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Lindahl et al.

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(45) **Date of Patent: Oct. 11, 2016**

(54) **IMAGE ALTERATION TECHNIQUES**

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(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

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(22) Filed: **Sep. 30, 2010**

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(51) **Int. Cl.**
G09G 5/00 (2006.01)
G06T 11/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G06T 11/00*** (2013.01)

(58) **Field of Classification Search**
CPC G06T 11/001; G06T 15/04
USPC 345/581, 619, 473
See application file for complete search history.

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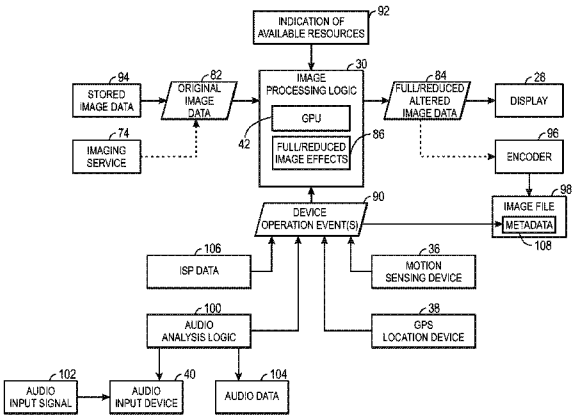
Primary Examiner — Devona Faulk
Assistant Examiner — Jin Ge
(74) *Attorney, Agent, or Firm* — Blank Rome LLP

(57) **ABSTRACT**

Various techniques relating to the alteration of image data are provided herein. An electronic device capable of carrying out such techniques may include data processing circuitry configured to receive image data and detect the occurrence of a device operation event (e.g., an audio event, a motion event, a location event, or an image event, and so forth). The data processing circuitry may alter the image data using a full-quality version or a reduced-quality version of an image alteration effect associated with the device operation event, depending on currently available resources.

23 Claims, 18 Drawing Sheets



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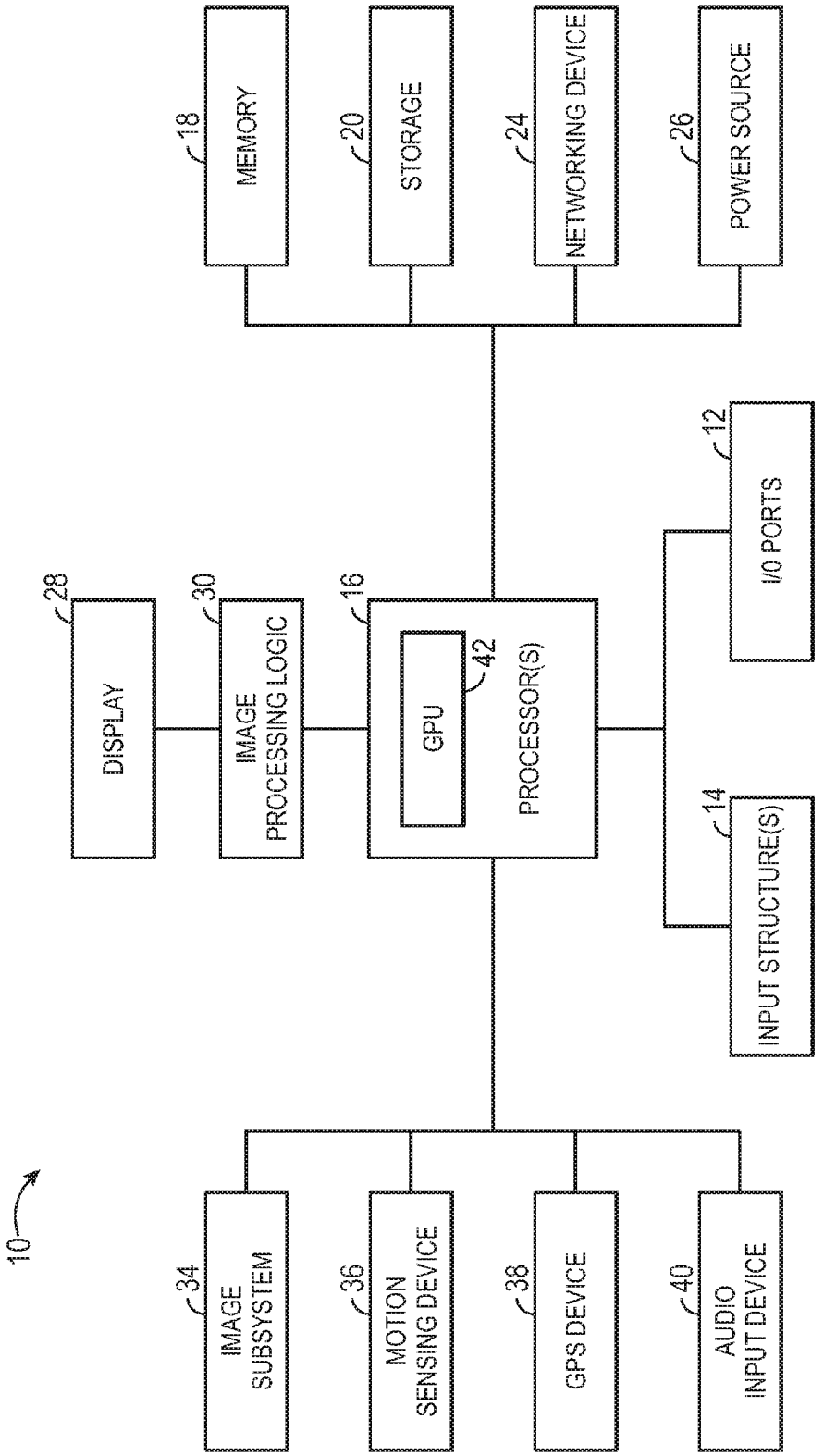
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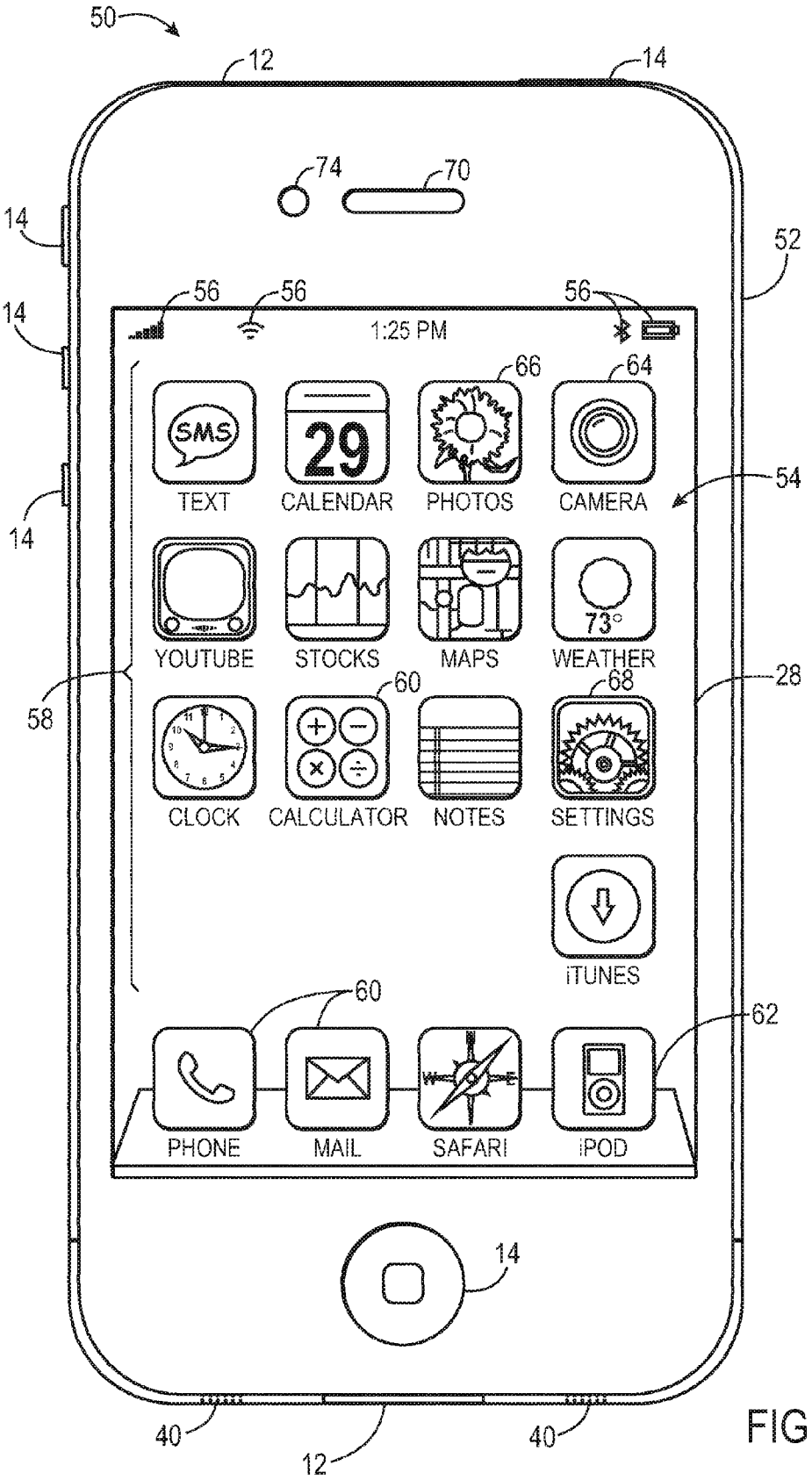
18
MEMORY
20
STORAGE
24
NETWORKING DEVICE
26
POWER SOURCE
28
DISPLAY
30
IMAGE PROCESSING LOGIC
16
GPU
42
PROCESSOR(S)
12
I/O PORTS
14
INPUT STRUCTURE(S)
34
IMAGE SUBSYSTEM
36
MOTION SENSING DEVICE
38
GPS DEVICE
40
AUDIO INPUT DEVICE

FIG. 1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CALENDAR
PHOTOS
CAMERA
54
14
YOUTUBE
STOCKS
MAPS
73°
WEATHER
58
60
68
28
CLOCK
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FIG. 2

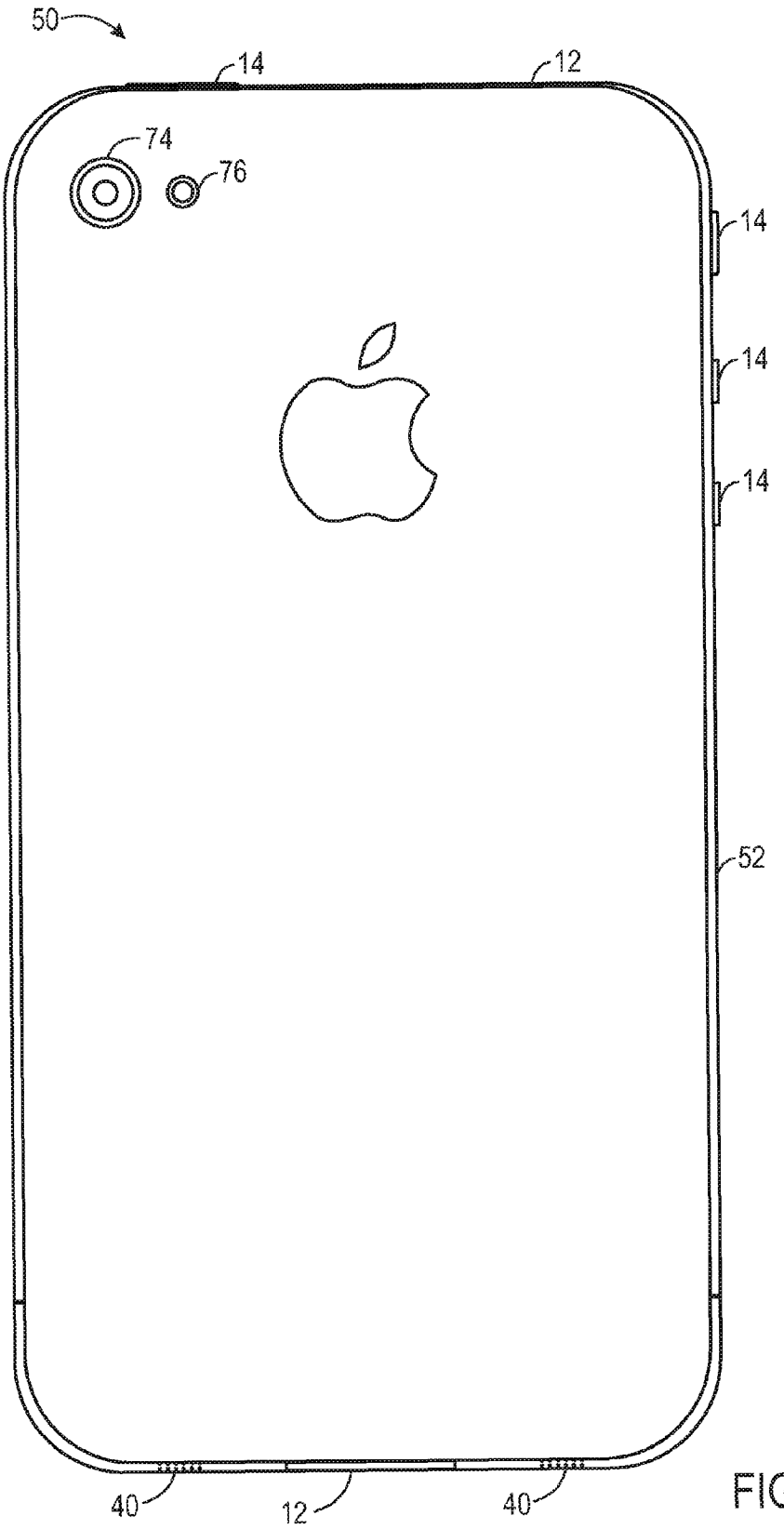
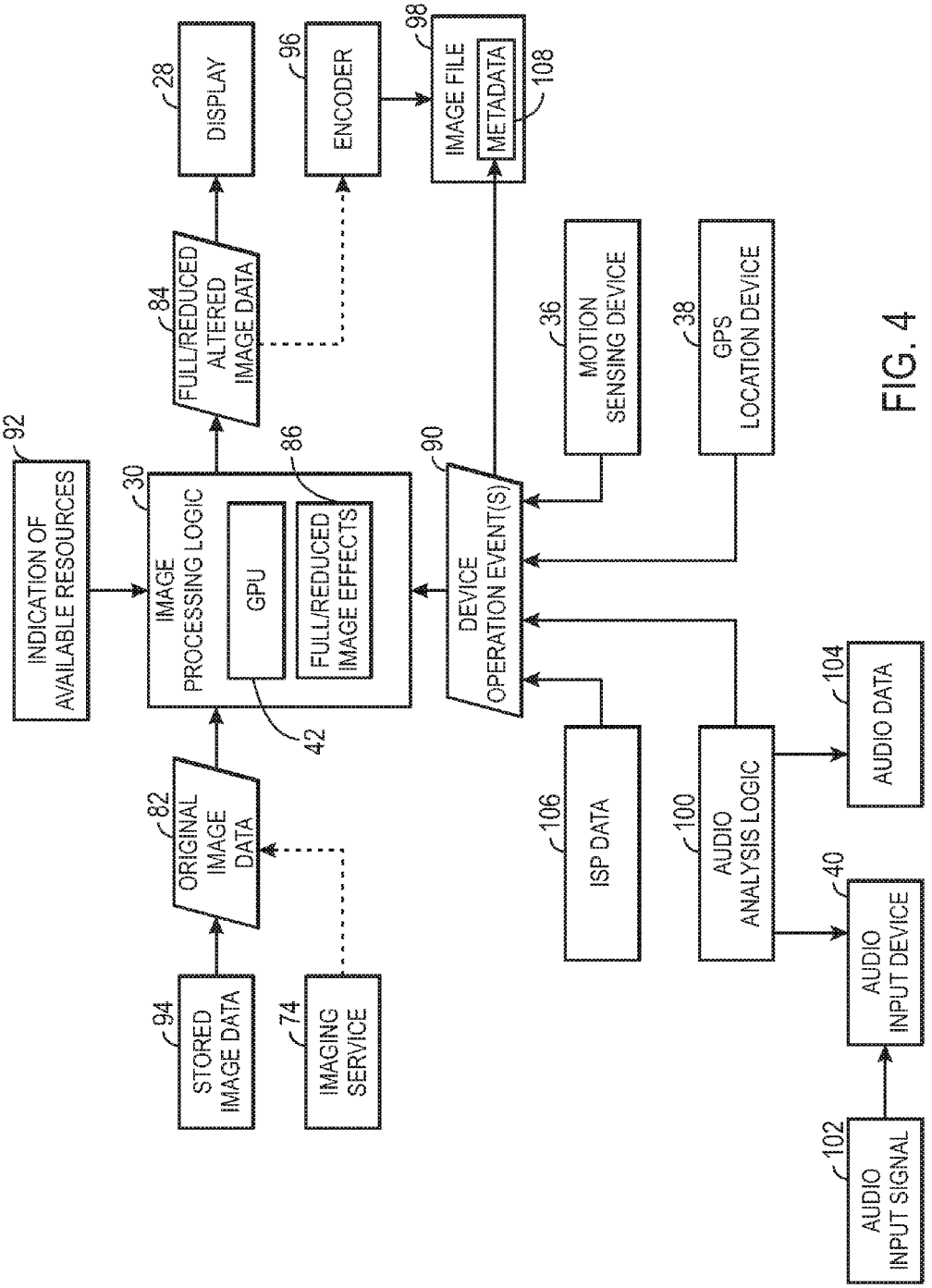


