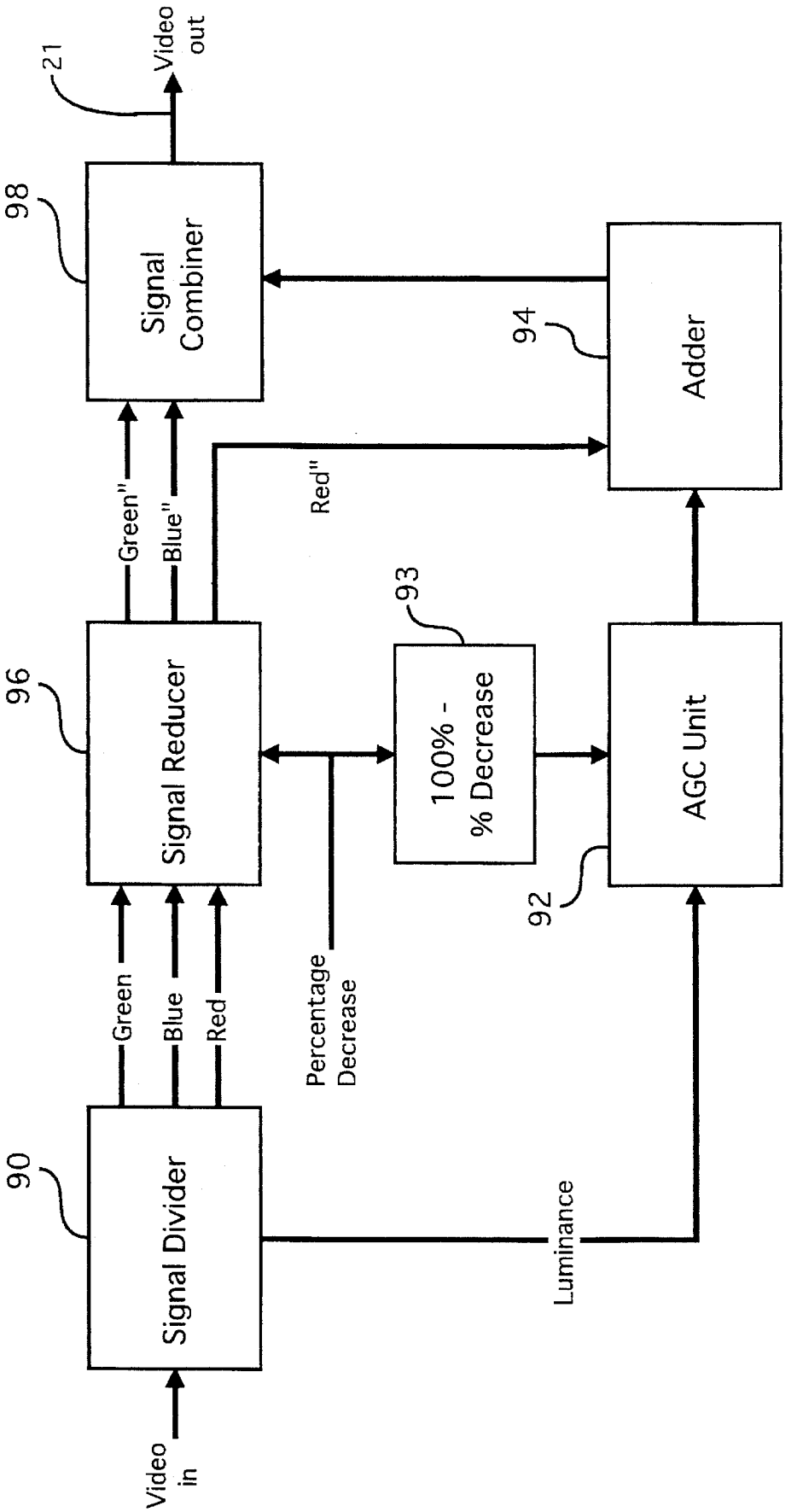

Video in
90
Signal Divider
Green
Blue
Red
96
Signal Reducer
Green"
Blue"
Red"
Percentage Decrease
93
100% - % Decrease
92
AGC Unit
Luminance
94
Adder
98
Signal Combiner
21
Video out

FIG. 5

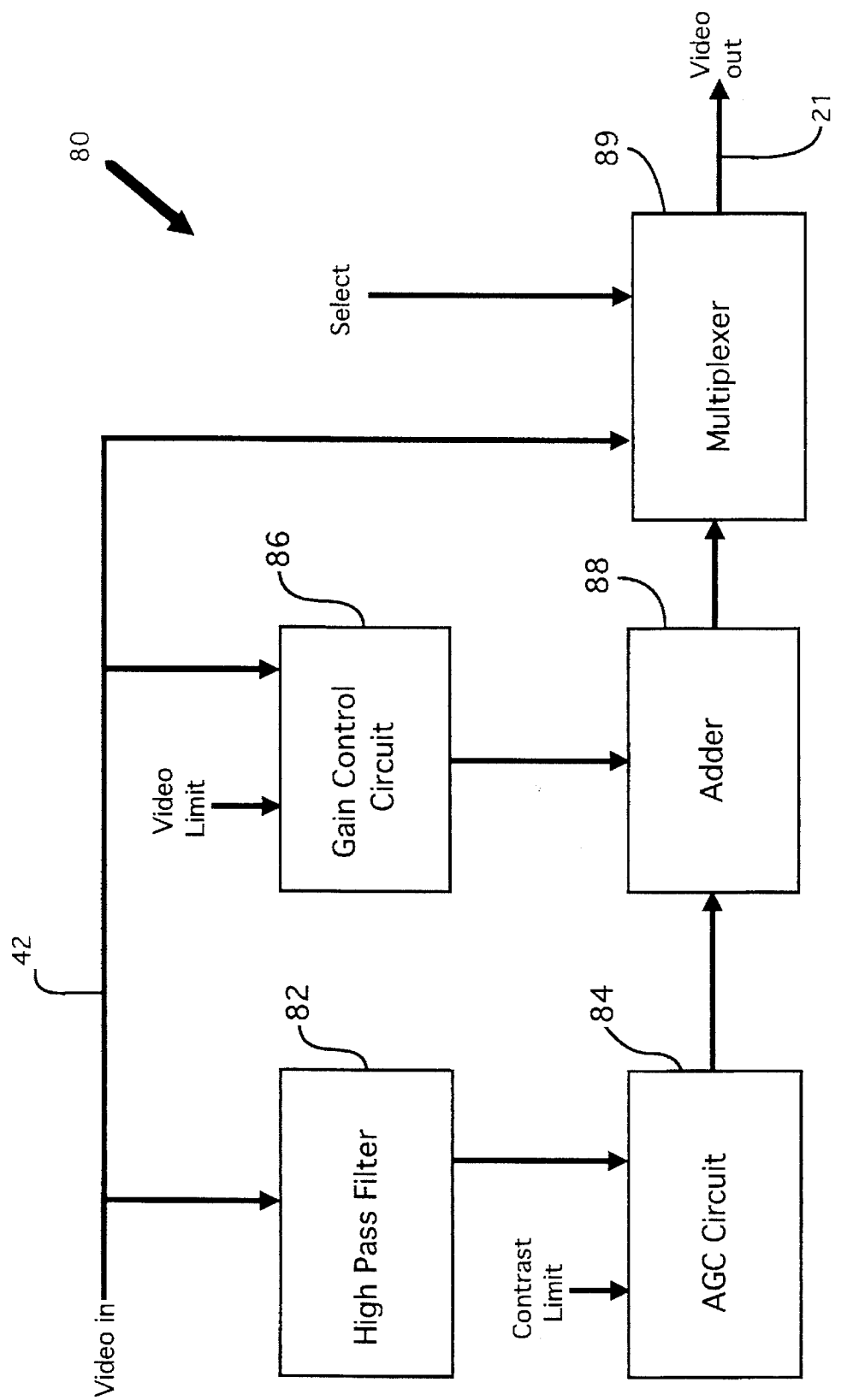
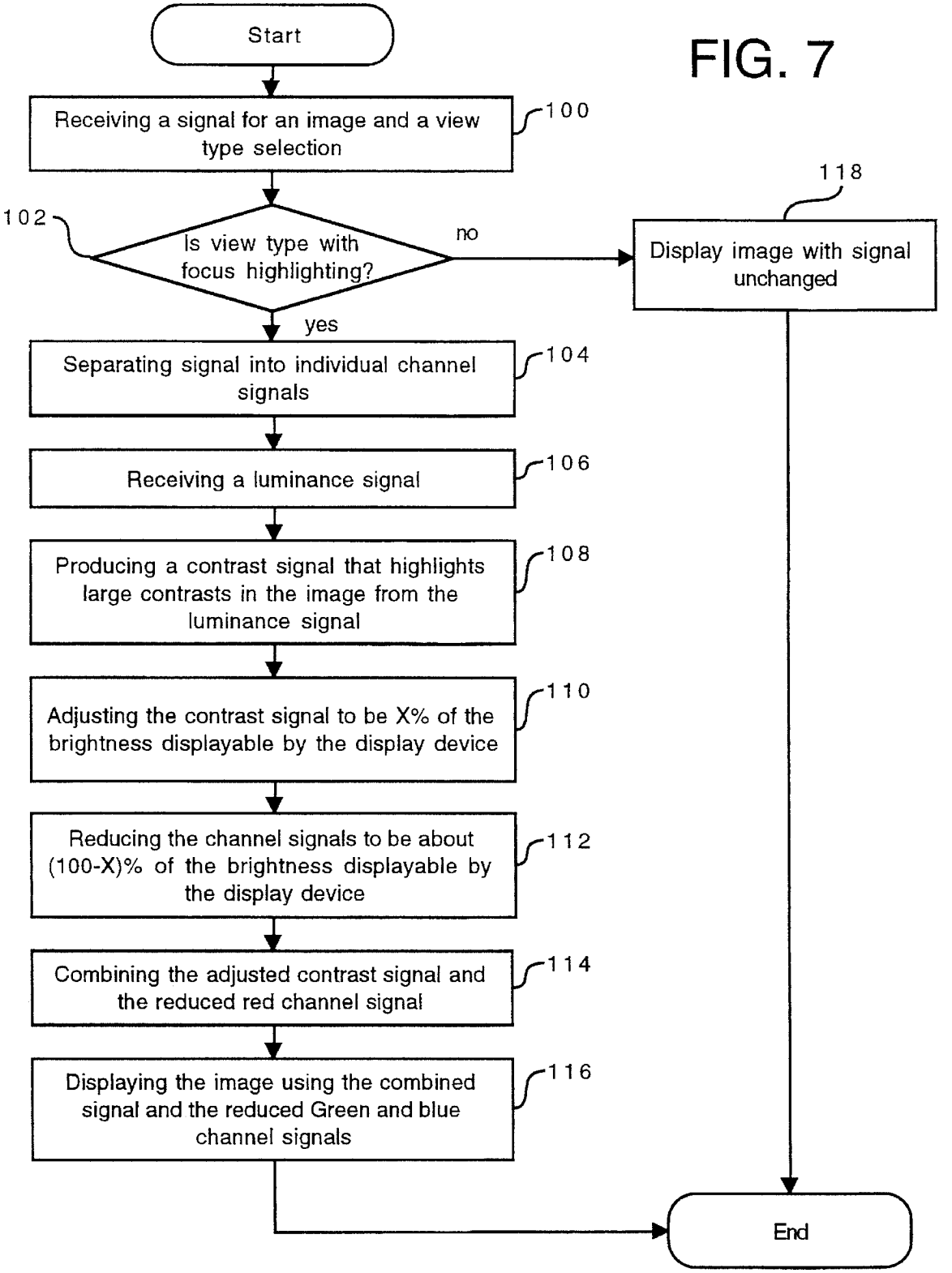

