

UNIVERSAL, HIGHLY CONFIGURABLE VIDEO AND GRAPHIC MEASUREMENT DEVICE

BACKGROUND

5 Field of the Invention

[0001] This invention generally relates to improving video and graphics quality.

Description of Related Art

[0002] A display device renders input data as a two-dimensional image in color or grayscale. The input data may be graphical in nature. An example of such a device is a
10 PC display monitor. The input data may be a video signal. An example of such a device is a TV or video monitor. The input data may be a combination of graphics and embedded video. An example of such a device is a PC display monitor displaying graphics with one or applications displaying video in a window, or a PC/TV display device with two or more input ports displaying graphics or full-screen video or a
15 combination of graphics and video, e.g. Picture-in-Picture.

[0003] A viewer typically manually controls the color and contrast of a display device. The issue with manual control is that it does not result in optimal display quality for all possible input data. For example, setting the contrast control to increase the contrast of a washed out image will result in over-contrasted images for a normal
20 image. Decreasing the color saturation setting for a highly saturated image would be optimal, but if the input changes to a de-saturated image, this setting would now be sub-optimal. It is not feasible or convenient for a viewer to continuously change display settings to adapt to the nature of the input image, particularly when the input is a video sequence.

[0004] Another problem with manual control of contrast and color is that it is not sensitive to the nature of the input data. Manual contrast control applies a multiplicative factor to the input luma component. Due to the finite dynamic range of luma values, increasing the contrast of a dark image in order to be able to see the shadow details results in loss of information in the bright highlights. The
30 multiplicative nature of this control also implies that there is no possibility of increasing the contrast of a predominantly bright image.

[0005] In order to apply image improvement effects to graphics or video images it is necessary to know the nature of the image content. In order to correctly display graphics or video material on a flat panel display, various qualities of the material

have to be measured. Implementing digital electronics for each of these measurements can be wasteful.

[0006] Therefore, what is needed is a universal, highly configurable measurement device that is more adaptive, flexible, and efficient.

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SUMMARY OF THE INVENTION

[0007] Broadly speaking, the invention relates to increasing the contrast for luminance levels that occur in significant areas of the image. The invention can be implemented in numerous ways, including as a method, system, device, apparatus, or computer readable medium. Several embodiments of the invention are discussed below.

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[0008] In one embodiment, a method of processing a video signal includes at least the following operations, receiving the video signal, analyzing the video signal based upon a user supplied set of instructions, processing the video signal in accordance with the analysis; and outputting the processed video signal.

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[0009] In another embodiment, an apparatus for processing a video signal includes means for receiving the video signal, means for analyzing the video signal based upon a user supplied set of instructions, means for processing the video signal in accordance with the analysis, and means for outputting the processed video signal.

[0010] Other aspects and advantages of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings.

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DESCRIPTION OF DRAWINGS

[0011] Fig. 1 shows a system in accordance with an embodiment of the invention.

[0012] Fig. 2 shows a flowchart detailing a process in accordance with an embodiment of the invention.

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DETAILED DESCRIPTION OF SELECTED EMBODIMENTS

[0013] Reference will now be made in detail to a particular embodiment of the invention an example of which is illustrated in the accompanying drawings. While the invention will be described in conjunction with the particular embodiment, it will be understood that it is not intended to limit the invention to the described embodiment. To the contrary, it is intended to cover alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

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[0014] The purpose of the invention is to provide a universal, highly configurable measurement device that is more adaptive, flexible, and efficient an example of which is illustrated in Fig. 1 as measurement device 100. As illustrated, measurement device 100 includes, video window detector 102 (described in more detail in U.S. Patent Application Serial No. 11/565,464, entitled "Video Window Detector" filed November 30, 2006 which is incorporated by reference in its entirety for all purposes), video content detector 104 (described in more detail in U.S. Patent Application Serial No. 11/613,009, entitled "Video Content Detector" filed December 19, 2006 which is incorporated by reference in its entirety for all purposes), and automatic adaptive contrast control 106 (described in more detail in U.S. Patent Application Serial No. 11/525,276, entitled "Integrated Histogram Auto Adaptive Contrast Control (ACC)" filed September 21, 2006 which is incorporated by reference in its entirety for all purposes) each of which coupled to image analyzer 108. In the described embodiment, user provided input instructions 110 are input to image analyzer 108 that, in turn, uses the received input instructions 110 to analyze input video stream 112. Based upon the analysis, input video stream 112 is forwarded to any or each of video window detector 102, video content detector 104, and automatic ACC 106 for appropriate processing. Once appropriately processed, the processed video stream is output to output interface 114. In some cases, image analyzer 108 determines that no additional image processing is to be performed on input video stream 112 that is, in this case, simply passed through to output interface 114 without additional processing.