FIG. 3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92
IMAGE PROCESSING LOGIC
30
GPU
42
FULL/REDUCED IMAGE EFFECTS
86
ORIGINAL IMAGE DATA
82
STORED IMAGE DATA
94
IMAGING SERVICE
74
FULL/REDUCED ALTERED IMAGE DATA
84
DISPLAY
28
ENCODER
96
IMAGE FILE
98
METADATA
108
DEVICE OPERATION EVENT(S)
90
MOTION SENSING DEVICE
36
GPS LOCATION DEVICE
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ISP DATA
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AUDIO ANALYSIS LOGIC
100
AUDIO DATA
104
AUDIO INPUT DEVICE
40
AUDIO INPUT SIGNAL
102

FIG. 4

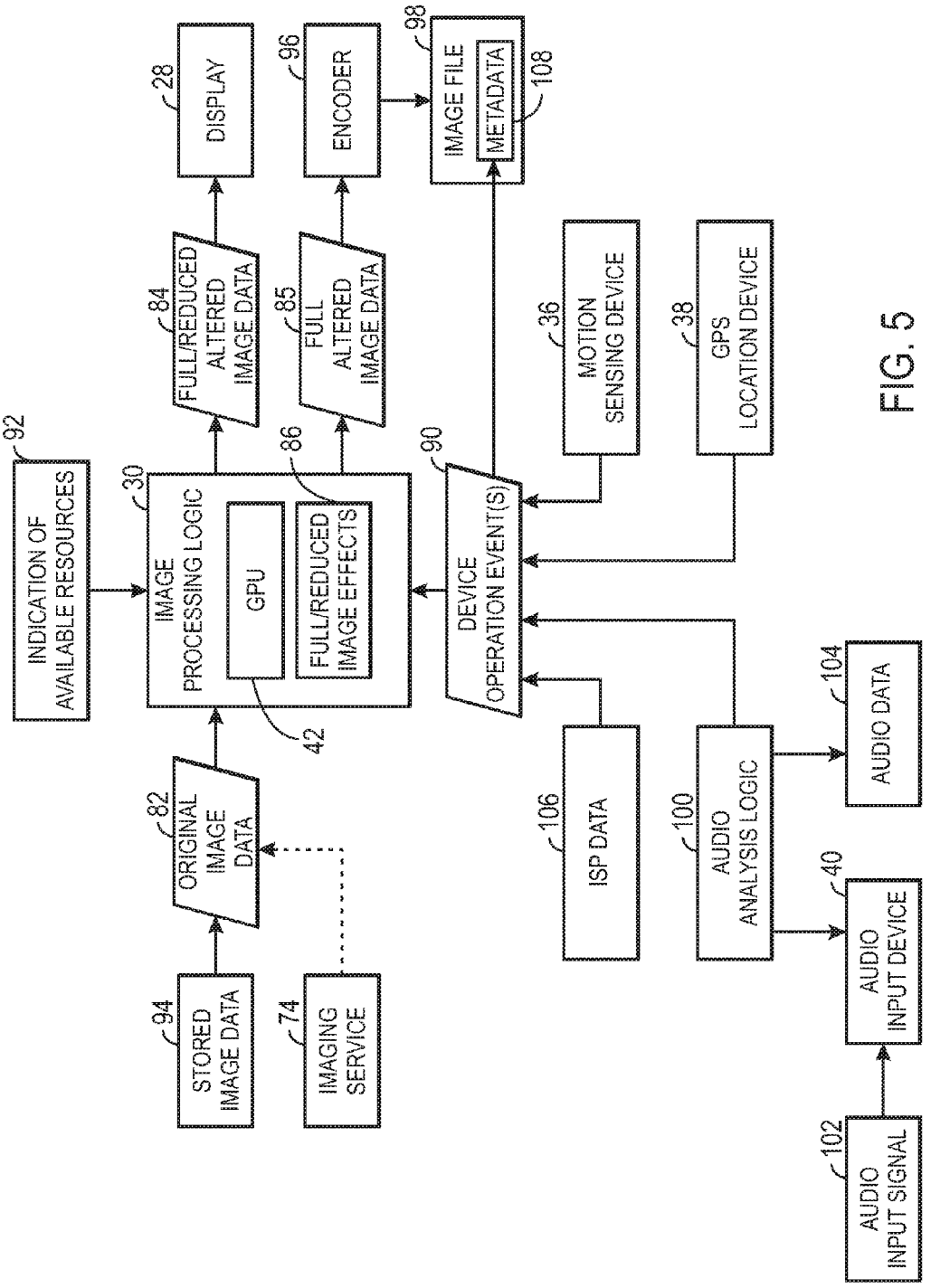
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IMAGE PROCESSING LOGIC
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FULL/REDUCED IMAGE EFFECTS
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STORED IMAGE DATA
94
IMAGING SERVICE
74
FULL/REDUCED ALTERED IMAGE DATA
84
FULL ALTERED IMAGE DATA
85
DISPLAY
28
ENCODER
96
IMAGE FILE
98
METADATA
108
DEVICE OPERATION EVENT(S)
90
MOTION SENSING DEVICE
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GPS LOCATION DEVICE
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ISP DATA
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AUDIO ANALYSIS LOGIC
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AUDIO INPUT DEVICE
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AUDIO INPUT SIGNAL
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FIG. 5

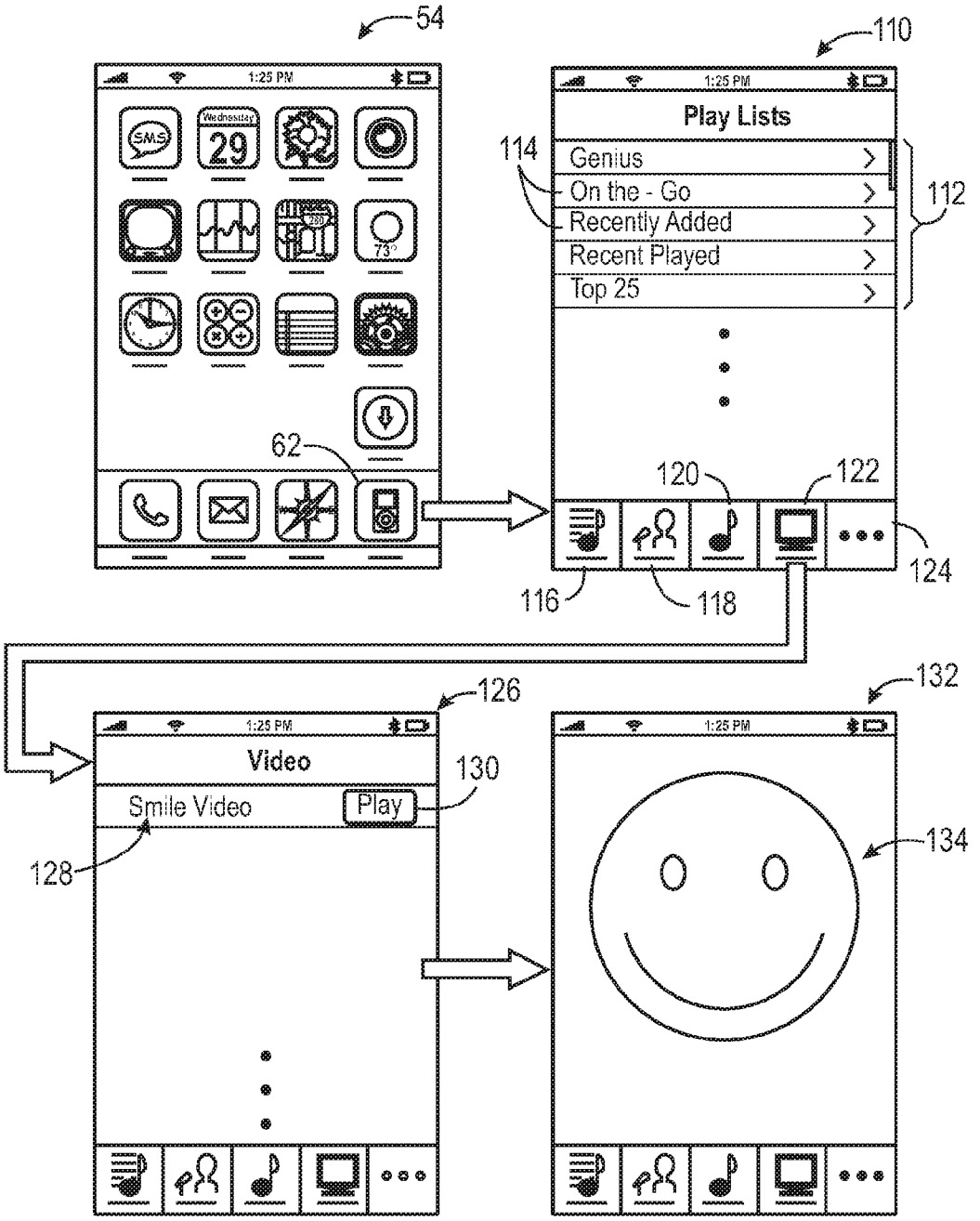

54
110
1:25 PM
Play Lists
Genius
On the - Go
Recently Added
Recent Played
Top 25
114
112
62
120
122
124
116
118
126
132
Video
Smile Video
Play
130
128
134

FIG. 6

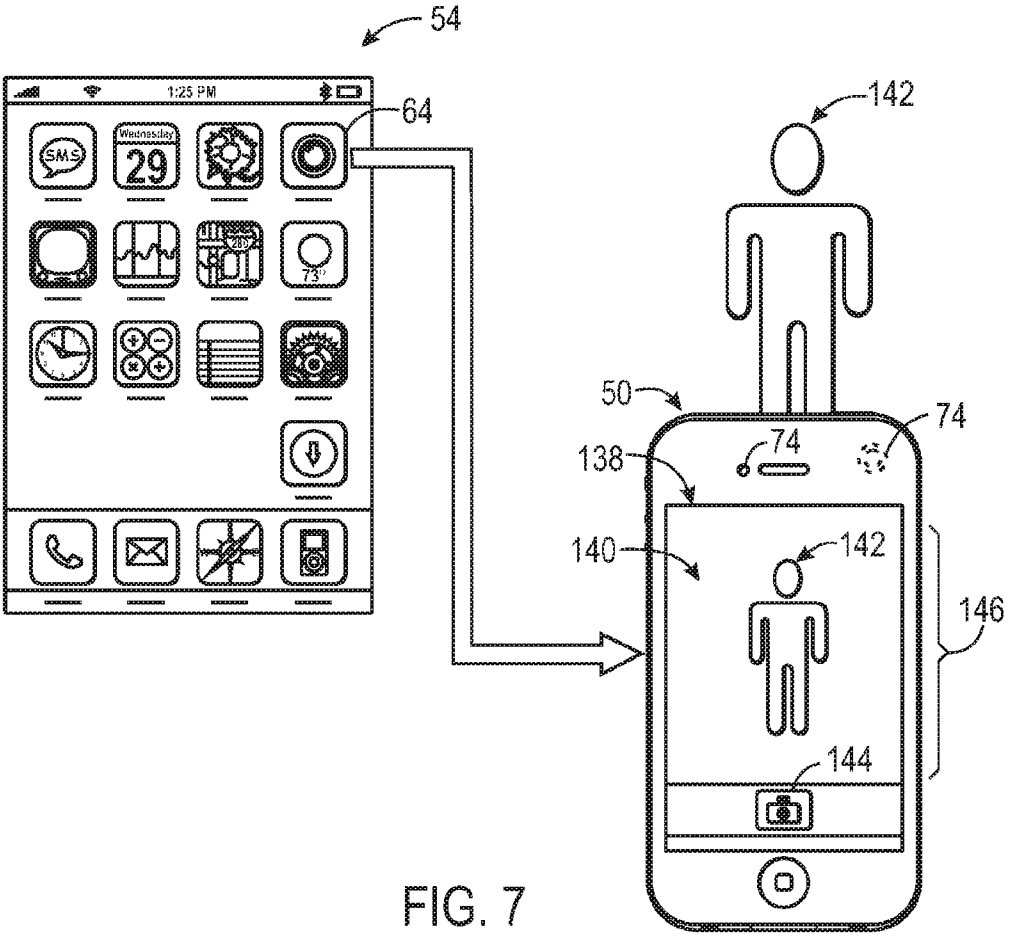
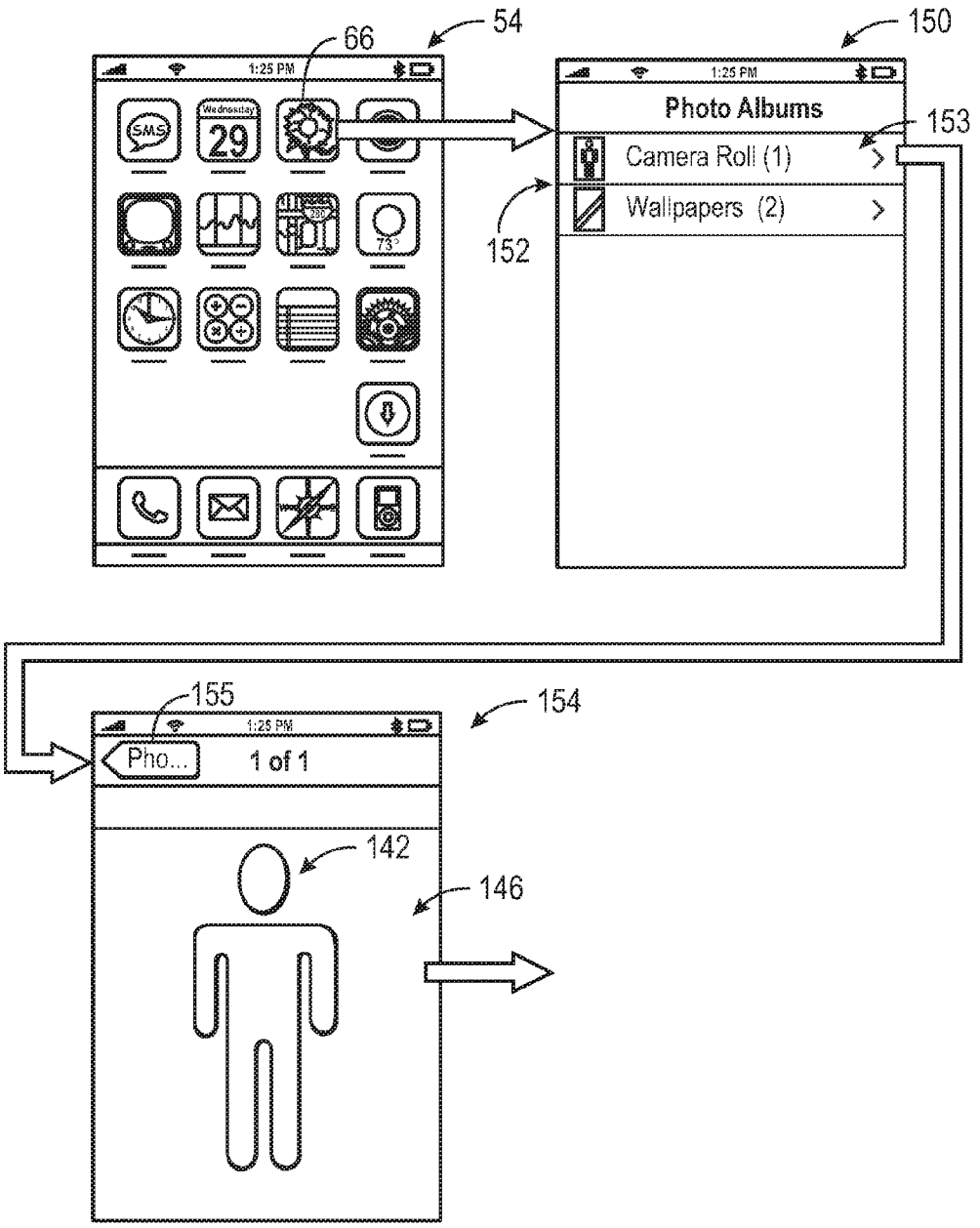