80
Video out
21
89
Select
Multiplexer
86
88
Video Limit
Gain Control Circuit
Adder
42
82
84
High Pass Filter
Contrast Limit
AGC Circuit
Video in

FIG. 6

FIG. 7


Start
Receiving a signal for an image and a view type selection
100
102
Is view type with focus highlighting?
no
yes
118
Display image with signal unchanged
Separating signal into individual channel signals
104
Receiving a luminance signal
106
Producing a contrast signal that highlights large contrasts in the image from the luminance signal
108
Adjusting the contrast signal to be X% of the brightness displayable by the display device
110
Reducing the channel signals to be about (100-X)% of the brightness displayable by the display device
112
Combining the adjusted contrast signal and the reduced red channel signal
114
Displaying the image using the combined signal and the reduced Green and blue channel signals
116
End

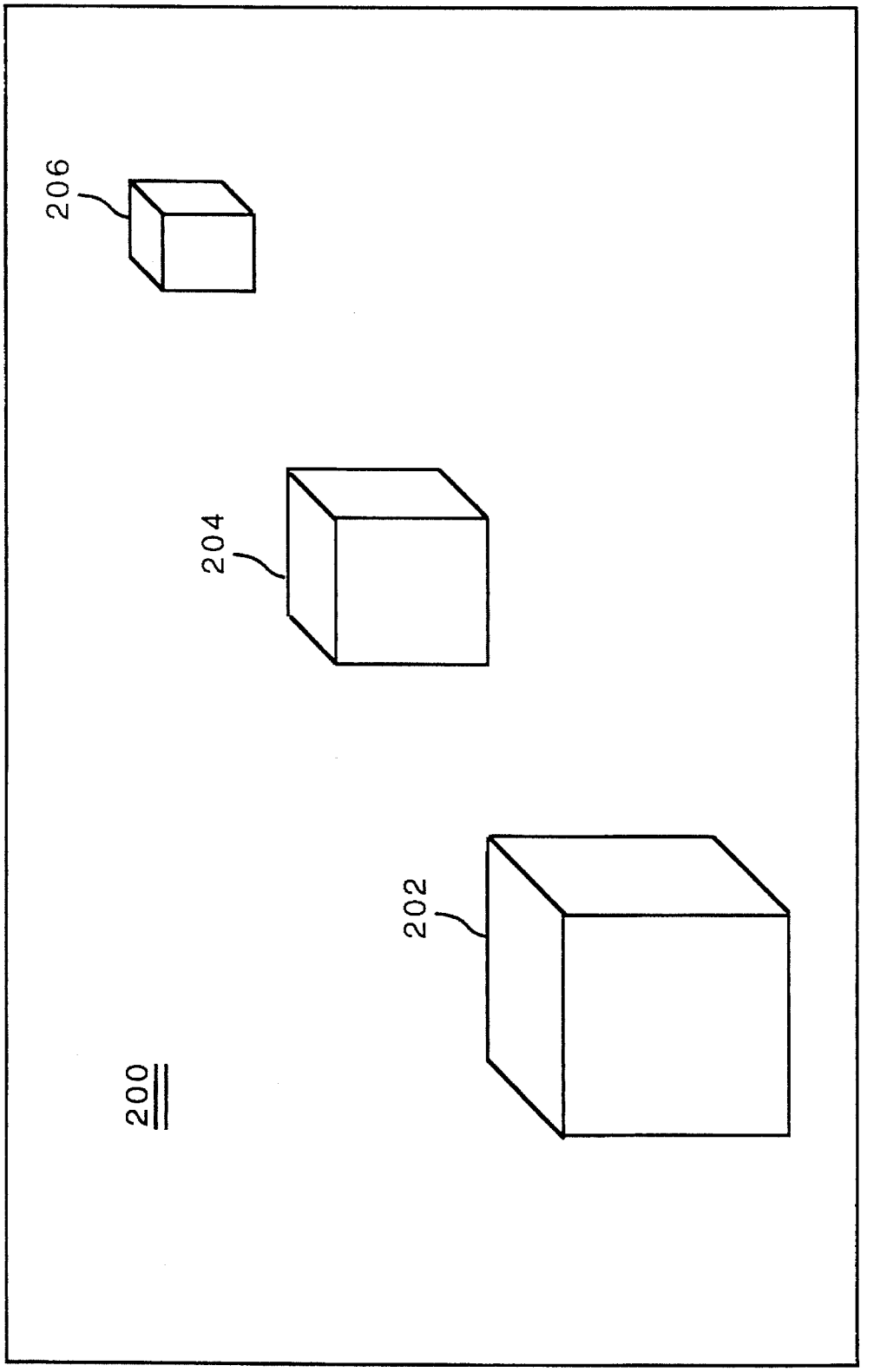


FIG. 8A

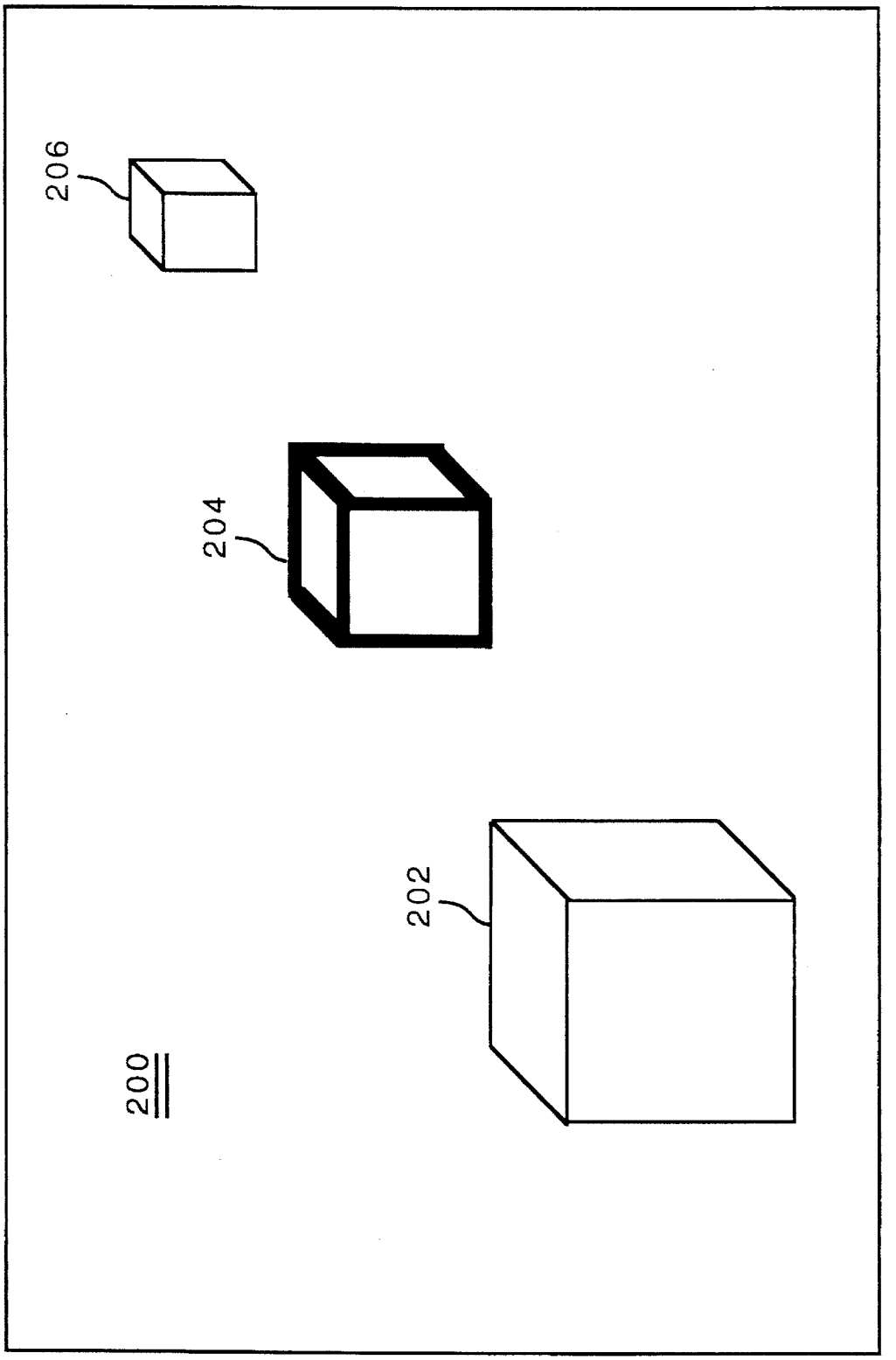


FIG. 8B

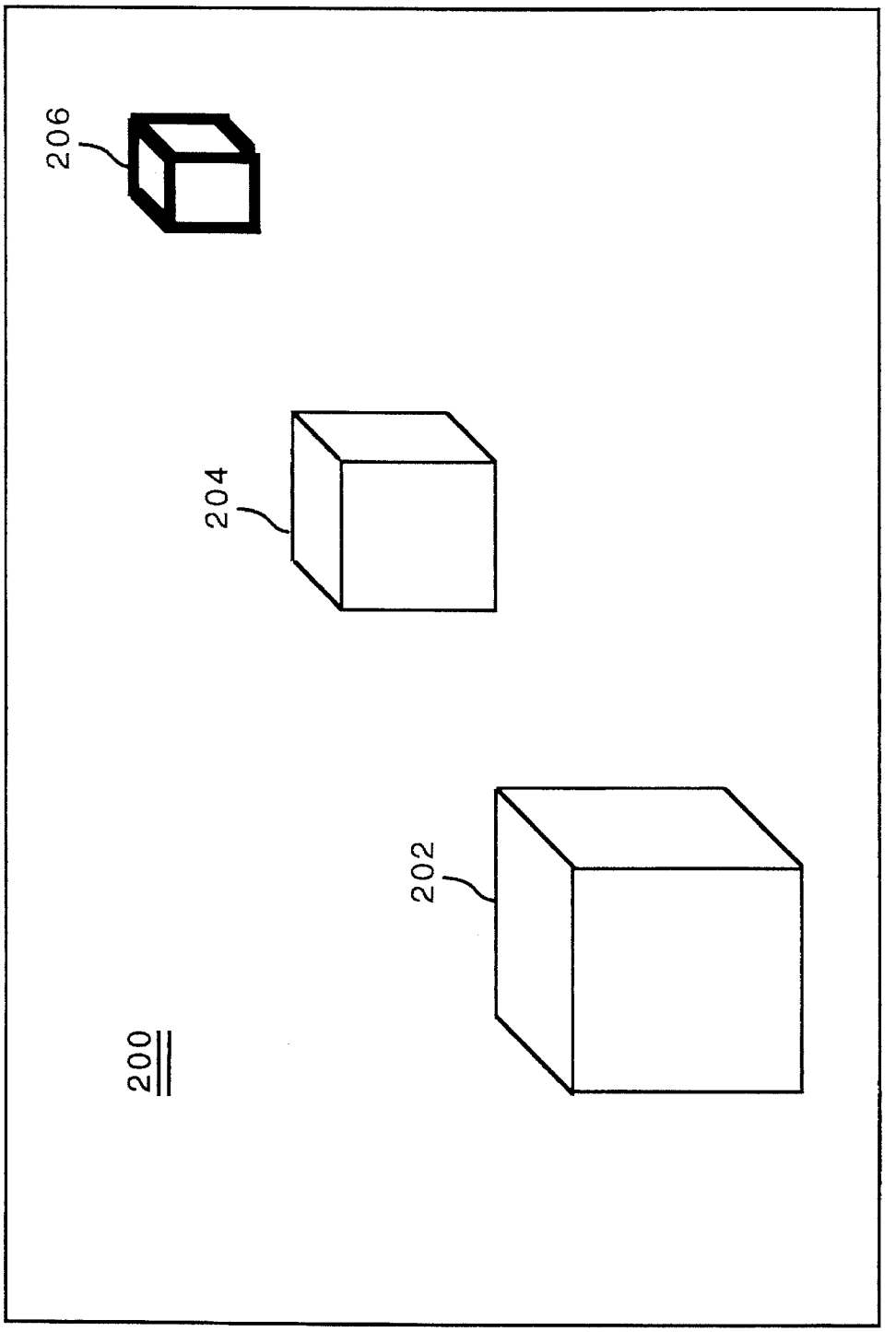


FIG. 8C

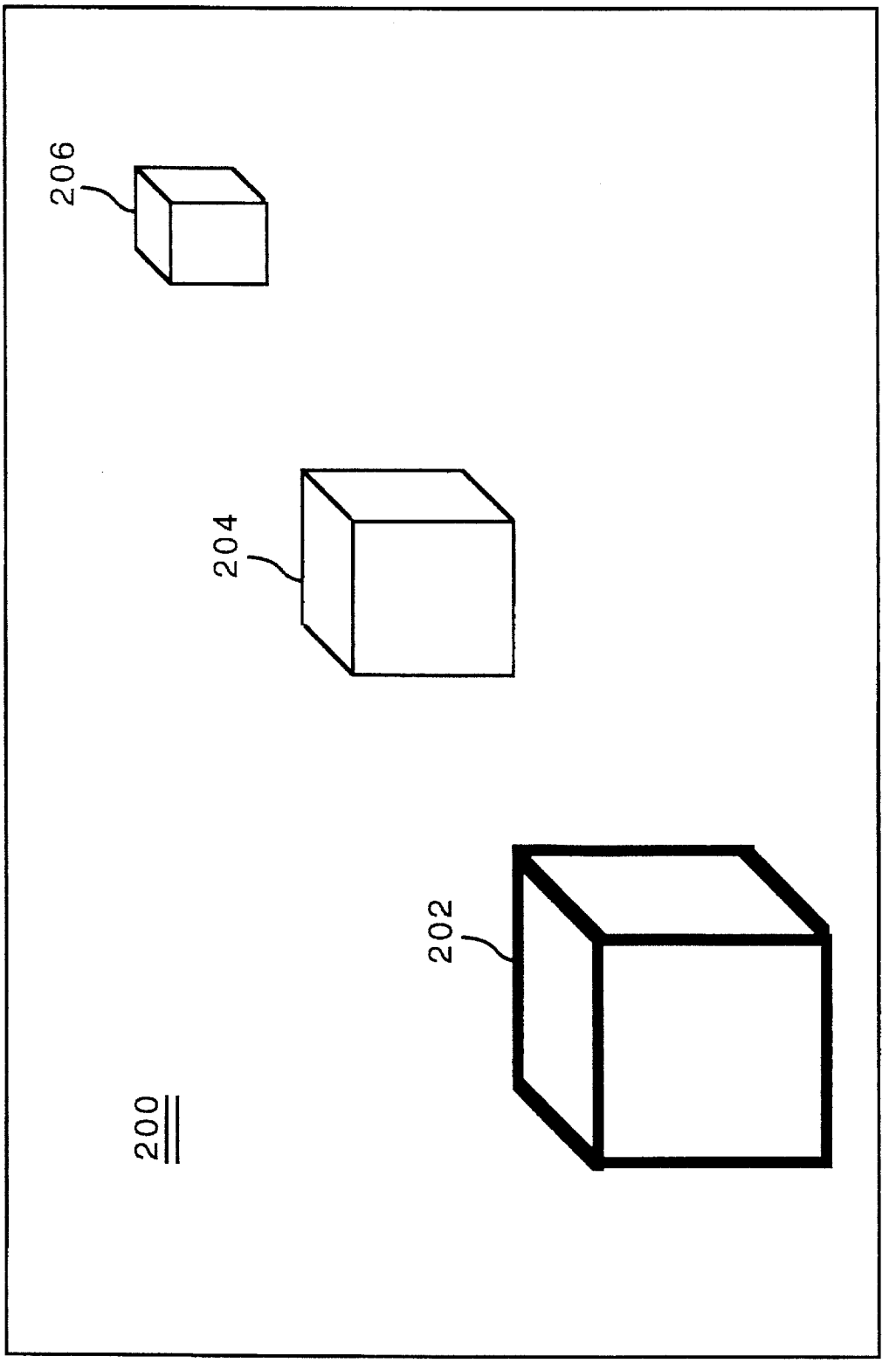


FIG. 8D

SYSTEM AND METHOD FOR GENERATING A CONTRAST OVERLAY AS A FOCUS ASSIST FOR AN IMAGING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to electronic imaging systems such as digital cameras. In particular, the present invention relates to systems and methods for providing the user with information as to the portion of an image that is in focus.

2. Description of the Related Art

During the recent past, camera technology has greatly improved. A variety of still cameras are presently commercially available that include such features as an "automatic" focus lens. Such cameras with the automatic focus feature, automatically gather focusing information and adjust the lens of the camera to bring the image received by the camera at the moment the picture is taken into focus. Conventionally, such auto-focus cameras selected predetermined areas in the image to be captured as points that must be in focus. With such cameras, the user is generally not able to view the image through the lens that will gather the image for exposure to the film. Instead, the user views the image or scene through a false lens that is built into the housing of the camera. The scene framed by the false lens generally approximates the image that will be captured on film when the picture is taken. However, a particular problem with such auto-focus cameras is that they do not provide the user with any feedback or information as to the portions of the image that will be in focus when the picture is taken. Since the image is viewed through a false lens, the user must hope the portion of the image of importance is in focus when the picture is taken or hope that the portion of the image of importance falls within an area used by the auto focus mechanism.