[0015] Fig. 2 illustrates a process 200 in accordance with an embodiment of the invention. The process 200 begins at 200 by receiving a video stream at 202 and based upon a user supplied set of instructions that can be used by an image analyzer to analyze the video stream at 204. Based upon the analysis, the video stream can be forward for further processing directly to video window detector at 206, video content detector at 208, and/or automatic adaptive contrast control at 210. It should be noted, however, that based upon the analysis, video stream can remain unprocessed and be passed directly to output at 212. In any case, once either the video stream is processed (or unprocessed as the case may be), the video stream is output at 212. In some cases, the video stream can undergo conditional processing in that the video stream can be processed by, for example, the adaptive contrast control first, followed by other processing such as video window detector. In this way, the invention provides for an integrated approach to processing a video stream that can be implemented as, for

example, a single integrated circuit thereby greatly reducing the time to manufacture, cost of manufacture, and overall cost.

[0016] Embodiments of the invention, including the apparatus disclosed herein, can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. Apparatus embodiments of the invention can be implemented in a computer program product tangibly embodied in a machine-readable storage device for execution by a programmable processor; and method steps of the invention can be performed by a programmable processor executing a program of instructions to perform functions of the invention by operating on input data and generating output. Embodiments of the invention can be implemented advantageously in one or more computer programs that are executable on a programmable system including at least one programmable processor coupled to receive data and instructions from, and to transmit data and instructions to, a data storage system, at least one input device, and at least one output device. Each computer program can be implemented in a high-level procedural or object-oriented programming language, or in assembly or machine language if desired; and in any case, the language can be a compiled or interpreted language.

[0017] Suitable processors include, by way of example, both general and special purpose microprocessors. Generally, a processor will receive instructions and data from a read-only memory and/or a random access memory. Generally, a computer will include one or more mass storage devices for storing data files; such devices include magnetic disks, such as internal hard disks and removable disks; magneto-optical disks; and optical disks. Storage devices suitable for tangibly embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, such as EPROM, EEPROM, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM disks. Any of the foregoing can be supplemented by, or incorporated in, ASICs (application-specific integrated circuits).

[0018] A number of implementations of the invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A method of processing a video signal, comprising:
 receiving the video signal;
 analyzing the video signal based upon a user supplied set of instructions;
 5 processing the video signal in accordance with the analysis; and
 outputting the processed video signal.
2. A method as recited in claim 1, wherein the processing comprises:
 automatically performing adaptive contrast control as required, if any, by the
 analysis.
- 10 3. A method as recited in claim 1, wherein the processing comprises:
 detecting co-ordinates of a video window, if any, as required by the analysis.
4. A method as recited in claim 3, wherein the processing comprises:
 if a video window is detected, then determining a content type of the video in
 the window if required by the analysis.
- 15 5. A method as recited in claim 1, wherein the method is performed by an
 integrated circuit.
6. An apparatus for processing a video signal, comprising:
 means for receiving the video signal;
 means for analyzing the video signal based upon a user supplied set of
 20 instructions;
 means for processing the video signal in accordance with the analysis; and
 means for outputting the processed video signal.
7. A method as recited in claim 1, wherein the processing comprises:
 means for automatically performing adaptive contrast control as required, if
 25 any, by the analysis.
8. An apparatus as recited in claim 1, wherein the processing comprises:
 means for detecting co-ordinates of a video window, if any, as required by the
 analysis.
9. An apparatus as recited in claim 3, wherein the processing comprises:
 30 means for determining a content type of the video in the window if required by
 the analysis if a video window is detected.
10. An apparatus as recited in claim 1, wherein the apparatus is incorporated into
 an integrated circuit.