FIG. 7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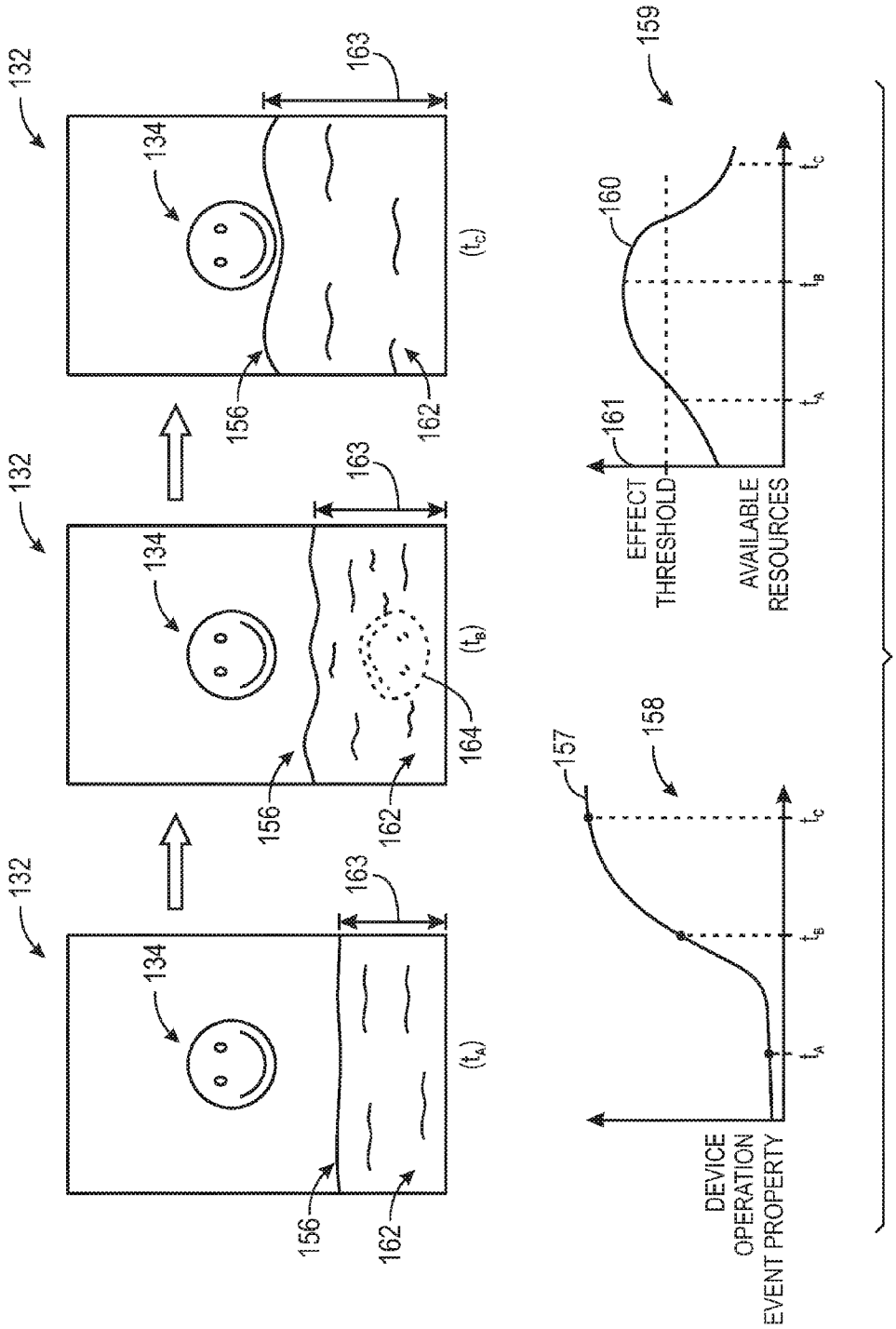
66
150
1:25 PM
Photo Albums
153
Camera Roll (1)
Wallpapers (2)
152
155
154
Pho...
1 of 1
142
146

FIG. 8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134
156
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164
(t_B)
132
134
156
162
163
(t_C)
157
158
DEVICE OPERATION EVENT PROPERTY
t_A
t_B
t_C
159
160
161
EFFECT THRESHOLD
AVAILABLE RESOURCES
t_A
t_B
t_C

FIG. 9

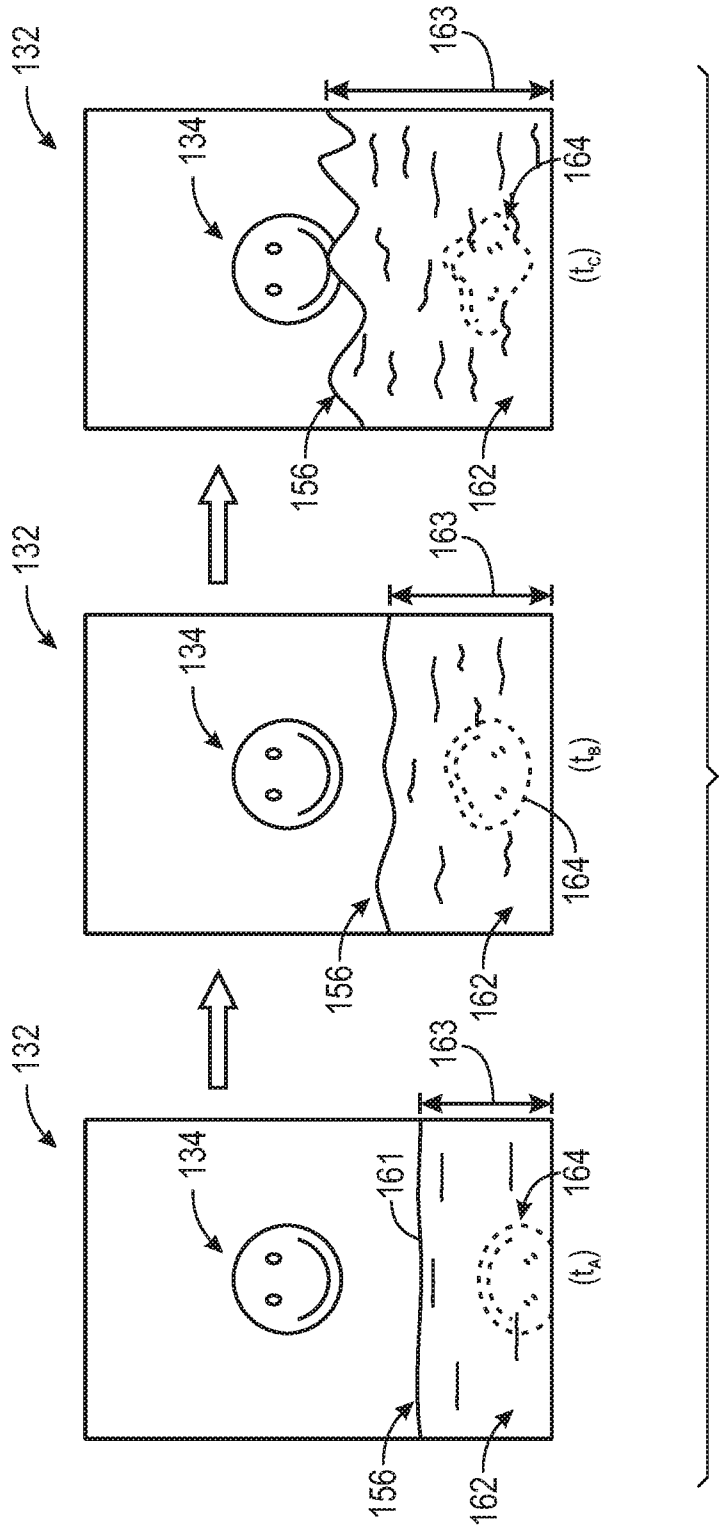


FIG. 10

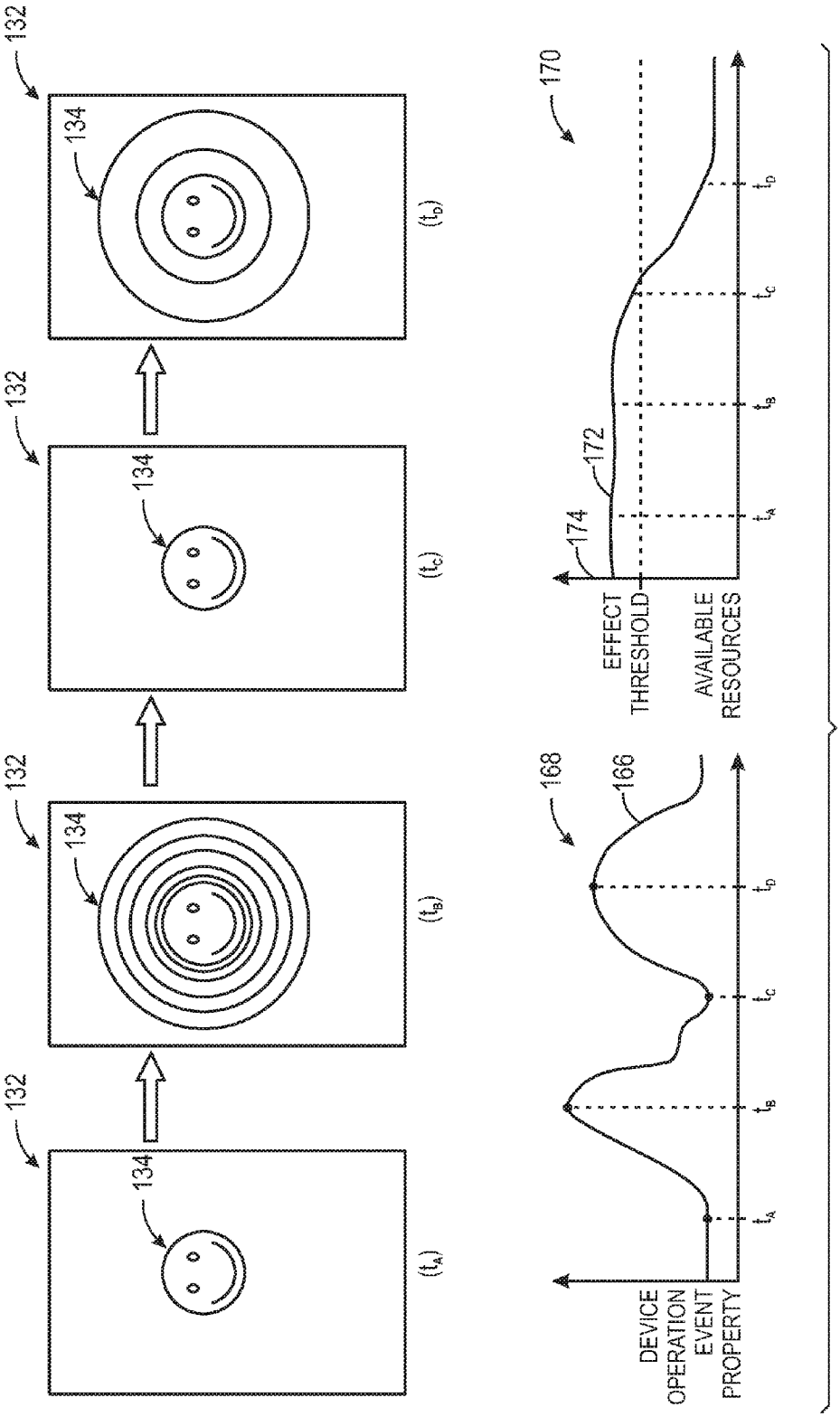
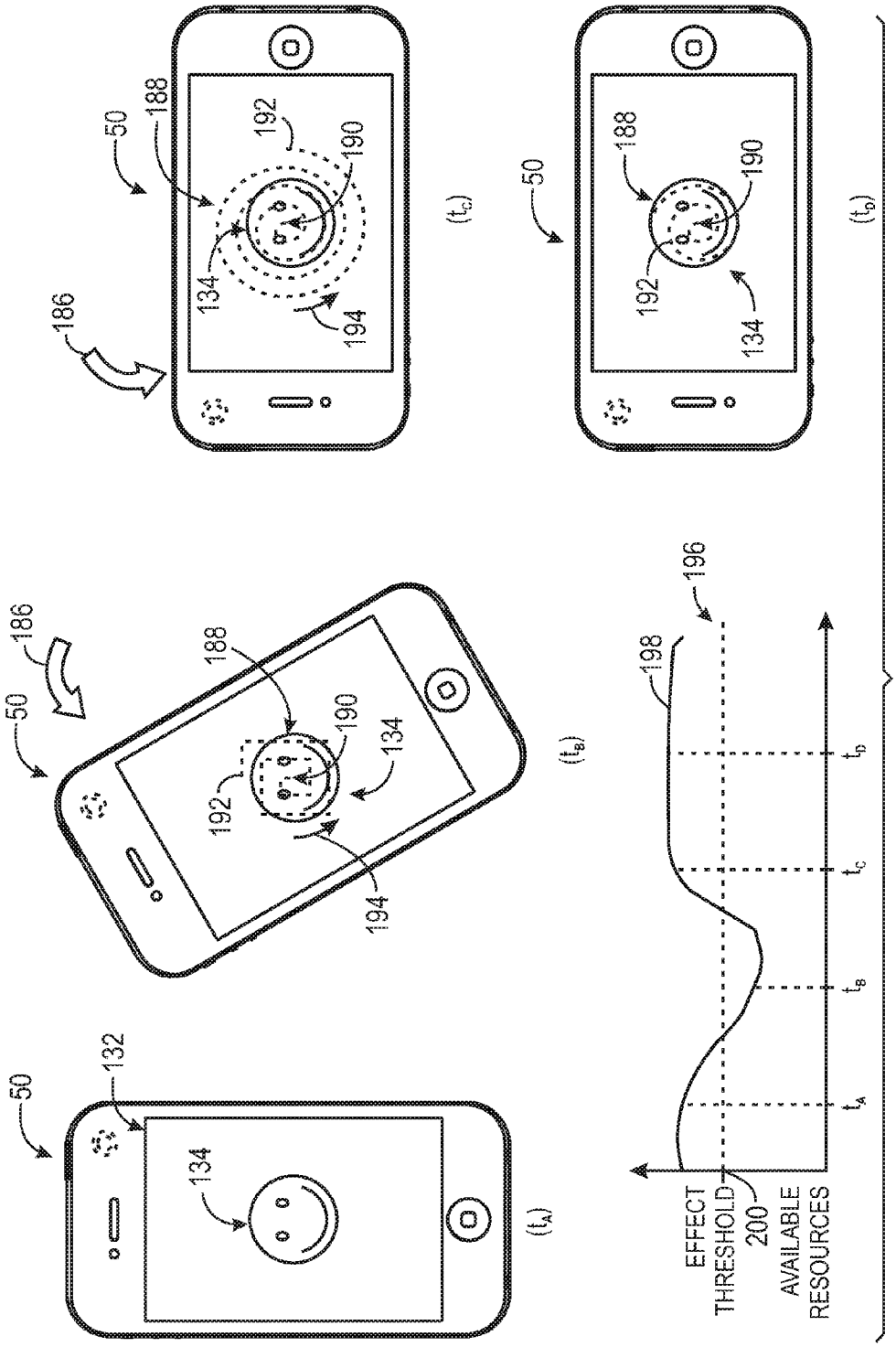