Even with cameras that allow the user to view the image to be captured through the current settings of the actual lens, such as a single lens reflex (SLR) camera or a digital camera with a live view finder, identifying the portions of the image that are in focus can be particularly problematic. The image to be captured is typically displayed in a view finder with the image significantly reduced in size. Moreover, the resolution and picture quality of such view finders is very poor. Therefore, when viewing an image to be photographed or captured it is very difficult to identify the portions of the image that are in focus. Because of the poor resolution and small size of the images, in many instances it is not possible to determine the portions of the image that are in focus. This problem is even more significant for digital cameras since ideally, the user will view the image through the view finder for only a few seconds before deciding whether to take the picture, change the view or adjust the focus. Moreover, in the normal use of such cameras, it is very difficult for the user to determine the portion of the image that is in focus, especially when under pressure of the moment to get a picture. It is very common for users, even with SLR and digital cameras, to get out of focus pictures. Thus, there is need for a system that alerts the user as to the portion of the image that is in focus.

A variety of video cameras for capturing moving pictures of live scenes have been developed and their use is now widespread. Many existing video cameras provide for both the manual and the automatic focusing on images being filmed. Like digital cameras, video cameras typically provide a live view finder. These view finders are also very small, usually less than one square inch. They also suffer from the shortcoming of providing little feedback to the user as to what portions of the scene being filmed are in focus and what portions are not in focus. Therefore, it is very difficult for the user to determine whether an image is satisfactorily in focus using the auto focus mechanisms of the video camera or whether the user should resort to manual adjustment to focus in on the portions of the image as desired. In many instances, the user must view the scene for a significant period of time to ensure that the objects of interest in the scene are in focus. For live action filming, this is a particular problem because the user is not able to quickly adjust the focus as desired to film objects in the scene of interest.