132
134
(t_A)
(t_B)
(t_C)
(t_D)
168
166
DEVICE OPERATION EVENT PROPERTY
170
172
174
EFFECT THRESHOLD
AVAILABLE RESOURCES

FIG. 11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134
(t_A)
186
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188
192
190
134
194
(t_B)
186
50
188
192
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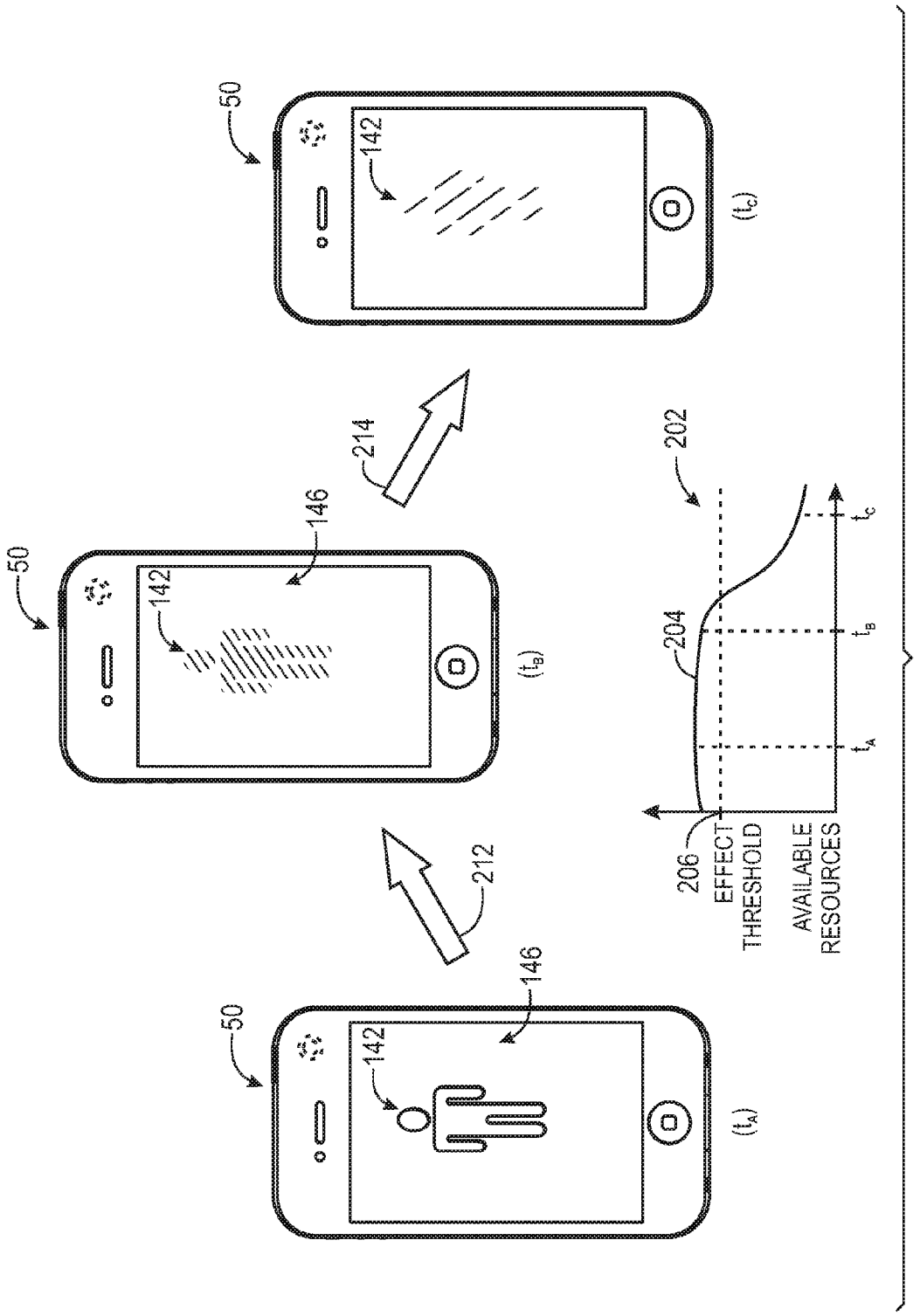
194
(t_C)
50
188
190
192
134
(t_D)
196
198
EFFECT THRESHOLD
200
AVAILABLE RESOURCES
t_A
t_B
t_C
t_D

FIG. 12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214
202
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EFFECT THRESHOLD
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t_A
t_B
t_C
(t_A)
(t_B)
(t_C)

FIG. 13

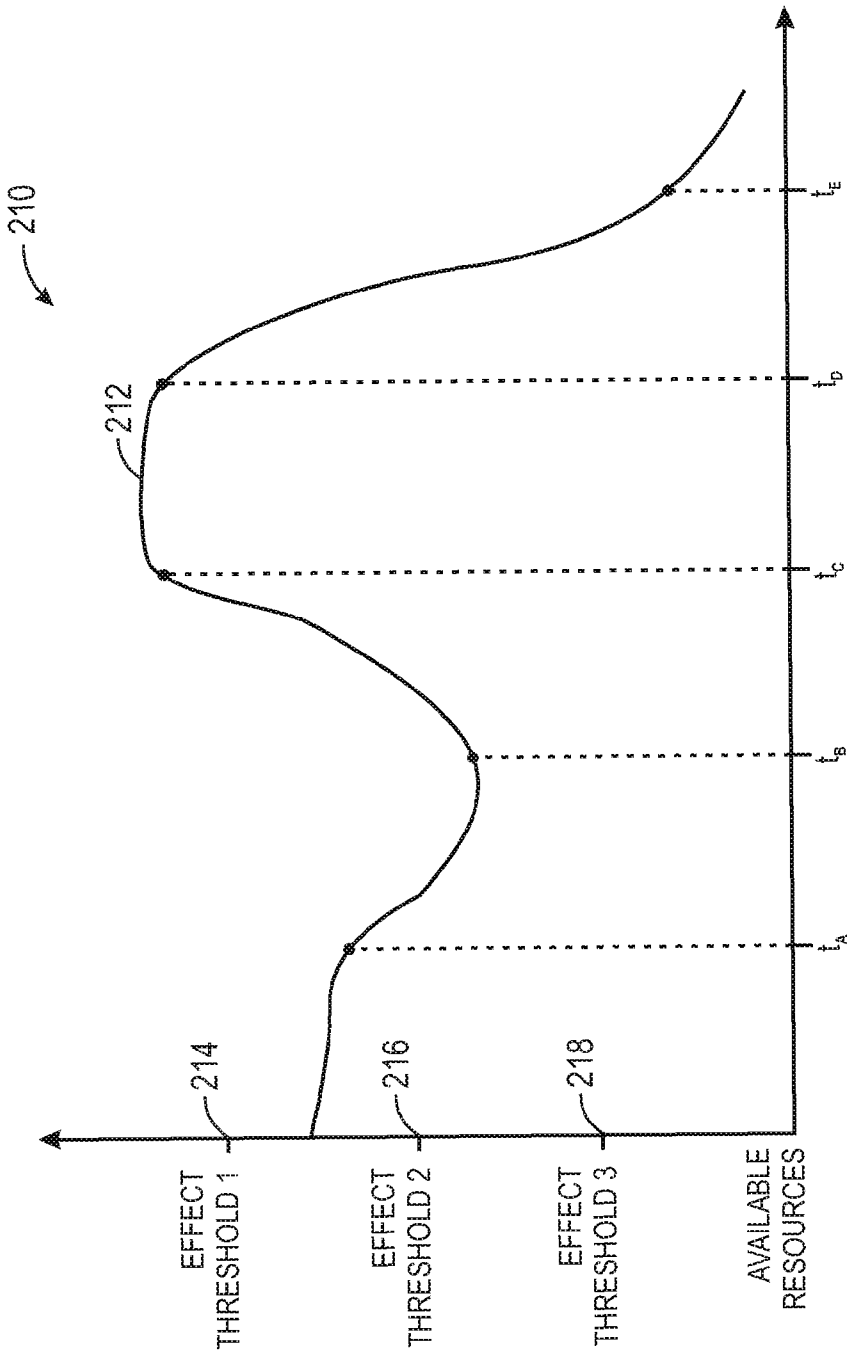
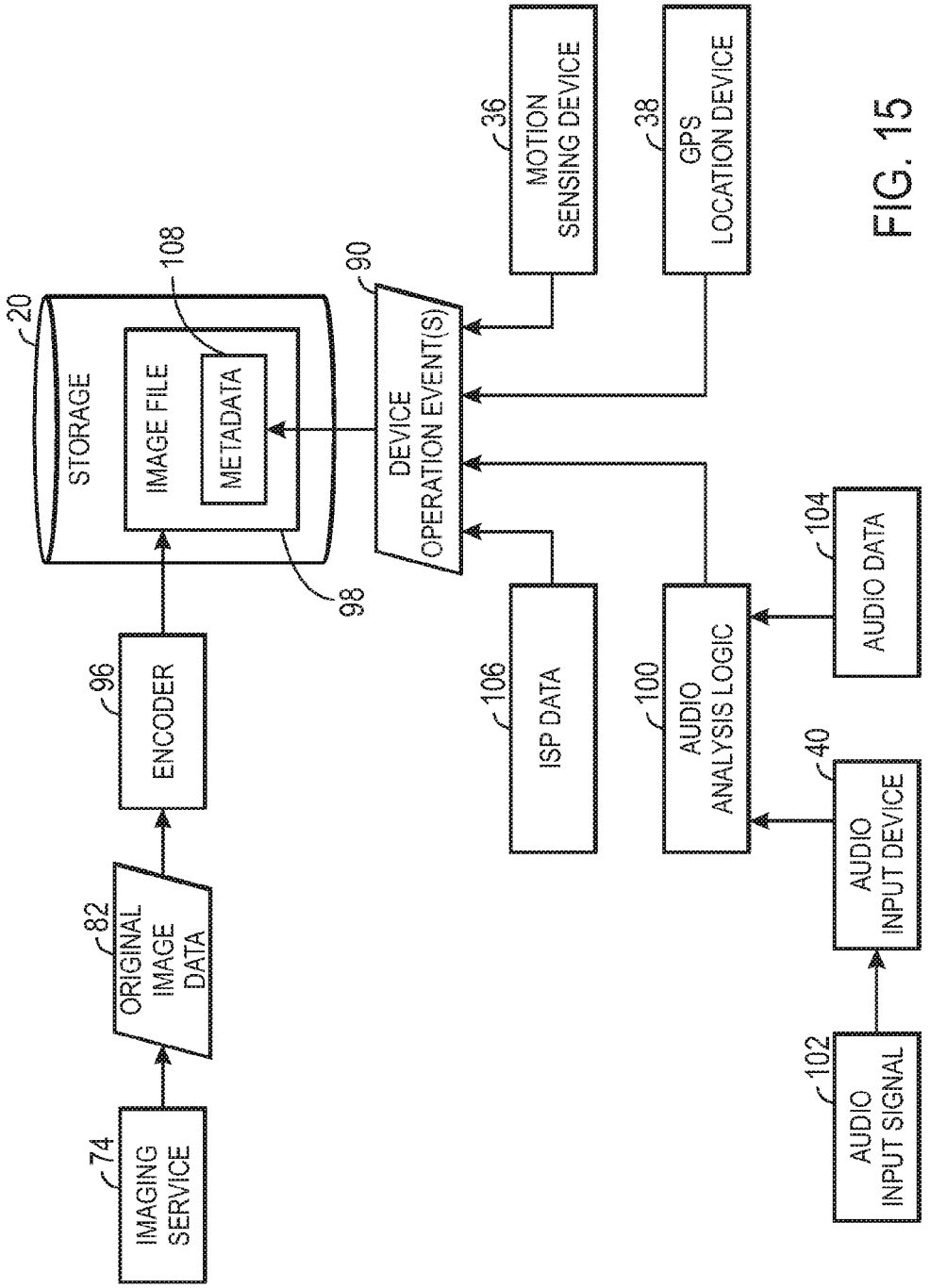

210
212
214
216
218
EFFECT THRESHOLD 1
EFFECT THRESHOLD 2
EFFECT THRESHOLD 3
AVAILABLE RESOURCES
t_A
t_B
t_C
t_D
t_E

FIG. 14


IMAGING SERVICE
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ORIGINAL IMAGE DATA
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ENCODER
96
STORAGE
20
IMAGE FILE
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108
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DEVICE OPERATION EVENT(S)
90
MOTION SENSING DEVICE
36
GPS LOCATION DEVICE
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FIG. 15

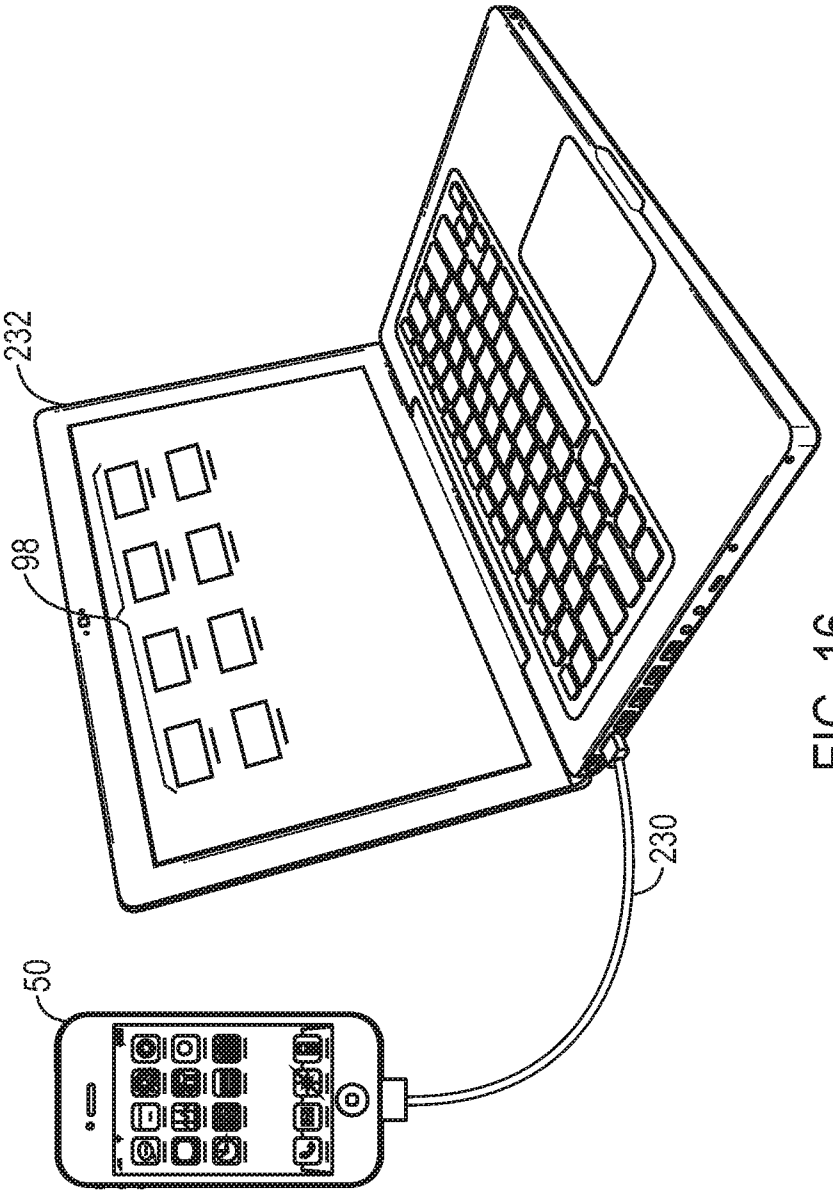

FIG. 16

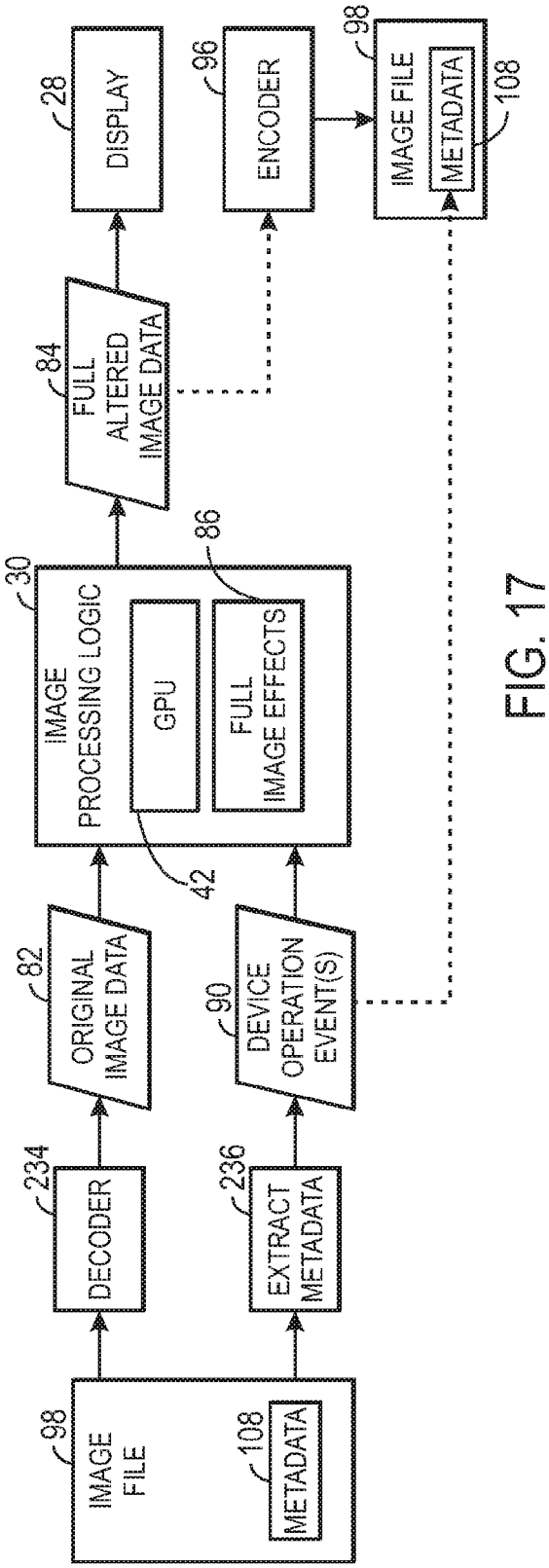
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IMAGE FILE
METADATA
108

FIG. 17

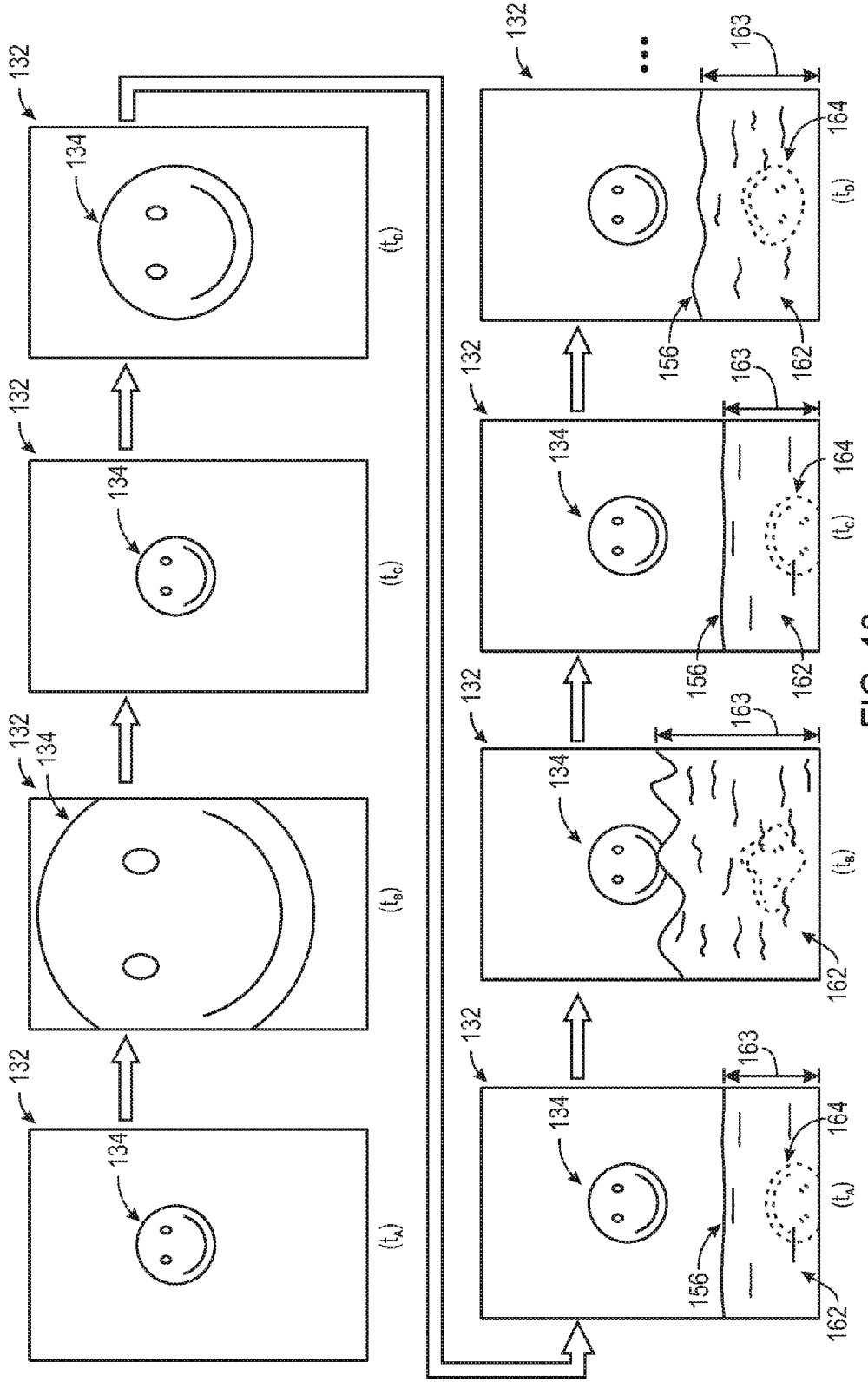

FIG. 18

IMAGE ALTERATION TECHNIQUES

BACKGROUND

The present disclosure relates generally to image data processing and, more particularly, to altering image data in response to device operation events.

This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present techniques, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

Consumer electronics increasingly combine multiple functionalities into a single portable electronic device. For example, in many cases cell phones and media players are no longer merely distinct devices, each with their own unique capabilities. Rather, cell phone and media player functionalities are often now merged into one multimedia device with a multitude of capabilities. Indeed, many modern cell phones, digital media players, and even laptop computers are often capable of providing for a number of additional functionalities, which may include: playing video games, providing for GPS location and navigation functions, providing for network communication functions (e.g., e-mail, text messaging, web-surfing, etc.), playing audio files, and displaying image data, the latter of which may include displaying image data (e.g., pictures and/or video files) stored on the electronic device, captured by the electronic device (e.g., using an integrated camera), or streamed and/or downloaded over a network, such as the Internet.

When a user captures or views an image on such an electronic device, the user also may desire to alter such images with their own creative and artistic initiatives. Such altered images may differ in appearance from the original image, but may provide the creator an aesthetically pleasing viewing experience. Most conventional graphics editing environments, however, may require users to manually select image alteration effects, potentially limiting the creative gamut of altered images that may be created. In addition, not all devices may have the same image processing capabilities. Indeed, some electronic devices may have significantly more or significantly less processing bandwidth than others, which could limit the range of potential image alteration effects available to a user.

SUMMARY

A summary of certain embodiments disclosed herein is set forth below. It should be understood that these aspects are presented merely to provide the reader with a brief summary of these certain embodiments and that these aspects are not intended to limit the scope of this disclosure. Indeed, this disclosure may encompass a variety of aspects that may not be set forth below.

Embodiments of the present disclosure relate to the alteration of image data. An electronic device capable of carrying out such techniques may include data processing circuitry configured to receive image data and detect the occurrence of a device operation event (e.g., an audio event, a motion event, a location event, or an image event, and so forth). The data processing circuitry may alter the image data using a full-quality version or a reduced-quality version of an image alteration effect associated with the device operation event, depending on currently available resources.

Various refinements of the features noted above may exist in relation to various aspects of the present disclosure. Further features may also be incorporated in these various aspects as well. These refinements and additional features may exist individually or in any combination. For instance, various features discussed below in relation to one or more of the illustrated embodiments may be incorporated into any of the above-described aspects of the present disclosure alone or in any combination. Again, the brief summary presented above is intended only to familiarize the reader with certain aspects and contexts of embodiments of the present disclosure without limitation to the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

Various aspects of this disclosure may be better understood upon reading the following detailed description and upon reference to the drawings in which:

FIG. **1** is a simplified block diagram depicting components of an electronic device that may include image alteration functions, in accordance with aspects of the present disclosure;

FIG. **2** is a front-facing view showing the electronic device of FIG. **1** in the form of a portable handheld electronic device, in accordance with aspects of the present disclosure;

FIG. **3** is a back-facing view of the electronic device shown in FIG. **2**;

FIG. **4** is a schematic block diagram depicting a technique for altering image data in response to various events that may be detected during operation of the electronic device of FIG. **1**, in accordance with aspects of the present disclosure;

FIG. **5** is a schematic block diagram depicting another technique for altering image data in response to various events that may be detected during operation of the electronic device of FIG. **1**, in accordance with aspects of the present disclosure;

FIG. **6** is a series of screens that may be displayed on the electronic device of FIG. **2** for video playback, in accordance with aspects of the present disclosure;

FIG. **7** is a series of screens that may be displayed on the electronic device of FIG. **2** for acquiring live image data, in accordance with aspects of the present disclosure;

FIG. **8** is a series of screens that may be displayed on the electronic device of FIG. **2** for viewing images stored on the device of FIG. **2**, in accordance with aspects of the present disclosure;

FIG. **9** illustrates an embodiment of a water ripple image alteration technique, in accordance with aspects of the present disclosure;

FIG. **10** illustrates altered image data stored in an image file resulting from the image alteration technique of FIG. **9**, in accordance with aspects of the present disclosure;

FIG. **11** illustrates an embodiment of a depth-changing image alteration technique, in accordance with aspects of the present disclosure;

FIG. **12** illustrates an embodiment of a depth-changing image alteration technique, in accordance with aspects of the present disclosure;

FIG. **13** illustrates an embodiment of a brush-stroke image alteration technique, in accordance with aspects of the present disclosure;

FIG. **14** is a plot modeling various levels of image alteration effect that may be applied depending on currently available device resources;

FIG. **15** is a schematic block diagram depicting the association of various events that may be detected during operation of the electronic device of FIG. **1** with image data, in accordance with aspects of the present disclosure;

FIG. **16** is a perspective view of an image transfer from the electronic device of FIG. **1** to an electronic device having higher image processing bandwidth to enable higher-bandwidth image alteration, in accordance with aspects of the present disclosure;

FIG. **17** is a schematic block diagram depicting a technique for altering image data based at least partly on previously recorded various device operation events that are associated with image data, in accordance with aspects of the present disclosure; and

FIG. **18** illustrates an embodiment of a series of image alteration techniques that may be applied based on recorded device operation events associated with image data, in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

One or more specific embodiments of the present disclosure will be described below. These described embodiments are only examples of the presently disclosed techniques. Additionally, in an effort to provide a concise description of these embodiments, all features of an actual implementation may not be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

When introducing elements of various embodiments of the present disclosure, the articles "a," "an," and "the" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Additionally, it should be understood that references to "one embodiment" or "an embodiment" of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features.

As discussed above, the creativity of altered image results that may be achieved using conventional graphics editing applications may be limited, as such conventional graphics editing environments may require the manual application of such effects. In addition, various electronic devices may have various image processing capabilities. Accordingly, the present disclosure provides various techniques for automatically applying image alteration effects to image data in response to one or more device operation events and varying the complexity of such image alteration effects depending on the currently available device processing resources of the electronic device. Such image alteration effects may include, for example, those disclosed by U.S. patent application Ser. No. 12/541,597, "IMAGE ALTERATION TECHNIQUES," assigned to Apple Inc. of Cupertino, Calif., which is incorporated herein by reference in its entirety.

Because different electronic devices may have different image processing capabilities, when a user desires to apply such image alteration effects to an image or video, the electronic device may consider its currently available processing resources. Thus, in some embodiments, the electronic device may apply a full-quality version of an image alteration effect only when the currently available device processing resources exceed a threshold. When the currently available device processing resources do not exceed the threshold, the electronic device may apply a reduced-quality version of the same image alteration effect. The electronic device may always apply a full- or reduced-quality version of the image alteration effect depending on its capabilities, or may vary between them as available processing resources change in real time. In this way, the same basic image alteration effect may be used across a variety of electronic devices and/or while the available processing resources of an electronic device increase or decrease over time.

In certain embodiments, the image alteration effects applied to an image in response to a device operation event may take place at a later time, using a different electronic device or using the same electronic device when sufficient device processing resources subsequently have become available. For such embodiments, the electronic device that captures the image data may record and associate the device operation events (e.g., audio events, motion events, location events, imaging events, and so forth, as discussed further below) with the image data by, for example, storing the device operation events as image file metadata. At a later time, the stored image data and associated device operation events may be used to perform image alteration according to such previously recorded device operation events.

Before continuing, several of the terms mentioned above, which will be used extensively throughout the present disclosure, will be first defined in order to facilitate a better understanding of disclosed subject matter. For instance, as used herein, the term "image alteration" or "image manipulation" or the like may be understood to mean the application of an image alteration effect to a digital image, which may be a still image (e.g., picture) or a moving image (e.g., video/movie). An "image alteration effect" may be understood to mean any type of image effect (such as a filter or shape manipulation effect) that alters or otherwise changes the appearance of an original image to which the image alteration effect is applied.

By way of example only, such image alteration effects may include any one of the various effects provided in the Photo Booth® software program (available from Apple Inc. of Cupertino, Calif.), such as sepia, black and white, glow, colored pencil, thermal camera, x-ray, pop art, comic, bulge, dent, twirl, squeeze, mirror, light tunnel, fisheye, or stretch effects, to name just a few. Image alteration effects may also include other types of effects, such as a water reflection effect, a water ripple effect, a spiral effect, a depth-changing ("zooming") effect, a brush-stroke effect, a night vision effect, and more. Thus, it should be understood that "image alteration" does not necessarily mean that the original image data is permanently modified, but rather that an image alteration effect is applied to the image data, such that the desired alteration effect is visible when the image data is displayed by an electronic device for viewing a by user. Additionally, it should be understood that the application of an "image alteration effect" means that the applied effect changes the appearance of the image data in some way other

than merely altering the orientation of the image (e.g., switching from a portrait to a landscape view), as displayed on an electronic device.

Further, the term "device operation event" or the like shall be understood to refer to certain events that occur during operation of the electronic device mentioned above, which may be used to trigger the application of an image alteration effect to a particular image. For instance, as will be discussed below, device operation events may include audio events, which may include certain audio properties detected during audio playback (e.g., a music file or the audio portion of a video file) or by analyzing audio signals received through an audio input device (e.g., a voice recording received via a microphone). Device operation events may also include motion-related events detected by a motion sensing device, such as an accelerometer. In further embodiments, image alteration effects may also be triggered by location events (e.g., determined by global positioning satellite (GPS) coordinates) and/or by image capture events, which may include the detection of certain lighting conditions, exposure values, sharpness data, etc., via an imaging subsystem of the electronic device. An image capture event may also include detecting the presence of a new object or subject entering the imaging acquisition frame. Accordingly, the term "image alteration rule" or the like shall be understood to refer to a defined relationship (e.g., defined through user preference settings) by which a particular device operation event triggers a particular image alteration effect. Further, it should be understood that a "device operation event" may refer to the occurrence of a single discrete event, or may refer to a continuous change in a particular parameter over time, such that image alteration is based upon the change in the parameter. It should also be understood that "device operation events" are meant to exclude specific "on-demand" user commands or inputs that directly request the application of an image alteration effect to image data, such as those received directly through a graphics editing program or setting, as discussed above.

As noted above, embodiments of the present disclosure may involve applying varying levels of image alteration effects depending on the currently available device processing resources. Thus, while a "full-quality version" of an image alteration effect may be sometimes applied, a "reduced-quality version" of the image alteration effect may be applied at other times. Accordingly, the term "full-quality version" of an image alteration effect should be understood to refer to the application of a particular an image alteration effect in full (i.e., without purposeful reduction in complexity). Likewise, the term "reduced-quality version" should be understood to refer to the application of an image alteration effect with reduced complexity from the "full-quality version." That is, although a "full-quality version" of an image alteration effect generally may be perceived by a user to be of higher quality (e.g., more aesthetically pleasing or more realistic), the "reduced-quality version" of such an image alteration effect should require fewer device resources while producing a similar effect as the "full-quality version" of the image alteration effect. By way of example, a "full-quality version" of a water ripple effect may involve water simulation that includes randomization, attenuation, and/or calculations of physics, while a "reduced-quality version" may involve simple sine waves.

As noted above, the currently available device processing resources may affect whether a "full-quality version" or a "reduced-quality version" of an image alteration effect is applied. As used herein, the terms "currently available device processing resources," "processing bandwidth," and the like refer to a current capability of an electronic device to process data (e.g., a capability to perform a particular image alteration effect). By way of example, the current capability of an electronic device to process data may be impacted by a current CPU processing load (e.g., an amount of idle time), a current GPU processing load (e.g., a current workload), currently available memory resources (e.g., a total amount of memory or an available bandwidth of memory), and/or current available storage capacity.

With the foregoing in mind, FIG. **1** is a block diagram illustrating an example of an electronic device **10**, which may implement the image alteration techniques discussed herein. The electronic device **10** may be any type of electronic device that includes capabilities for displaying image data, which may include still images (e.g., pictures) or moving images (e.g., video), such as a portable media player, a mobile phone, a laptop computer, or the like. By way of example only, the electronic device **10** may be a portable electronic device, such as a model of an iPod®, iPhone®, or iPad® available from Apple Inc. In another embodiment, the electronic device **10** may be a desktop or laptop computer, including a MacBook®, MacBook® Pro, MacBook Air®, iMac®, Mac® Mini, or Mac Pro®, also available from Apple Inc. In further embodiments, the electronic device **10** may be a model of an electronic device from another manufacturer that is capable of displaying image data. As will be discussed further below, the electronic device **10** may include circuitry or logic (e.g., image processing logic **30**) configured to process image data in response to one or more device operation events, which may include audio-related events, motion-related events, location-related events, or image capture events, to name just a few.