Therefore, there is a need for a system and method for providing the user with feedback as to the portions of an image that will be in focus when the picture is taken. In particular, there is a need for a system and method that displays in a visually distinct manner the portions of an image that are in focus so that they can be readily and quickly identified by the user.

SUMMARY OF THE INVENTION

The present invention overcomes the limitations and shortcomings of the prior art with a system and method for generating and displaying a contrast false color overlay as a focus assist for an imaging device. One embodiment of the system of the present invention includes an imaging device, a signal processing unit, a computer and an output device. The signal processing unit advantageously comprises a false contrast unit having a signal divider, an automatic gain control (AGC) unit, an adder, a signal reducer and a signal combiner. The signal divider receives a signal representing an image and divides the signal into a red channel signal, a green channel signal and a blue channel signal. A luminance signal (for example, the "black & white" video signal, comprising the combination of red, blue, and green) is advantageously input to the automatic gain control unit which produces a contrast signal whose brightness is proportional to the contrast in the image. The Red channel signal is input to the signal reducer where it is reduced in value to ensure that when later combined with contrast signal, the combination is within the brightness range of the output device. The contrast signal is input to the adder along with the reduced version of the red channel signal where the two signals are added together. The green and blue signal divided out by the signal divider are also input to the signal reducer and respectfully reduced in value. The reduced Green and Blue channel signals are input to the signal combiner and combined with the output of the adder. The combined signal is then provided to the output device for display of the image. The signal output by the signal combiner advantageously provides a false color image where the portions of the image that are in focus are highlighted with increased brightness in the red channel. Such an enhanced image allows the user to quickly and easily identify the portion of the image that is in focus.