As shown in FIG. **1**, the electronic device **10** may include various internal and/or external components which contribute to its function. Those of ordinary skill in the art should appreciate that the various functional blocks shown in FIG. **1** may represent hardware elements (including circuitry), software elements (including computer code stored on a computer-readable medium) or a combination of both hardware and software elements. It should further be noted that FIG. **1** is merely one example of a particular implementation and is intended to illustrate the types of components that may be present in the electronic device **10**. For example, in the presently illustrated embodiment, these components may include input/output (I/O) ports **12**, input structures **14**, one or more processors **16**, memory **18**, nonvolatile storage **20**, one or more networking devices **24**, a power source **26**, a display **28**, and image processing logic **30**. The electronic device **10** may additionally include an imaging subsystem **34**, a motion sensing device **36**, a positioning device **38**, and an audio input device **40**, all of which may contribute to operation events that may be utilized by imaging processing logic **30** to trigger the application of one or more image alteration effects to certain image data.

Before continuing, it should be noted that the image processing logic **30**, the processor(s) **16**, the GPU **42**, and/or other data processing circuitry of the electronic device **10** generally may be referred to herein as "data processing circuitry." Such data processing circuitry may be embodied wholly or in part as software, firmware, hardware, or any combination thereof. Furthermore, the data processing circuitry may be a single contained processing module or may be incorporated wholly or partially within any of the other elements within electronic device **10**. Additionally or alternatively, the data processing circuitry may be partially

embodied within electronic device **10** and partially embodied within another electronic device connected to the electronic device **10**.

With regard to each of the illustrated components, the I/O ports **12** may include ports configured to connect to a variety of external devices, such as headphones or other electronic devices. The input structures **14** may provide user input or feedback to processor(s) **16**. For example, the input structures **14** may include buttons, sliders, switches, and so forth. In certain embodiments, the input structures **14** may include a touch-sensitive mechanism of the display **28**.

In the electronic device **10** of FIG. **1**, the processor(s) **16** and/or other data processing circuitry may be operably coupled to the memory **18** and the nonvolatile storage **20** to carry out the presently disclosed techniques. These techniques may be carried out by the processor(s) **16** (e.g., the GPU **42**) and/or other data processing circuitry (e.g., firmware or software associated with the image process logic **30**) based on certain instructions executable by the processor(s) **16** and/or other data processing circuitry. Such instructions may be stored using any suitable article(s) of manufacture that include one or more tangible, computer-readable media to at least collectively store the instructions. The article(s) of manufacture may include, for example, the memory **18** and/or the nonvolatile storage **20**. The memory **18** and the nonvolatile storage **20** may include any suitable articles of manufacture for storing data and executable instructions, such as random-access memory, read-only memory, rewritable flash memory, hard drives, and optical discs. In addition, the memory **18** may include one or more frame buffers for buffering or caching image data, including unprocessed (e.g., original) and processed (e.g., altered) image data.

The network device **24** may provide network connectivity to a personal area network (PAN) (e.g., a Bluetooth network), a local area network (LAN) (e.g., an 802.11x Wi-Fi network), and/or a wide area network (WAN) (e.g., a 3G or 4G cellular network). In certain embodiments, the network device **24** may provide for a connection to an online digital media content provider, such as the iTunes® service available from Apple Inc. Through such a service, a user may access, stream, or download digital video to the electronic device **10**, which may then be played back and processed by image processing logic **30** in accordance with one or more of the image alteration techniques disclosed herein.

The display **28** may display various image data, including stored image data (e.g., picture or video files stored in the nonvolatile storage **20**), streamed image data (e.g., from the network device **24**), as well as live captured image data (e.g., via imaging subsystem **34**). Additionally, the display **28** may display various images generated by the electronic device **10**, including a GUI for an operating system or other application. The display **28** may be any suitable display such as a liquid crystal display (LCD), plasma display, or an organic light emitting diode (OLED) display, for example. In one embodiment, display **28** may be provided in conjunction with a touch screen that may function as part of a control interface for the electronic device **10**.

As mentioned above, the electronic device **10** may include certain image processing logic **30**, which may be used to alter image data in response to one or more device operation events. As will be discussed below, such device operation events may include audio events (e.g., provided by the audio input device **40**), motion events (e.g., provided by the motion sensing device **36**), location events (e.g., provided by the positioning device **38**), or image capture events (e.g., provided by the imaging subsystem **34**), or some combination thereof. Based at least partly on device operation events associated with the image data to be altered, the image processing logic **30** and/or other data processing circuitry may apply a corresponding image alteration effect or effects to image data as it is displayed on display **28**. Rather than always apply a full-quality version of an image alteration effect, however, the electronic device **10** sometimes may apply a reduced-quality version of the image alteration effect.

The various components **34**, **36**, **38**, and **40** that may contribute to device operation events in the presently illustrated embodiment will now be described beginning with the imaging subsystem **34**. The imaging subsystem **34** may be configured to capture still or moving images. For instance, the imaging subsystem **34** may include one or more cameras having a plurality of image sensors, as well as an image signal processor (ISP), which may be part of the processor(s) **16**. As will be appreciated, the ISP may process data acquired via the image sensors to generate a digital representation of the captured data, which may be displayed and/or stored on the electronic device **10**. As will be discussed further below, certain embodiments may provide for image alteration based upon one or more properties of the imaging subsystem **34**, such as a detected lighting condition, exposure value, brightness level, sharpness level, or some other type of imaging property.

The motion sensing device **36** may be any device configured to measure motion or acceleration experienced by the electronic device **10**, such as an accelerometer or a gyroscope. In one embodiment, the motion sensing device **36** may be a three-axis accelerometer that includes a sensing element and an integrated circuit interface for providing the measured acceleration and/or motion data to the processor(s) **16**. The motion sensing device **36** may be configured to sense and measure various types of motion including, but not limited to, velocity, acceleration, rotation, and direction, all of which may be configured to trigger one or more image alteration effects.

The electronic device **10** also may include the positioning device **38**. By way of example, the positioning device **38** may be a GPS system, such as an Assisted GPS (A-GPS) system. The positioning device **38** may be configured to determine the geographic coordinates of the electronic device **10**. In one embodiment, the image processing logic **30** may determine whether or not to apply a particular image alteration effect based upon the geographic position of the electronic device **10**.

Additionally, the electronic device **10** may include the audio input device **40**, which may be configured to receive audio signals. In one embodiment, the audio input device **40** may include one or more audio receivers, such as microphones. Based upon certain audio events, which may be the detection of certain properties of a received audio signal, such as a key, tempo, beat, frequency, volume, spectral content, RMS level, etc., the image processing logic **30** may determine whether or not to apply an image alteration effect to an image that is being displayed on the display **28**. Further, in addition to analyzing audio signals received by the audio input device **40**, audio events that may trigger image alteration could also be determined via analysis of audio data being played on the electronic device **10**. For instance, in one embodiment, image alteration may be triggered based on a key, tempo, beat, frequency, volume, spectral content, RMS level, etc., of music data being played on the electronic device **10**, which may be a song or an audio portion of a concurrently played video file. In the latter case, the audio portion of the video data may trigger image alteration of the video data as it is being played. Still further,

one embodiment may provide for image alteration based upon metadata information, such as genre or artist information corresponding to a music or audio file being played back on the electronic device **10**. As can be appreciated, image alteration effects implemented by the image processing logic **30** may include any suitable type of image alteration effect, including, without limitation, the examples listed above, and may be triggered by operation events provided from any of the components **34**, **36**, **38**, or **40** depending on user preference settings.

Referring now to FIG. **2**, the electronic device **10** is illustrated in the form of a portable the handheld device **50**, which may be a model of an iPod® or iPhone® available from Apple Inc. It should be understood that while the illustrated the handheld device **50** is generally described in the context of portable digital media player and/or cellular phone, additional embodiments of the handheld device **50** may incorporate additional functionalities, such as a camera, a portable gaming platform, a personal data organizer, or some combination thereof.

In the depicted embodiment, the handheld device **50** includes an enclosure **52**, which may function to protect the interior components from physical damage and shield them from electromagnetic interference. The enclosure **52** may be formed from any suitable material or combination of materials, such as plastic, metal, or a composite material. As shown in the present embodiment, the enclosure **52** includes several user input structures **14**, through which a user may interface with the handheld device **50**. By way of example, one or more of input structures **14** may be configured to invoke a "home" screen **54** or menu to be displayed, to toggle between a sleep, wake, or powered on/off mode, to silence a ringer for a cellular phone application, to increase or decrease a volume output, and so forth. It should be understood that the illustrated input structures **14** are merely exemplary, and that the handheld device **50** may include any number of suitable user input structures existing in various forms including buttons, switches, keys, knobs, scroll wheels, and so forth.

In the illustrated embodiment, the display **28** may be provided in the form of a liquid crystal display (LCD), which may display various images generated by the handheld device **50**. For example, the display **28** may display various system indicators **56** providing feedback to a user with regard to one or more states of the handheld device **50**, such as power status, signal strength, external device connections, and so forth. The display **28** may also display a graphical user interface ("GUI") **58** to allow a user to interact with the handheld device **50**. The GUI **58** may include various layers, windows, screens, templates, or other graphical elements that may be displayed in all, or a portion, of the display **28**. For instance, as shown on the home screen **54**, the GUI **58** may include graphical elements representing applications and functions of the handheld device **50**.

The graphical elements may include icons **60**, each of which may correspond to various applications that may be opened or executed upon detecting a user selection of a respective icon **60**. By way of example, one of the icons **60** may represent a media player application **62**, which may provide for the playback of digital audio and video data stored on the handheld device **50**, as well as the playback of streamed video data. Another icon **60** may represent a camera application **64**, which may provide for the capture of still or moving images by a camera which, in one embodiment, may be integrated with the handheld device **50**. Additionally, one of the icons **60** may also represent a photo browser application **66**, by which a user may view images stored on the handheld device **50**, some of which may have been acquired using the camera application **64**. Further, one of the icons **60** may represent an application **68** through which a user may set various user preferences for controlling the alteration of image data based upon device operation events. In some embodiments, the selection of an icon **60** may lead to a hierarchical navigation process, such that selection of an icon **60** leads to a screen that includes one or more additional icons or other GUI elements. As will be appreciated, the icons **60** may be selected via a touch screen included in the display **28**, or may be selected using one of the user input structures **14**.

As shown, the handheld device **50** may include audio input devices **40**, which may be provided as one or more microphones. In some embodiments, the audio input devices **40** may also be integrated with audio output devices, such as speakers, for transmitting audio signals to a user, such as during playback of music data, for example. Further, where the handheld device **50** includes a cell phone application, an additional audio output transmitter **70** may be provided, as shown in FIG. **2**. The output transmitter **70** may also include one or more speakers configured to transmit audio signals to a user, such as voice data received during a telephone call. Thus, the audio input devices **40** and the output transmitter **70** may operate in conjunction to function as the audio receiving and transmitting elements of a telephone.

Referring briefly to FIG. **3**, a rear view of the handheld device **50** is illustrated. As shown in FIG. **3**, the electronic the handheld device **50** may include a camera **74**, which may be used in conjunction with the camera application **64** to acquire still or moving images, such as digital photographs or movies, with or without a light source **76**. Such a light source **76** may include, for example, a light emitting diode (LED) or a xenon flash. As will be discussed in further detail below, images acquired via the camera **74** may be stored on the handheld device **50**, and may be subsequently processed by the image processing logic **30** for the addition of one or more image alteration effects. Additionally, various device operation events that take place while such images are captured may be stored in association with the captured images. These device operation events may be used in the automatic application of an image alteration effect to the associated image data at a later time. In some embodiments, the image processing logic **30** may apply either a full-quality version or a reduced-quality version of an image alteration effect in real time during image capture, depending on the currently available device processing resources.

Continuing to FIG. **4**, a schematic block diagram showing a process by which image data is altered by image processing logic **30** in response to one or more device operation events on the electronic device **10** is illustrated, in accordance with aspects of the present technique. As shown in the illustrated embodiment, input image data, referred to as "original image data" **82**, may be captured live (e.g., in substantially real time) using the camera **74**, or may be played back or viewed from an image file **94** stored on the electronic device **10**. In a further embodiment, the original image data **82** may be streamed over a network, such as the Internet, in the context of a video conferencing application, such as iChat® or FaceTime® (available from Apple Inc.). In processing the original image data **82**, the image processing logic **30**, which may operate in cooperation with the GPU **42**, may apply one or more image alteration effects **86** to original image data **82** to produce altered image data **84**. Such image alteration effects **86** may be applied in response to the occurrence of one or more device operation events **90**.

The association of specific triggering device operation events **90** to corresponding image alteration effects **86** may be configured as "image alteration rules," as discussed further by U.S. patent application Ser. No. 12/541,597, "IMAGE ALTERATION TECHNIQUES," assigned to Apple Inc., which as noted above is incorporated herein by reference in its entirety. In addition, while the GPU **42** is shown in FIG. **4** as being integrated with the image processing logic **30**, it should be understood that the image processing logic **30** and the GPU **42** could also be separate components in other embodiments (e.g., FIG. **1**).

Since certain image alteration effects may be particularly resource-intensive, the image processing logic **30** and/or other data processing circuitry may not always apply a full-quality version image alteration effect **86**. Indeed, in some embodiments, depending on an indication of currently available device processing resources **92**, the image processing logic **30** and/or the other data processing circuitry may apply a reduced-quality version of an image alteration effect **86** instead. Such an indication of currently available device processing resources **92** may represent, for example, an amount of available memory **18**, a current usage of the processor(s) **16**, performance counters, and so forth. As noted below, in certain embodiments, the image processing logic **30** and/or other data processing circuitry may vary between applying the full-quality version of the image alteration effect **86** and the reduced-quality version of the image alteration effect **86** in real time depending on the indication of currently available device processing resources **92**. Specifically, in some embodiments, the image processing logic **30** and/or other data processing circuitry may apply the full-quality version when the indication of available device processing resources **92** exceeds a threshold, and may apply a reduced-quality version at other times.

As shown, the altered image data **84** (resulting from either the full- or reduced-quality version of an image alteration effect **86**) may be output to the display **28** for viewing on the electronic device **10**. In some embodiments, the altered image data **84** may also be stored on the electronic device **10** as an image file **98**. For instance, the altered image data **84**, which may include still pictures or video data, may be encoded into one or more suitable image formats using an encoder **96**. By way of example, where the altered image data **84** includes video data, the image file **98** may be encoded using a codec into a variety of image file formats, including those based upon H.264, MPEG-4, or 3GP multimedia formats. In one embodiment, the image file **98** may be a stored as a QuickTime® file for later playback on the electronic device **10** using the QuickTime® Player application, available from Apple Inc. It should be appreciated that any type of suitable video or picture formats may be utilized by the encoder **96** for creating the image file **98** for storage (e.g., in the nonvolatile storage **20**) on the electronic device **10**. In certain embodiments, the device operations events **90** that shaped the application of the image alteration effect(s) **86** in the altered image data **84** may be associated with the image file **98** (e.g., stored as metadata **108** or stored in a database linked to the image file **98**).

As discussed above, these device operation events **90** that may contribute to the triggering of image alteration effects **86** may include audio, motion, location, or image capture events, among other things. In certain embodiments, as discussed below, certain processing for determining the device operation events **90** may be performed as full- or reduced-quality versions, in which reduced-quality versions may be analyses that are less detailed than full-quality versions. Additionally or alternatively, this device operation event **90** processing may take place in another electronic device **10** (e.g., an electronic device **10** having greater device processing resources), as discussed in greater detail below.

When such device operation events **90** are determined in the electronic device **10**, the electronic device **10** may include audio analysis logic **100**. The audio analysis logic **100** may be configured to analyze audio signals **102** received by the audio input device **40**, which may be a microphone in one embodiment. Thus, the audio signals **102** received by the audio input device **40** may include a user's voice, as well as voice and/or music from external audio sources. Additionally, the audio analysis logic **100** may also be configured to analyze the playback of audio data **104** on the electronic device **10**. The audio data **104** may be, for instance, an audio file being concurrently played with the original image data **82**, such as the audio portion of a movie or music video. Accordingly, both audio input signals **102** and audio data **104** may be analyzed by logic **100** for the determination of various audio properties, such as key, tempo, beat, frequency, volume, spectral content, or RMS level properties, as well as properties based upon metadata information, such as genre or artist information. In some embodiments in which the audio data **104** is a radio broadcast, metadata information may be determined by analyzing a metadata sub-carrier associated with the broadcast, such as an RDS data signal associated with an FM broadcast. Based upon the determined audio property or properties, the image processing logic **30** may determine whether an image alteration effect **86** is to be applied to the original image data **82** (e.g., in accordance with an image alteration rule employed by the image processing logic **30**).