The present invention also comprises a method for adjusting the display to provide a false color contrast overlay as a focus assist. The preferred method comprises the steps of: receiving a signal representing an image; separating the signal into channels; generating a luminance signal; producing a contrast signal with an amplitude that varies with the contrast in the image from the luminance signal; reducing the contrast signal; reducing the channel signals; combining a reduced contrast signal with the reduced selected channel

signal; and generating an image on the output device using the combined signal and the reduced channel signals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a preferred embodiment of the system of the present invention for generating a false contrast overlay as a focus assist for an imaging device;

FIG. **2** is a block diagram of a preferred embodiment of the imaging device of the present invention;

FIG. **3** is a block diagram of a preferred embodiment of a computer of the present invention;

FIG. **4** a block diagram of a preferred embodiment of signal processing unit of the present invention;

FIG. **5** is a functional block diagram of a first embodiment of a false contrast unit of the present invention;

FIG. **6** is a block diagram of a second embodiment of the false contrast unit of the present invention;

FIG. **7** is a flowchart of the preferred method for adjusting the display to provide a false contrast overlay as a focus assist; and

FIG. **8**A is a graphical representation of a screen of the output device showing an image in a normal view; and

FIGS. **8**B, **8**C and **8**D are graphical representations of the screen of the output device showing an image with a false contrast overlay according to the present invention to identify the area of the image that is in focus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. **1**, a block diagram of a system **10** for generating a false contrast overlay as a focus assist is shown. The system **10** is used to capture an image of an exemplary object **12**. The system **10** built in accordance with the present invention preferably comprises an imaging device **14**, a signal processing unit **16**, an output device **18**, a computer **20** and an electronic interface **22**. An image is captured by the imaging device **14**, and the imaging device **14** produces an electrical signal representing the image. The imaging device **14** is coupled by the electronic interface **22** to the signal processing unit **16**. The electronic interface **22** is used by the imaging device **14** to send signals representing images to the signal processing unit **16**, and by the signal processing unit **16** for sending control signals back to the imaging device **14**. The signal processing unit **16** is coupled to the output device **18** by a line **21** for displaying to the user the image received by the imaging device **14** and transformed by the signal processing unit **16**. The output device **18** is preferably an active matrix, liquid crystal display, and produces a live viewfinder image. However, those skilled in the art will realize that the output device **18** could be any variety of other types of conventional display devices such as a flat panel display or a CRT. The output device **18** may also include LEDs or other types of lights as status indicators. The signal processing unit **16** is also coupled to the computer **20** to store images gathered by the imaging device **14** and for further processing and display of such images.

Referring now to FIG. **2**, the imaging device **14** is shown in more detail. The imaging device **14** preferably comprises a lens **23** having an iris, a filter **24**, an image sensor **26**, a timing generator **30**, an analog signal processor **32**, an analog-to-digital (A/D) converter **34** and one or more motors **46**. Light passes from the object **12** along an optical path **28** through the lens **23** and the filter **24** to the image sensor **26**. The lens **23**, the filter **24** and the image sensor **26** are preferably disposed in succession coaxially along the optical path **28**. The lens **23** is preferably a close-up lens and a fixed focus lens, however, lens **23** could be any plurality of lens providing for adjustment to focus on different parts of the image received, as will be understood to those skilled in the art. The filter **24** preferably includes an infrared filter and an ultraviolet filter such that visible light is passed to the image sensor **26**, while wavelengths of infrared and ultraviolet light are absorbed. The filter **24** may also include optical low and high pass filters of various wavelengths of visible light as known to those skilled in the art. Additionally, the filter **24** preferably includes a "color filter array" on the image sensor **26** for receiving a color image. Those skilled in the art with realize that alternatively, a beam splitter and 3 separate CCD sensors, one for each color, may be used.

The image sensor **26** is disposed in coaxial alignment with the optical path **28**, and is positioned to receive filtered light containing image data from the filter **24**. Filtered light is received by the image sensor **26** which is preferably a charge coupled device (CCD) that records image data as an array of analog voltages. The image sensor **26** measures the illumination of the filtered light on a pixel by pixel basis, and outputs a two-dimensional array of corresponding analog voltages to the analog signal processor **32**. The image sensor **26** is coupled to the timing generator and driver **30** that provides signals for reading out the analog voltages from the CCD **26**. The timing generator and driver **30** includes an internal clock and other control circuitry, that periodically directs the image sensor **26** to receive image data corresponding to the object **12** and output the data to the analog signal processor **32**. The timing generator and driver **30** also has an input coupled to receive control signals on a line **38** of the electronic interface **22**. The control signals applied to line **38** specify the focus, exposure and balance by indicating the frequency at which the data in the image sensor **26** is output and essentially provide exposure control. The control signals include signals setting the exposure time and the modes of the sensor **26** (i.e., flush sensor in preparation for image capture, expose image, shift image data array, etc.) These signals are used as in conventional video cameras to sample the image at a single, fixed rate (60/sec for NTSC), or as in digital still cameras were the sampling rate can have several "rates" of capture, or can do it "one at a time". Also, the control signals provide for sub-sampled capture (such as every other line, or every other line pair, etc.,) for collecting data to focus and set exposure, where basic image information is needed but the computational expense of gathering and processing full image data is not required.

The analog signal processor **32** has a data input, a control input and a data output. The data input is coupled to the output of the image sensor **26** to receive the image data. The control input is coupled to line **40** of the electronic interface **22** for receiving control signals to specify how the analog signal processor **32** will manipulate the image data received from the image sensor **26**. One such control signal provides gain control for the ASP (AGC circuitry in DSP or computer feed back to set gain). For example, typical operations that the analog signal processor **32** will perform include double correlated sampling (DCS), dark level clamping, level shifting, gain control, and other industry standard signal conditioning techniques designed to improve the quality of the data captured by the A/D. Once the image data has been processed by the analog signal processor **32**, it is output on line **42**. The output of the analog signal processor **32** is coupled by line **42** to the input of the A/D converter **34** to provide the analog image signals. The A/D converter **34** converts the analog voltages to corresponding digital values,

on a pixel by pixel basis, and outputs the digital array on line **36** to the signal processing unit **16**.

The imaging device **14** also includes one or more motors **46** for controlling the position of the lens **23** from the image sensor, its focus and the size of an iris that is part of the lens **23**. In an exemplary embodiment, the motors **46** include a focus motor, an iris motor and a zoom motor. The exposure is adjusted by changing the exposure time (sampling rate of time generator **30**), the ASP gain (gain of analog signal processor **32**), and the iris (iris motor). The focus of the image on the image sensor **26** is modified using the focus motor and any zooming is controlled by moving the lens **23** or some lens elements with respect to the image sensor **26** using the zoom motor. The motors **46** are preferably a conventional type known in the art. The motors **46** are coupled to line **44** to receive signals for controlling the focus motor, the iris motor and the zoom motor. For ease of understanding the effect of the motors on the lens **23** that includes an iris is shown by the dashed line **48**.

Referring now to FIG. **3**, the computer **20** is shown in more detail. The computer **20** preferably comprises a central processing unit (CPU) **50**, a memory card **52**, a buffer **54**, random access memory (RAM) **56**, read-only memory **58**, and an input/output device **60**. The central processing unit (CPU) **50**, the memory card **52**, the RAM **56**, the ROM **58**, and the input/output device **60** are coupled in a von Neuman architecture via a bus **62**. In a first and preferred embodiment, the computer **20** is embedded as part of the system **10** similar to computers in digital cameras. The central processing unit **50** is preferably a microprocessor such as a Motorola 68040. The RAM **56** preferably forms a frame buffer and also includes work space for processing the image data. Additional memory may be provided through the use of the memory card **52**, which preferably includes flash memory. The ROM **58** stores an operating system, start up information, programs for processing the raw data from the CCD **26** into first fully interpolated and color corrected images and then compressed images, and other predetermined routines.

The input/output device **60** is preferably a series of control buttons for selecting an operating mode for the output device **18** such as between normal view and focus assist view. Additional control buttons or mechanisms might also be included for adjusting the focus and other operating parameters of the imaging device **14**. For example, the input/output device **60** includes function buttons, such as shutter buttons, focus and zoom buttons, mode setting buttons, LCD panels, etc. These inputs are processed by the CPU **50** under direction and control of routines stored in RAM **56** and/or ROM **58**, and the operating system stored in ROM **58**. The CPU **50** generates control signals that are provided to the imaging device **14** via line **76** through the signal processing unit **16** and the electronic interface **22**. The computer **20** is preferably coupled by line **76** to the signal processing unit **16**. Via line **76**, the computer **20** is able to receive image data for images captured and processed by the imaging device and signal processing unit **16**, respectively. The buffer **54** is preferably a first-in, first-out buffer for temporarily storing image data. The buffer **54** has inputs that are coupled to line **76**. The outputs of the buffer **54** are coupled to the bus **62** for transmitting image data on the bus **62**. The buffer **54** also provides for the transmission of control signals to the signal processing unit **16**. For this application, the buffer **54** has inputs coupled to the bus and outputs coupled to line **76**.

In a second and alternate embodiment, the computer **20** may be a desktop type computer. In such a case, the input/output device **60** also includes a keyboard and mouse type controller. In the second embodiment, the computer **20** is a Macintosh Quadra 800 computer. Those skilled in the art will realize that the computer **20** could also be implemented on an IBM personal computer. Those skilled in the art will further realize that the in the second and alternate embodiment the work space, programs and routines are stored in RAM as opposed to being stored ROM in the embedded computer case (the preferred embodiment).

Referring now to FIG. **4**, one embodiment of the signal processing unit **16** will be described. While the preferred embodiment of the signal processing unit **16** will now be described with reference to specialized hardware, those skilled in the art will understand that the functions of the signal processing unit **16** could be performed by the computer **20** using specialized software if the CPU **50** is fast enough, or if viewfinder update rate can be slower than video "real time." The signal processing unit **16** preferably comprises a digital signal processor **70**, a false contrast unit **72** and a gamma correction unit **74**. The digital signal processor **70** is preferably coupled to the electronic interface **22** and has an input coupled to line **36** for receiving the image data produced by the imaging device **14**. The digital signal processor **70** also has outputs coupled to lines **38**, **40** and **44** of the electronic interface **22** for controlling the focus, balance and exposure for the image captured by the imaging device **14**. The digital signal processor **70** also has inputs and outputs coupled to a bi-directional line **76** for communicating with the computer **20**. The signal processing unit **16** is preferably constructed as an application specific integrated circuit (ASIC) with the functionality described below. Thus, while the signal processing unit **16** will now be described as including the false contrast unit **72** and the gamma correction unit **74**, these functions may be performed by the digital signal processor **70** and its associated memories and registers with the appropriate routines and data stored therein.

The digital signal processor **70** receives image data in the form of an array of digital pixel values from the imaging device **14**. The digital signal processor **70** processes these digital pixel values in a conventional manner and applies color corrections and other transformations to the input image data such as for resolution adjustment and for transforming the data to different color spaces. The digital signal processor **70** also process the image data to provide a variety of statistics such as luminance, chrominance and focus in a conventional manner. The focus statistics preferably include contrast information. These statistics are also used in a conventional manner to produce the control signals applied on lines **38**, **40** and **44** of the electronic interface **22**. Essentially, the digital signal processor **70** produces a stream of bits that can be utilized by the output device **18** (i.e., video data of an appropriate format) from the two-dimensional array of digital pixel values received from the imaging device **14**. The data from the image sensor **26** is preferably color space sub-sampled (i.e., only one color per pixel is sampled). Thus, the digital signal processor **70** reconstructs a full set of color values for each pixel, either RGB, CMY, or YCC/YUV, depending on the desired output format.

The digital signal processor **70** has an output coupled to the false contrast unit **72** for providing image data. The data can also be output on line **76** and then be stored in the buffer **54** of the computer **20** for additional processing as desired. The digital signal processor **70** is also coupled to receive input control signals from the computer **20** along line **76**. In an alternate embodiment, the signal processing unit **16**, in particular the digital signal processor **70**, may be connected

directly to one or more buttons for inputting signals to control the focus and the type of display presented to the user, either normal view or a view with a contrast overlay highlighting the areas in focus.

The digital signal processor **70** also outputs the stream of bits that will produce the image on the output device **18** to the false contrast unit **72**. The false contrast unit **72** reduces the brightness of the signal received and superimposes a signal whose brightness is proportional to the contrast in the image. This effectively produces a false color image over the viewfinder image, with the areas that are in focus highlighted with the false color image. Since the output device **18** has a limited brightness range, the brightness of the original signal is reduced by 50%, for example, and the false color image is limited to a brightness range of 50% of the output device **18**, for example, in the preferred embodiment described below. However, those skilled in the art will realize that the percentage contribution of the original signal and the false overlay signal are adjustable by the user. For example, the brightness of the original signal might be reduced by 25% and the false color image limited to a brightness range of 25% of the output device **18**.

Once the image signal has been processed by the false contrast unit **72**, it is sent to the gamma correction unit **74** for additional processing before display. The false contrast unit **72** outputs the stream of bits to the gamma correction unit **74**. The gamma correction unit **74** applies a conventional gamma correction and the data is output by the gamma correction unit **74** on line **21**. Gamma is a standard non-linear adjustment of the intensity of the data to compensate for the characteristics of the display device. Data from the image sensor **26** typically has a gamma of 1.0 - linear. Typical CRT monitors require a gamma of about 1.8 to 2.3. Thus, output of the image sensor **26** is corrected by the gamma correction unit **74** according the needs of the output device **18** so that the data is displayed correctly for viewing. The output of the gamma correction unit **74** is provide on line **21** to the output device **18**. Those skilled in the art will realize that in alternate embodiment the gamma correction unit **74** may be coupled between the digital signal processor **70** and the false contrast unit **72**.

The false contrast unit **72** will now be described with reference to the functional block diagram of FIG. **5**, however, as was noted above, these functions are preferably performed by the digital signal processor **70** and its associated memories and registers. Nonetheless, the false contrast unit **72** could be constructed of dedicated hardware components in an alternate embodiment. The false contrast unit **72** preferably comprises a signal divider **90**, an automatic gain control (AGC) unit **92**, an adder **94**, a signal reducer **96**, and a signal combiner **98**. The signal divider **90** has an input that receives the stream of bits representing the image from the digital signal processor **70**. The signal divider preferably divides the signal into the channels comprising the signal. While the present invention will now be described with respect to an RGB color space, those skilled in the art will understand that the present invention may also operate in other color spaces such as CMY or YUV. In the preferred embodiment, the stream of bits represents the image in a RGB format, and is divided in a conventional manner into a Red channel signal, a Blue channel signal and a Green channel signal. The signal divider **90** provides three outputs each providing a respective channel signal. These three outputs of the signal divider **90** are coupled to corresponding inputs of signal reducer **96**. A fourth output of the signal divider **90** provides a luminance signal and the fourth output is coupled to an input of the AGC unit **92**. In an exemplary embodiment, the luminance signal is the Y value in YCC/YUV systems, or can be computed from the RGB or CMY values. The green value can be used as a good approximation for Y.

The signal reducer **96** preferably has three data inputs: one for receiving the Green channel signal from the signal divider **90**, one for receiving the Blue channel signal from the signal divider **90**, and one for receiving the Red channel signal from the signal divider **90**. The signal reducer **96** preferably reduces the intensity of each channel signal by a percentage. The percentage is adjustable by the user using a percentage decrease signal applied to the control input to the signal reducer **96**. The percentage decrease signal can be produce by a control knob or button that is part of the input/output device **60**. Those skilled in the art will realize the percentage may be varied according to the amount of intensity or highlighting that is desired for the false contrast overlay. Thus, the signal applied to the first input of the signal reducer **96**, the Green signal, is reduced in intensity by a percentage, and provided on the first output of the signal reducer **96** as the Green" signal. Similarly, the signals applied to the second and third inputs of the signal reducer **96**, the Blue and Red signals, are reduced in intensity by the same percentage, and provided on the second and third outputs of the signal reducer **96** as the Blue" and Red" signals, respectively. The signal reducer **96** operates in a conventional manner to reduce the intensity of each channel signal such as for example by performing a right shift by half the number of bits defining the intensity for a 50% reduction. In an alternate embodiment, the signal reducer **96** includes a shift register for performing such a right shift operation.