The electronic device **10** may also include an image signal processor (ISP) **106**, which may operate in cooperation with the camera **74** as components of the imaging subsystem **34**. The ISP **106** may process data received from image sensors of the camera **74** to generate a digital image representing the data captured by the image sensors. In accordance with the presently described image alteration techniques, certain image capture properties, such as lighting conditions, sharpness, brightness levels, or exposure values, may be determined by ISP **106** and provided to image processing logic as the device operation events **90**, which may be used to trigger the alteration of the original image data **82**. Additionally, as discussed above, the electronic device **10** may include the motion sensing device **36** and the positioning device **38** to provide motion and location data, respectively, to the image processing logic **30**. Under such conditions, the image processing logic **30** may perform image alteration if the motion or location data corresponds to an operation event that triggers image alteration. To summarize, the image processing logic **30** may apply one or more image alteration effects **86** to the original image data **82** based at least partly on the occurrence of certain triggering device operation events **90**, which may include audio events, motion events, location events, or image capture events, or some combination thereof.

In the embodiment of FIG. **4**, the altered image data **84** displayed on the display **28** may vary between representing full-quality versions of the image alteration effect(s) **86** and reduced-quality versions of the image alteration effect(s) **86**. When such altered image data **84** is encoded by the encoder **96** to produce the image file **98**, the resulting image file **98** may likewise represent altered image data **84** that varies between representing full-quality versions of the image alteration effect(s) **86** and reduced-quality versions of the image alteration effect(s) **86**. In the embodiment of FIG. **5**,

while the altered image data **84** displayed on the display **28** may vary between representing full-quality versions of the image alteration effect(s) **86** and reduced-quality versions of the image alteration effect(s) **86**, the altered image data **84** may not be encoded to produce an image file **98**. Rather, at a time when sufficient resources become available, the image processing logic **30** and/or other data processing circuitry may apply the full-quality version of the image alteration effect(s) **86** to the original image data **82** to produce full altered image data **85**. This full altered image data **85** may be encoded by the encoder **96** to produce an image file **98**. In this way, a user may view the application of an image alteration effect **86** in real time on the display **28** via the altered image data **84**, which may appear as a full- or reduced-quality version depending on the current indication of available device processing resources **92**. However, the user may also obtain an image file **98** for which the full-quality version of the image alteration effect **86** has been applied.

With the above points in mind, various techniques for acquiring, viewing, or playing back still and moving image data using the handheld device **50** are illustrated in FIGS. **6-8** by way of a plurality of screen images that may be displayed on the display **28**. Particularly, FIG. **6** depicts the playback of a video file using the media player application **62**, FIG. **7** depicts the live capture of image data using the camera **74** and the camera application **64**, and FIG. **8** depicts the viewing of image data stored on the handheld device **50** using the photo browser application **66**, all in accordance with aspects of the present disclosure. As should be understood, the depicted screen images in FIGS. **6-8** may be generated by the GUI **58** and displayed on the display **28** of the handheld device **50**. For instance, these screen images may be generated as the user interacts with the handheld device **50**, such as via input structures **14**, or by way of a touch screen interface.

It should also be understood that the GUI **58**, depending on the inputs and selections made by a user, may display various screens including icons (e.g., **60**) and graphical elements. These elements may represent graphical and virtual elements or "buttons" which may be selected by the user from the display **28**. Accordingly, it should be understood that the term "button," "virtual button," "graphical button," "graphical elements," or the like, as used in the following description of screen images below, is meant to refer to the graphical representations of buttons or icons represented by the graphical elements provided on the display **28**. Further, it should also be understood that the functionalities set forth and described in the subsequent figures may be achieved using a wide variety graphical elements and visual schemes. Therefore, the illustrated embodiments are not intended to be limited to the precise user interface conventions depicted herein. Rather, additional embodiments may include a wide variety of user interface styles.

As initially shown in FIG. **6**, beginning from home screen **54** of GUI **58**, the user may initiate the media player application **62** by selecting the graphical button indicated by numeral **62**. By way of example, the media player application **62** may be an iPod® application running on a model of an iPod Touch® or an iPhone®, available from Apple Inc. Upon selection of graphical button associated with the media player application **62**, the user may be navigated to a home screen **110** of the media player application **62**. As shown in FIG. **5**, the screen **110** may initially display a listing **112** showing various playlists **114** stored on the electronic device **10**. The screen **110** also includes graphical buttons **116**, **118**, **120**, **122**, and **124**, each of which may correspond to specific functions. For example, if the user navigates away from the screen **110**, the selection of the graphical button **116** may return the user to the screen **110** and display the playlists **114**. The graphical button **118** may organize the media files stored on the handheld device **50** and display the media files in groupings based upon artist names, whereas the graphical button **120** may represent a function by which media files are sorted and displayed alphabetically in a listing that may be navigated by the user. Additionally, the graphical button **122** may present the user with a listing of video files available for playback on the handheld device **50**. Finally, the graphical button **122** may provide the user with a listing of additional options that the user may configure to further customize the functionality of the handheld device **50** and/or the media player application **62**.

As shown, the selection of the graphical button **122** may advance the user to a screen **126**, which may display a listing of video files available for playback on the handheld device **50**. By way of example, video files stored on the handheld device **50** may include music videos, captured videos (e.g., using the camera **74**), or movies. In some embodiments, video files may be downloaded from an online digital media service, such as iTunes®. As illustrated in the screen **126**, a video file **128** is stored on the handheld device **50** and may be played by selecting a graphical button **130**. For instance, upon selection of the graphical button **130**, the video file **128** may be played back on the screen **132**, which may sequentially display video images **134** corresponding to the video file **128**.

FIG. **7** shows screen images depicting the live capture of image data using the camera **74**. Returning to the home screen **54**, a user may initiate a camera application by selecting a graphical button associated with the camera application **64**. The initiation of the camera application **64** may activate image sensors within the camera **74** for acquisition of image data, as well as the ISP **106** for processing the image data captured via the image sensors. As shown, selection of icon associated with the camera application **64** may cause a screen **138** to be displayed on the handheld device **50**. The screen **138** may include a viewfinder **140**, which may display image data captured by the camera **74** in substantially real time. For instance, if the user wishes to capture an image of a subject **142**, the user may position the handheld device **50** in such a manner that an image of the subject **142** appears in the viewfinder **140**. As will be discussed in greater detail below with reference to FIG. **15**, in certain embodiments, while the camera application **64** is capturing image data, certain device operation events **90** happening concurrently with such image capture may be stored as metadata for use at a later time.

The screen **130** also may include a graphical button **144**, which may be selected to store the captured images shown in the viewfinder **140**. The stored image data, referred to here by reference number **146**, may include still images, such as pictures, as well as moving images, such as video. The stored image data **146** (which may be analogous to the stored image data **94** of FIG. **4**), may be viewed or played back on the handheld device **50** at a later time. The device operation events **90** that occurred while the stored image data **146** was originally captured may or may not be associated with the stored image data **146**.

FIG. **8** shows screen images depicting how a user may view images stored on the handheld device **50** using the photo browser application **66**. For instance, beginning at the home screen **54**, a user may select an icon associated with the photo browser application **66** to run a photo browser

application. By way of example, photo browser application **66** may be a version of iPhoto®, available from Apple Inc., or a mobile photo browser application, which may be found on models of the iPod® Touch or the iPhone®, also available from Apple Inc. As shown in FIG. **8**, the selection of the icon associated with the photo browser application **66** may advance the user to a home screen **150** of the photo browser application **66**. The screen **150** may display a listing **152** of "albums" or groupings of images stored on the handheld device **50**. By selecting an album **153**, the user may be advanced to a screen **154**, on which the image **146** (showing the subject **142**) that was previously acquired using the camera application **64** (FIG. **7**) is displayed. In embodiments where an album includes multiple images, the multiple images may be sequentially displayed in the form of a slideshow. The screen **154** also includes a graphical button **155**, which the user may select to return to the listing **152** on the screen **150**.

Having described several techniques in FIGS. **6-8** by which image data may be acquired, viewed, or played back on the handheld device **50**, FIGS. **9-13** are intended to illustrate various examples of image alteration effects **86** that may be applied to images displayed on the handheld device **50** in response to various types of device operation events **90**, in accordance with aspects of the present disclosure. Before continuing, it should be understood the present disclosure is not intended to be limited to the specific image alteration examples depicted in FIGS. **9-13**. Rather, these examples are intended to provide a better understanding of the disclosed image alteration techniques, which may, in additional embodiments, utilize a number of image alteration effects not specifically discussed herein.

With the foregoing points in mind, FIGS. **9** and **10** show examples of the application of a "water ripple" or "water reflection" image alteration effect **86**. Among other things, such an image alteration effect **86** may be triggered based upon audio events. For example, FIG. **9** illustrates the real-time application of a full-quality version and a reduced-quality version of a "water reflection" effect to the video file **128** (FIG. **6**) depending on the indication of currently available device processing resources **92** (FIGS. **4** and **5**). As discussed above with reference to FIG. **6**, the video file **128** may be played back using the media player application **62**, in which the video images **134** are displayed on the screen **132**.

In the presently illustrated embodiment, the water reflection effect, referred to by reference number **156**, may be triggered or influenced by any suitable device operation event **90** property. Such a device operation event **90** property may include audio event properties, such as the detection of changes in a particular audio property over time. Such a change in a device operation event **90** property is illustrated on a curve **157** on a graph **158**. As discussed above, device operation event **90** data, such as audio event data, may be determined by analyzing audio input data (via the audio analysis logic **100**) to determine one or more properties of the audio input data, such as key, tempo, beat, frequency, volume, spectral content, or RMS level properties, as well as properties based upon metadata information, such as genre or artist information. For instance, the audio data may be an audio signal (e.g., voice input) received by the audio input device(s) **40**, or may be audio data played back on the handheld device **50** substantially concurrently with the video file **128**. By way of example, where the video file **128** is a music video file, the analyzed audio data may be the audio portion of the music video that is played back in synchronization with the video portion of the music video.

Since the currently available device processing resources also may be changing over time, whether to apply a full-quality version of the water ripple effect **156** or a reduced-quality version of the water ripple effect **156** may depend upon the indication of currently available device processing resources **92** (FIGS. **4** and **5**). In particular, as shown by a plot **159** modeling the currently available device processing resources over time (trace line **160**), the currently available device processing resources **160** may occasionally be above an effect threshold **161** and occasionally be above the effect threshold **161**. Such a threshold **161** may define when the handheld device **50** has the processing resources to perform the full-quality version of the water ripple effect **156**.

As shown, the water ripple effect **156** may alter the video image **134** by the addition (e.g., overlaying) of a water-like graphical element **162** near the bottom of the screen **132**. In the depicted embodiment, the height **163** and overall "turbulence" characteristic of the water-like graphical element **162** may change in response to changes in the device operation event **90** property **157**. For instance, as shown on the graph **158**, from time t_A to time t_B, the value of device operation event **90** property **157** has increased. By way of example, the increase in the device operation event **90** property **157** could correspond to an increase in volume, tempo, frequency level, spectral content, or any suitable type of property that may be used to trigger image alteration. As such, the screen **132** may also change from time t_A to time t_B in response to the change in the device operation event **90** property **157**. For instance, as shown in FIG. **9**, due to the increase in the device operation event **90** property **157**, both the height **163** and turbulence of the water-like graphical element **162** may increase. For instance, as shown on the screen **132** at time t_B, the increased turbulence (which may be displayed as "ripples") in the water-like graphical element **162** may cause a reflection **164** to become slightly distorted and the surface of the water-like graphical element **162** to become more wave-like in appearance. As further indicated by the graph **158**, the device operation event **90** property **157** continues to increase from time t_B to time t_C. Accordingly, as shown by the screen **132** at time t_C, the height **163** and turbulence of the water-like graphical element **162** may continue to increase when compared to the screen **132** at time t_B.

Whether a full-quality version or a reduced-quality version of the water ripple effect **156** is applied may depend upon when the available device processing resources **160** exceed the threshold **161**. In some embodiments, as shown in FIG. **9**, the currently available device processing resources may cause the application of either the full-quality version or a reduced-quality version of the water ripple effect **156** substantially in real time. Thus, since the available device processing resources **160** do not exceed the threshold **161** at times t_A and t_C, the reduced-quality version of the water ripple effect **156** may appear on the screen **132** at times t_A and t_C. Since the available device processing resources **160** do exceed the threshold **161** at time t_B, the full-quality version of the water ripple effect **156** may appear on the screen **132** at time t_B.

As shown on the screen **132** at time t_B, the full-quality version of the water ripple effect **156** may be relatively realistic, imitating the physics of water and including such effects as attenuation and randomization, in addition to wave calculations. In addition, the full-quality version of the water ripple effect **156** may include a reflection **164** of the video images **134** that ripples accordingly. A reduced-quality version of the water ripple effect **156**, shown on the screens **132** of times t_A and t_C, may represent the same general image

alteration effect **86**, but may be less complex to consume fewer device processing resources. Thus, for example, the reduced-quality version of the water ripple effect **156** may be less realistic than the full-quality version, including simple sine waves rather than complex water physics. In this way, despite changes in the device processing resources available, the handheld device **50** may be capable of continuing to display the water ripple effect **156**, albeit at varying levels of complexity and resource-intensity.

As mentioned above with reference to FIG. **5**, although the real-time display of an image alteration effect **86** may vary depending on the currently available device processing resources, the ultimate altered images encoded and saved in the image file **98** may be of the full effect only. Thus, where FIG. **9** may represent an example of real-time application of the water ripple effect **156**, in which a full-quality version of the effect is applied only when the currently available device processing resources exceed the threshold **161**, FIG. **10** represents the ultimate image file **98** that is generated. In particular, while the real-time application of the water ripple effect **156** may vary between the full-quality version and the reduced-quality version to enable the effect to be shown in real time on the display **28**, the full-quality version of the water ripple effect **156** may be applied shortly thereafter. Since the water ripple effect **156** is to be applied for the purpose of generating an image file **98**, and not for immediate display on the display **28** of the handheld device **50**, the currently available device processing resources may not be a limiting factor. Indeed, the handheld device **50** may take additional time as necessary to apply the full-quality version of the water ripple effect **156** to the images **134** and/or may wait, when sufficient device processing resources are not available, until sufficient device processing resources do become available. As a result, as seen in FIG. **10**, the full-quality version of the water ripple effect **156** may be applied at all times (e.g., t_A, t_B and t_C).

Continuing to FIG. **11**, another example of an image alteration effect that responds to changes in a particular device operation event **90** property is shown. The image alteration effect shown in FIG. **11** may be a "zooming" effect, in which the depth of the displayed image, which may be video images **134** (corresponding to the video file **128**) displayed by the screen **132**, changes based on corresponding changes in a device operation event **90** property **166**, as illustrated by a graph **168**. By way of example only, the device operation event **90** property **166** may indicate the level of a particular frequency range, such as a low frequency level (e.g., bass content), that is present in the audio data being analyzed by the audio processing logic **100**.

In addition, since the currently available device processing resources also may be changing over time, whether to apply a full-quality version of the zooming effect or a reduced-quality version of the zooming effect may depend upon the indication of currently available device processing resources **92** (FIGS. **4** and **5**). In some embodiments, whether to apply a full-quality version of a determination of the device operation event **90** property (e.g., the level of a certain frequency band) also may depend upon the currently available device processing resources **92**. In particular, as shown by a plot **170** modeling the currently available device processing resources over time (trace line **172**), the currently available device processing resources **172** may occasionally be above an effect threshold **174** and occasionally be below the effect threshold **174**. Such a threshold **174** may define when the handheld device **50** has the processing resources to perform the full-quality version of the zooming effect. The same threshold **174** or a different threshold may define when the handheld device **50** may perform a full-quality version of the determination of the device operation event **90** property. By way of example, a full-quality version of the determination of the device operation event **90** property may be more precise or may be updated more often than a reduced-quality version, but may consume fewer device processing resources.

The zooming effect may be applied such that the depth of a displayed image decreases as the device operation event **90** property **166** (e.g., bass content in the audio data) increases. For instance, referring to the screen **132** at time t_A, the video image **134** may be displayed at a first depth based upon the value of the device operation event **90** property **166** at time t_A. Subsequently, at time t_B, the device operation event **90** property **166** has significantly increased. As such, the screen **132** at time t_B may display video image **134** at a lesser depth, thus creating the visual appearance that video image **134** is "zoomed in." Thereafter, at time t_C, the device operation event **90** property **166** may decrease and return to approximately the same level from previous time t_A. Thus, as shown by the screen **132** at time t_C, the depth of video image **134** may increase ("zoom out") to approximately the same depth that was used in displayed video image **134** at time t_A. Finally, at time t_D, the device operation event **90** property **166** may increase again, thereby decreasing the depth at which the screen **132** displays video image **134** at time t_D, essentially creating the visual effect that video image **134** is "zoomed in" at time t_D, although to a lesser extent than at time t_B due to the difference between the device operation event **90** properties **166** at times t_B and t_D.