The input of the AGC unit **92** is coupled to the signal divider **90** to receive a luminance signal. The AGC unit **92** controls the gain of over an entire frame. More specifically, the gain is set by the output signal from the conversion circuit **93** so that the peak value for an entire frame is at the level required. The AGC unit **92** preferably performs two operations on the input luminance signal. First, the signal is filtered such as by using a conventional FIR or IIR high-pass filter. In an exemplary embodiment, the absolute value of the signal is also taken. The filter receives the signal and produces an signal whose intensity is proportional to the contrast in the image. (i.e., proportional to the absolute value of the rate of change in the signal). For example, the greater the contrast between adjacent pixels of the image, the greater the intensity of the signal. Second, the signal output by the filter is the provided to an automatic gain control circuit where the gain on the signal output by the filter is limited so that when added to the output of the signal reducer **96**, the sum totals 100%. In one embodiment, the "percentage decrease" signal applied to adjust the amount the signal reducer **96** reduces the divided video signal is also input to a conversion circuit **93**. The conversion circuit **93** translates the "percentage decrease" signal into a signal that controls the gain of the AGC unit **92**. The conversion circuit **93** effectively subtracts the "percentage decrease" signal from 100% to determine the range to which the gain of the AGC unit **92** should be limited. The input of the conversion circuit **93** is coupled to receive the "percentage decrease" signal and the conversion circuit **93** has an output that is coupled to the gain control input of the AGC unit **92**. Thus, when the output of AGC unit **92** is summed with the output of the signal reducer **96**, the resulting signal is sure to be within the useful range of the output device **18**. For example, if the signal reducer **96** reduces the channel signals by 50%, the automatic gain control circuit will control the gain on the signal output by the filter such that it does not exceed 50%

of the intensity range of the output device **18**. Similarly, if the signal reducer **96** reduces the divided signals to 33%, then the AGC unit **92** is limited to 67%. Those skilled in the art will realize that the automatic gain control circuit can limit the output of the AGC unit to a variety of intensity ranges. Once the signal has been processed by the automatic gain control circuit, it is output by the AGC unit **92**.

In an alternate embodiment of the present invention, the AGC unit **92** receives a contrast signal from contrast circuitry in the digital signal processor **70**. Such a contrast signal from contrast circuitry is conventionally used to control the focusing of the imaging device **14**. If such a contrast signal is available, the filter may be eliminated and the contrast signal provided directly to the input of the automatic gain control circuit, which operates as has been described above.

The output of the AGC unit **92** is coupled to a first input of the adder **94**. The second input of the adder **94** is coupled to the third output of the signal reducer **96** to receive the Red" signal. The adder **94** sums the signals applied to its first and second inputs, and outputs the sum on its output. The output of the adder **94** is coupled to a first input of the signal combiner **98**. The second and third inputs of the signal combiner **98** are coupled to the first and second outputs of the signal reducer **96** to receive the Green" signal and the Blue" signal, respectively. The signal combiner **98** merges the three signals applied to its inputs to generate a signal in RGB format that can be used by the output device **18**. The signal combiner **98** operates in a conventional manner performing effectively an inverse function of that performed by the signal divider **90**. The resulting combined signal is output on line **21** and provides a view of the image gathered by the imaging device **14**, but reduced in intensity and having a false contrast overlay on the red channel. The resulting output device **18** will show bright red, for the preferred embodiment, around the edges of the objects that are in focus in the image. Less well focused objects will have less red highlights, and out of focus object will have no red highlighting. This additional highlighting in the image produced on the output device **18** advantageously allows the user to quickly and easily identify what an portions of an image are used by an auto focus mechanism, and whether any manual adjustment to the focus is necessary.

While the preferred embodiment of the present invention only produces a false contrast overlay for the Red channel (i.e., red highlighting), those skilled in the art will realize that various other channels or combinations of channel signals may be used to provide highlighting. Alternatively, the blue channel or the green channel may be used processed through the AGC unit **92** and the adder **94** instead of the Red channel in a similar manner as has been described above to produce a blue or green contrast overlay. Yet another embodiment, might use a combination of channels such as the red and blue channels and provide an AGC unit and an adder for each channel with similar couplings as described above for the red channel.

Referring now to FIG. **6**, a second embodiment **80** of the false contrast unit is shown. This second embodiment **80** of the false contrast unit preferably comprises a high pass filter **82**, an AGC circuit **84**, a gain control circuit **86**, an adder **88** and a multiplexer **89**. The second embodiment **80** of the false contrast unit is designed for an analog camera with a real-time (live) viewfinder such as a conventional camcorder. An video signal is received on line **42**, such as from the analog signal processor **32** after being processed in a conventional analog manner to convert the CCD data to video as in an analog video camera. Line **42** is preferably coupled to an input of the high pass filter **82**, an input of the gain control circuit **86** and a first input of the multiplexer **89**. The high pass filter **82** is a resistor capacitor combination as known to those skilled in the art. The high pass filter **82** differentiates the Y from the input video signal to extract the high frequency components (contrast extraction) and produce a contrast signal. The contrast signal is output by the high pass filter **82** which has its output coupled to the input of the AGC circuit **84**. The AGC circuit **84** is a standard automatic gain control circuit and properly adjusts the contrast signal to the operating parameters of the output device **18**. The amplitude of the signal sent to the output device **18** is set for the most pleasing appearance in the viewfinder. This setting is a ratio of the contrast signal to the video signal. In an exemplary embodiment, this ratio is adjustable by the user and set applying the desired values for a video limit signal to the gain control circuit **86** and a contrast limit signal to the AGC circuit **84**. Again, as in the digital embodiment, the user may set the ratio of contrast signal to video to maximize the parameters of the output device such as setting the video limit signal to be X% and setting the contrast limit signal to be (100–X)%. The output of the AGC circuit **84** is applied to a first input of the adder **88**. The other input of the adder **88** is provided by the output of the gain control circuit **86**. The gain control circuit **86** reduces the gain of the video signal and along with the AGC circuit **84** maintains the desired ratio of contrast signal to video signal. The adder **88** sums the two signals applied to its inputs and provides its output to a second input of the multiplexer **89**. The first input of the multiplexer **89** is coupled to line **42** to receive the original video signal, as noted above. The multiplexer **89** also has a selection input coupled to receive a control signal either from a user selection button or from the processor in response to camera software. Thus, by asserting a signal on the selection input of the multiplexer **89**, either a normal view with the video signal unchanged is output or a focus assist view with highlighting for the areas in focus is output. Those skilled in the art will realize that the multiplexer **89** may be eliminated in an alternate embodiment, and that an unmodified video signal could be output by the adder **88** directly by setting the contrast limit signal to 0%, thus, setting the gain of the contrast signal to 0 and setting the video limit signal to 100%, thus, setting the gain of the video signal to 1.

Referring now to FIG. **7**, a flow chart of the preferred method for adjusting the display to provide a false contrast overlay as a focus assist is shown. The preferred method begins in step **100** by receiving a signal representing an image and view type selection. Next in step **102**, the method determines whether the view type selection includes focus highlighting. If the view type selection does not includes focus highlighting (the user selected a normal view), then the method proceeds to step **118**. In step **118**, the image is displayed on the output device **18** using the signal that was received in step **100** and then the method ends. However, if the view type selection is with focus highlighting then the method continues in step **104**. In step **104**, the method separates the signal received in step **100** into its constituent channel signals. Then in step **106**, a luminance signal is received or is generated from the channel signals. For the preferred method, a luminance signal is received as part of the input. Alternatively, the green channel can be used if it has sufficient bandwidth. Next in step **108**, a contrast signal that highlights the large contrasts in the image is produced from the luminance signal. In step **110**, the method adjusts the contrast signal to range between a percentage, X, of the brightness displayable by the output device **18**. In the

preferred embodiment, the contrast signal ranges between 0% and 100%. Then in step **112**, each of the individual channel signals is reduced or adjusted to be about a percentage of (100%–X) of the brightness displayable by the output device **18**. In step **114**, the adjusted contrast signal produced by step **110** and the reduced selected channel signal produced by step **112** are combined. This combination is preferably accomplished by adding the adjusted contrast signal produced in step **110** to the reduced red channel signal produced in step **112**. While the Red channel is used in the preferred embodiment, those skilled in the art will realize that other channels such as Blue or Green or combinations there of may be used. Finally in step **116**, the image is displayed using the combined signal from step **114** and the reduced versions of the blue and green channels from step **112**.

Referring now to FIGS. **8**A–**8**D, graphical representations of a screen **200** of the output device **18** with various views displayed is shown. FIG. **8**A illustrates the screen **200** showing a normal view of an image having three objects **202**, **204** and **206**. The image is displayed without a false contrast and there is no indication to the user which portions of the image are in focus and which are not. FIG. **8**B illustrates the screen **200** of the output device **18** showing an image with the focus assist view of the present invention activated. This view indicates that the imaging device **14** is focusing on the middle object **204**. This is clearly presented to the user because of the highlighting about the portion of the image that is in focus. While the actual image would show the border of object **204** highlighted in red, the figure shows the borders in bold for demonstration purposes. Assuming the middle object **204** was not of interest to the user, but rather the rightmost object **206** was of interest, the focus could be adjusted manually (or the user could command the auto focus system to focus closer or farther away, or move a selection pointer to the object desired to be in focus) and the focus assist view would provide the user with clear feedback as to when the rightmost object **206** was in focus, such as illustrated in FIG. **8**C. The user is able to quickly and easily identify the portion of the image because of the highlight created by combining the false contrast signal with a reduced version of the original image signal. If the leftmost object **202** were in focus, this would be displayed by the focus assist view as shown in FIG. **8**D.

While the present invention has been described with reference to certain preferred embodiments, those skilled in the art will recognize that various modifications may be provided. These and other variations upon and modifications to the preferred embodiment are provided for by the present invention which is limited only by the following claims.

What is claimed is:

1. An apparatus for generating a contrast false color overlay as a focus assist from an input signal, the apparatus comprising:

a signal reducer having an input and an output, the input of the signal reducer coupled to receive the input signal, the signal reducer reducing the amplitude of the input signal by a predetermined amount;

an automatic gain control unit having an input and an output for producing a contrast signal whose amplitude is proportional to the contrast in an image, the input of the automatic gain control unit coupled to receive the input signal; and

an adder having a first input, a second input and an output for summing two signals, the first input of the adder coupled to the output of the signal reducer, the second input of the adder coupled to the output of the automatic gain control unit.

2. The apparatus of claim **1**, wherein said automatic gain control unit also adjusts the amplitude of the contrast signal to a predetermined range.

3. An apparatus for generating a contrast false color overlay as a focus assist from an input signal, the apparatus comprising:

a divider having an input and a plurality of outputs, for dividing the input signal into a plurality of output signals, the input of the divider coupled to receive the input signal;

a combiner having a plurality of inputs and an output for combining a plurality of signals into a single signal; and

a signal reducer having a plurality of inputs and at least a first output and a second output, each of the plurality of inputs coupled to a corresponding one of the plurality of outputs of the divider, the signal reducer decreasing the amplitude of each divided input signal by a predetermined amount, the second output of the signal reducer coupled to one of the plurality of inputs of the combiner;

an automatic gain control unit having an input and an output, for producing a contrast signal whose amplitude is proportional to the contrast in an image, the automatic gain control unit coupled to receive one of the plurality of output signals by coupling the input of the automatic gain control unit to one of the plurality of outputs of the divider, and

an adder having a first input, a second input and an output for summing two signals, the first input of the adder coupled to the first output of the signal reducer, the second input of the adder coupled to the output of the automatic gain control unit, and the output of the adder coupled to one of the plurality of inputs of the combiner.

4. The apparatus of claim **3**, wherein the divider divides the input signal into three channel signals and the combiner combines the three channel signals into the single signal.

5. The apparatus of claim **4**, wherein the divider divides the input into one from the group of RGB channels, CMY channels and YUV channels, and the combiner combines the one from the group of RGB channels, CMY channels and YUV channels into the single signal.

6. The apparatus of claim **4**, wherein the divider divides the input signal into a red channel signal, a blue channel signal and a green channel signal, and a luminance signal is processed by the automatic gain control unit.

7. The apparatus of claim **2**, wherein-the predetermined amount by which the signal reducer reduces the amplitude of the input signal is about 50% of an intensity displayable by a display device, and wherein the predetermined range by which the automatic gain control unit adjusts the amplitude of the contrast signal is about 50% of the intensity displayable by the display device.

8. The apparatus of claim **1**, wherein the automatic gain control unit includes one from the group of an FIR and IIR high-pass filter for generating the contrast signal whose amplitude is proportional to the contrast in the image.

9. An apparatus for generating a contrast false color overlay as a focus assist from an input signal, the apparatus comprising:

a high pass filter having an input and an output, for differentiating a signal to extract high frequency components and produce a contrast signal, the input of the high pass filter coupled to receive the input signal;

an AGC circuit having an input and an output, for limiting the gain of the contrast signal, the input of the AGC circuit coupled to the output of the high pass filter;

a gain control circuit having an input and an output, for reducing the amplitude of the input signal, the input of the gain control circuit coupled to receive the input signal; and

an adder having an first input, a second input and an output, for summing signals applied to the first and second inputs, the first input of the adder coupled to the output of the AGC circuit, the second input of the adder coupled to the output of the gain control circuit.

10. The apparatus of claim **9**, wherein the AGC circuit is an automatic gain control circuit and adjusts the contrast signal to match operating parameters of an output device.

11. The apparatus of claim **9**, wherein the AGC circuit limits the amplitude of the contrast signal to a first predetermined range of values, and the gain control circuit reduces the amplitude of the input signal to a second predetermined values such that the sum of-the contrast signal and the input signal is within a display range of an output device.

12. The apparatus of claim **9**, further comprising a multiplexer having an first input, an second input, an third input and an output, for selectively outputting a signal applied to-the first input or the second input in response to a control signal on the third input, the first input of the multiplexer coupled to receive the input signal, the second input coupled to the output of the adder, and the third input coupled to receive the control signal.

13. A method for displaying a false color contrast overlay as a focus assist on an output device, the method comprising the steps of:

receiving an input signal representing an image;

separating the input signal into channel signals;

receiving a luminance signal;

producing, from the luminance signal, a contrast signal with an amplitude that varies with contrast in the image;

reducing the contrast signal;

reducing the channel signals;

combining the reduced contrast signal with the reduced channel signals to produce a combined signal; and

generating the image on the output device using the combined signal.

14. A method for displaying a false color contrast overlay as a focus assist on an output device, the method comprising the steps of:

receiving an input signal representing an image;

separating the input signal into channel signals;

generating a luminance signal;

producing, from the luminance signal, a contrast signal with an amplitude that varies with contrast in the image;

reducing the contrast signal;

reducing the channel signals;

combining the reduced contrast signal with the reduced channel signals to produce a combined signal; and

generating the image on the output device using the combined signal.

15. The method of claim **14**, wherein the signal representing an image is in RGB format and the combining step adds the reduced contrast signal to a red channel.

16. The method of claim **14**, further comprising the steps of:

receiving a signal indicating a view type selection;

determining whether the signal indicating a view type selection is normal; and

generating the image on the output device using the received signal representing the image if the view type selection is normal.

17. The method of claim **14**, wherein the contrast signal is reduced to range between 0% and 50% of brightness displayable by the output device.

18. The method of claim **14**, wherein the channel signals are reduced to range between 0% and 50% of brightness displayable by the output device.

19. The method of claim **14**, wherein the contrast signal and the channel signals are each reduced such that their sum is about 100% of a displayable range of the output device.

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