Like the water ripple effect **156** discussed above, whether a full-quality version or a reduced-quality version of the zooming effect is applied may depend upon when the available device processing resources **172** exceed the threshold **174**. In some embodiments, as shown in FIG. **11**, the currently available device processing resources may cause the application of either the full-quality version or a reduced-quality version of the zooming effect substantially in real time. Thus, since the available device processing resources **172** exceed the threshold **172** at times t_A, t_B, and t_C, the full-quality version of the zooming effect may appear on the screen **132** at times t_A, t_B, and t_C. Since the available device processing resources **172** do not exceed the threshold **174** at time t_D, the reduced-quality version of the zooming effect may appear on the screen **132** at time t_D.

As shown on the screen **132** at time t_B, the full-quality version of the zooming effect **156** may be relatively smooth, involving a "zooming in" on the subject of the video image **134** at a relatively high frame rate (e.g., 10-30 frames per second). In contrast, a reduced-quality version of the zooming effect, shown on the screen **132** of time t_D, may represent the same general image alteration effect **86**, but may be less complex to consume fewer device processing resources. Thus, for example, the reduced-quality version of the zooming effect may be less smooth than the full-quality version, involving a "zooming in" on the subject of the video image **134** at a relatively lower frame rate (e.g., less than 10-30 frames per second, such as between 1 and 5 frames per second in some embodiments). In this way, despite changes in the device processing resources available, the handheld device **50** may be capable of continuing to display the zooming effect, albeit at varying levels of complexity and resource-intensity.

It should also be understood that, as noted above with reference to FIGS. **5** and **10**, while the real-time application of the zooming effect may vary between the full-quality version and the reduced-quality version, the full-quality

version of the zooming effect may be applied shortly thereafter to produce an image file **98**. For such embodiments, the handheld device **50** may take additional time as necessary to apply the full-quality version of the zooming effect (e.g., not in real time) to the images **134** and/or may wait, when sufficient device processing resources are not available, until sufficient device processing resources do become available. As a result, for the purposes of generating an image file **98** containing the zooming effect, the full-quality version of the zooming effect may be applied to the video images **134** for all times (e.g., t_A, t_B, t_C, and t_D).

Next, FIGS. **12** and **13** show examples of image alteration effects that may be triggered based upon motion events. For instance, such motion events may be provided by motion data sensed by the motion sensing device **36**, which may include an accelerometer and/or gyroscope, configured to sense or measure various types of motion, such as velocity, acceleration, rotation, and direction, all of which may be configured to trigger one or more image alteration effects.

Referring to FIG. **12**, an example of an image alteration effect that is triggered by rotational motion of the handheld device **50** is shown at three different points in time: t_A, t_B, and t_C. Initially, the handheld device **50** may be in a first position at time t_A. As shown at time t_A, the handheld device **50** is in the process of playing back video file **128** and may display video image **134** using the screen **132** of the media player application **62**, as previously described in FIG. **5**. Between times t_A and t_B, the handheld device **50** experiences a rotational motion **186** in the counter-clockwise direction, and is eventually moved into a second position, as shown at time t_B.

Based on the rotation **186**, the image processing logic **30** may apply a spiral effect, referred to by reference number **188**, to video image **134**. For instance, the spiral effect **188** may include a curve **192** that emanates from the center **190** of the screen **132** in a direction **194**. The direction **194** may be the same direction as the direction of the rotation **186**, i.e., counter-clockwise, as shown in the presently illustrated embodiment, or may be opposite the direction of the rotation **186**, i.e., clockwise. Additionally, in certain embodiments, the image processing logic **30** may also alter the video image **134** based upon the rotation **186**, such that the orientation of the video image **134** remains generally constant from the viewpoint of a user viewing the screen **132**, even though the handheld device **50** has changed positions. In other words, despite the movement experienced by the handheld device **50**, the video image **134** may appear to remain stationary (though with a spiral effect applied). Also, it should be noted that the present embodiment shows that image alteration may be triggered by any degree of rotation, i.e., triggered by "continuous" rotation. In other embodiments, a triggering rotation event may be defined such that image alteration is not triggered until at least a certain degree of rotation, such as 90 or 180 degrees, is detected.

In some embodiments where image alteration is triggered by continuous rotation, the "intensity" of the image alteration effect may increase and decrease in proportion to the amount of rotational motion experienced by the handheld device **50**. That is, some aspect of the image alteration effect may increase or be applied more vigorously as rotation continues, and may decrease or be applied less vigorously when rotation decrease or stops. For instance, as shown in FIG. **12**, the handheld device **50** may continue to experience rotation **186** times t_B and t_C, eventually reaching a third position at time t_C. Based upon this continued rotational motion **186**, the "intensity" of the spiral effect **188** may increase, such that the curve **192** emanates even further outward from the center **190** of the screen **132** at time t_C. Next, from times t_C to t_D, the handheld device **50** may experience little or no motion, thus retaining approximately the same position from times t_C to t_D. As shown, because rotational motion was not detected during between times t_C and t_D, the "intensity" of the spiral effect **188** may decrease and the curve **192** may retract back toward the center **190** of the screen **132**. Further, although not specifically shown in FIG. **12**, it should be understood that additional factors, such as the velocity of the rotational motion **186**, could also contribute to an increase or decrease in the intensity of an applied image alteration effect.

Like the image alteration effects **86** discussed above, the spiral effect shown in FIG. **12** also may be applied as either a full-quality version or a reduced-quality version depending on the currently available device processing resources. For example, as shown in plot **196** of FIG. **12**, when the currently available device processing resources (curve **198**) exceed a threshold **200**, a reduced-quality version of the spiral effect may be applied. When the currently available device processing resources **198** exceed the threshold **200**, a full-quality version of the spiral effect may be applied. Since the currently available device processing resources **198** do not exceed the threshold **200** at time t_B, the reduced-quality version of the spiral effect may be applied at time t_B. As shown in FIG. **12**, such a reduced-quality version of the spiral effect may employ fewer vertex transformations than the full-quality version to conserve the total amount of resources consumed. By way of example, in some embodiments, the reduced-quality version of the spiral effect may employ fewer than half or even fewer than one quarter the total number of vertex transformations computed by the full-quality version. In this way, the handheld device **50** may continue to apply the spiral effect, albeit with less complexity, despite changes in the device processing resources currently available.

Continuing to FIG. **13**, a "brush-stroke" effect that may be triggered by motion of the handheld device **50** is illustrated, in accordance with aspects of the present disclosure. The brush-stroke effect may cause an image displayed on the handheld device **50** to be altered, such that the image appears as a plurality of "brush-like" strokes, wherein the direction of the strokes may be determined based on the direction of motion that the handheld device **50** experiences. For example, at time t_A, the handheld device **50** generally may be stationary and may display an image **146** of a subject **142** (e.g., using photo the browser application **66**). From time t_A to time t_B, the handheld device **50** may experience linear motion in the direction indicated by arrow **212**. Thus, at time t_B, a brush-stroke effect may be applied to the image **146**, such that the subject **142** appears as a number of brush-like strokes, each stroke generally being oriented in direction **212**. Next, from time t_B to time t_C, the handheld device **50** may experience linear motion in the direction indicated by arrow **214**. As such, the image **146** is further altered at time t_C, such that the direction of the brush-strokes (representing subject **142**) are re-oriented in direction **214**. In some embodiments, the length, thickness, color, or distribution of the brush-strokes may be at least partially influenced by the velocity at which the handheld device **50** is moved and/or the amount of time over which the motion (e.g., **212** or **214**) occurs.

To enable the handheld device **50** to continue to apply the brush-stroke effect despite changes in the currently available device processing resources, the handheld device **50** may variably apply a full-quality version or a reduced-quality version of the brush-stroke effect depending on the amount

of device processing resources currently available. In some embodiments, such an application of the full-quality version or reduced-quality version of the brush-stroke effect may take place in real time. For example, as shown by a plot **202** of FIG. **13**, available device processing resources (curve **204**) may vary over time. While the currently available device processing resources **204** exceed a threshold **206** (e.g., at times t_C and t_B), the handheld device **50** may apply a full-quality version of the brush-stroke effect. When the currently available device processing resources **204** do not exceed the threshold **206** (e.g., at time t_C), the handheld device **50** may apply a reduced-quality version of the brush-stroke effect. By way of example, the level of realism or detail of the full-quality version of the brush-stroke effect may be higher than that of the reduced-quality version, which may consume fewer resources than the full-quality version of the brush-stroke effect.

As can be appreciated, the various image alteration examples described herein are not intended to be limited to one type of device operation event **90**. Indeed, a user may have the option of configuring image alteration effects to be triggered by different device operation events **90**, or by a combination of multiple device operation events **90**. Any suitable device operation event **90**, alone or in combination with other device operation events **90**, may be employed to affect the application of an image alteration effect **86**.

Moreover, while the above-discussed examples of applications of image alteration effects **86** have illustrated only the application of a full-quality version of the image alteration effect **86** or a single reduced-quality version of the image alteration effect **86**, it should be appreciated that any suitable number of reduced-quality versions of the image alteration effect **86** may be employed. For example, as shown by a plot **210** of FIG. **14**, when available device processing resources (curve **212**) change over time, several different reduced-quality versions of an image alteration effect **86** may be applied. As particularly illustrated by the plot **210**, a full-quality version of an image alteration effect **86** may be applied during times t_C and t_D, when the currently available device processing resources exceed a first threshold **214**. A first reduced-quality version of the image alteration effect **86** may be applied during time t_A, when the currently available device processing resources do not exceed the first threshold **214** but do exceed a second threshold **216**. Such a first reduced-quality version of the image alteration effect **86** may be less complex, and thus less resource-intensive, than the full-quality version of the image alteration effect **86**. A second reduced-quality version of the image alteration effect **86** may be applied during time t_B, when the currently available device processing resources do not exceed the second threshold **216** but do exceed a third threshold **218**. The second reduced-quality version of the image alteration effect **86** may less complex, and thus less resource-intensive, than the first reduced-quality version of the image alteration effect **86**. Finally, a third reduced-quality version of the image alteration effect **86** may be applied during time t_E, when the currently available device processing resources do not exceed the third threshold **218**. The third reduced-quality version of the image alteration effect **86** may less complex, and thus less resource-intensive, than the second reduced-quality version of the image alteration effect **86**.

Not every electronic device **10** may be capable of applying a full-quality version of an image alteration effect **86**. Such electronic devices **10** may apply only reduced-quality versions of the image alteration effect **86**. In addition, even an electronic device **10** capable of applying a full-quality version of an image alteration effect **86** still may occasionally lack the device processing resources to apply the full-quality version of the image alteration effect **86** in real time. To enable an image alteration effect **86** to be applied to images on such electronic devices **10** in full, certain embodiments of the electronic device **10** may store device operation events **90** that occurred while image data **82** is captured as metadata **108** in an image file **98**, as illustrated in FIG. **15**. At a later time, the same or another electronic device **10** may apply an image alteration effect **86** to the image data **82** based on the associated device operation events **90**.

As shown in FIG. **15**, original image data **82** may be obtained from an imaging service **74** and subsequently encoded in an encoder **96** to produce an image file **98**. The image file **98** may be stored in the nonvolatile storage **20**. As the original image data **74** is being captured by the imaging service **74**, one or more device operation events **90** may be occurring. As noted above, such device operation events **90** may represent image events deriving from ISP data **106**, audio events from the audio analysis logic **106** (which may analyze an audio signal **102** input to the audio input device **40** or previously obtained audio data **104**), location events from the positioning device **38**, and/or motion events from the motion sensing device **36**. These device operation events **90** may be associated with the resulting image file **98** as metadata **108** or in a database associated with the image file **98**. In some embodiments, the device operation events **90** associated with the image file **98** may be obtained at a different time than capture (e.g., when the electronic device **10** is applying an image alteration effect **86** as shown in FIG. **4** or **5**).

When the image data **98** and one or more device operation events **90** are associated (e.g., via the metadata **108** of the image file **98**), image alteration effects **86** may be applied to the image data **82** of the image file **98** independent of the electronic device **10** that produced the device operation events **90**. That is, as shown in FIG. **16**, such image files **98** may be transferred from one electronic device **10** (e.g., a handheld device **50**) via a data connection **230** to another electronic device (e.g., a notebook computer **232**). The handheld device **50** may have originally produced the device operation events **90** associated with image files **98**, but the notebook computer **232** may have more image processing capabilities, and thus may be better suited to applying a full-quality version of an image alteration effect than the handheld device **50**.

The notebook computer **232** may obtain both the original image data **82** and the associated device operation events **90** from an image file **98** transferred from another electronic device **10**, as shown in FIG. **17**. A decoder **234** may decode the image file **98** to obtain the original image data **82**, while the device operation events **90** may be extracted **236** from the metadata **108**. In some embodiments, the computer **232** may perform further analysis on the device operation events **90** or on other information present in the original image data **82** to determine certain device operation event **90** properties. By way of example, when the original image data **82** is a video file that includes an audio stream, the computer **232** may perform a full-quality version of a determination of an audio property (e.g., a frequency analysis) of the audio stream.

Image processing logic **30** of the computer **232** may apply an image alteration effect **86** to the image data **82** based at least partly on the associated device operation events **90**. Altered image data **84** that results may be displayed on a display **28** or encoded by an encoder **96** to produce another

image file **98**. In some embodiments, the device operation events **90** originally associated with the original image file **98** also may be associated with the newly created image file **98** of altered image data **84** (to enable further image alteration effects **86** to be applied based at least partly on the device operation events **90** at a later time). Although the embodiment of FIG. **17** has been described as occurring within the computer **232**, it should be understood that any other suitable electronic device **10** may apply the image alteration effects **86** to the image data **82** based at least partly on the device operation events **90** associated with the image file **98**. In at least one embodiment, the application of the image alteration effect(s) **86** shown in FIG. **17** occur in an electronic device **10** (e.g., the notebook computer **232**) having generally higher device processing resources than the electronic device **10** in which the device operation events **90** occurred (e.g., the handheld device **50**).

Since the image alteration effects **86** applied to the image data **82** in the flow diagram of FIG. **17** may be based at least partly on previously obtained device operation events **90** (e.g., from the metadata **108**), rather than device operation events **90** being detected as the image alteration effects **86** are applied, many different types of image alteration effects **86** may be tested by a user before a desired image alteration effect **86** is ultimately selected. For example, FIG. **18** illustrates the application of an image alteration effect **86** based at least partly on the video images **134** and device operation event(s) **90** property **166** in the example of FIG. **11**. In the example illustrated by FIG. **18**, an electronic device **10** such as the computer **232** may loop the playback of video images **134** derived from an image file **98** transferred from another electronic device. Each time the video images **134** are looped, a different image alteration effect **86** may be applied. Since the device operation events **90** are associated with the image file **98**, the device operation events **90** may remain the same each time the video images **134** loop.

In the example of FIG. **18**, the device operation event **90** property upon which the application of the image alteration effect(s) **86** are applied may be the device operation event **90** property **166** shown in FIG. **11**. When the video images **134** first begin to loop, a first image alteration effect **86** may be applied (e.g., the zooming effect) in accordance with the device operation event **90** property **166**. Thus, since the device operation event **90** property **166** is low at times t_A and t_C, the image alteration effect **86** may "zoom out" on the video image **134** at times t_A and t_C. Since the device operation event **90** property **166** is relatively high at times t_B and t_D, the image alteration effect **86** may "zoom in" on the video image **134** at times t_B and t_D.

Next, the video images **134** may repeat with a different image alteration effect **86** but the same device operation event **90** property **166** (FIG. **11**). For example, a water ripple effect may be applied in accordance with the same device operation event **90** property **166** with which the zooming effect was applied. Thus, since the device operation event **90** property **166** is low at times t_A and t_C, the image alteration effect **86** may overlay a relatively small amount of the water-like graphical element **162** (e.g., reaching a relatively low height **163**) onto the video image **134** at times t_A and t_C. Since the device operation event **90** property **166** is relatively high at times t_B and t_D, the image alteration effect **86** may overlay a relatively large amount of the water-like graphical element **162** (e.g., reaching a relatively high height **163**) onto the video image **134** at times t_B and t_D. This process of applying various image alteration effects **86** based at least partly on the same device operation event(s) **90** may continue for any suitable number of image alteration effects **86** as the video images **134** continue to loop. A user then may select the particular application of an image alteration effect **86** that the user finds most appealing (e.g., for encoding in the encoder **96** and storage as a new image file **98**).

As will be appreciated, the various techniques described above and relating to alteration of image data based upon one or more device operation events are provided herein by way of example only. Accordingly, it should be understood that the present disclosure should not be construed as being limited to only the examples provided above. Indeed, many variations of the image alteration effects **86** set forth above may exist. Further, it should be appreciated that the above-discussed image alteration techniques may be implemented in any suitable manner. For instance, the image processing logic **30** may be implemented using hardware (e.g., suitably configured circuitry), software (e.g., via a computer program including executable code stored on one or more tangible computer readable medium), or via using a combination of both hardware and software elements. Through use of the disclosed image alteration techniques, a user may be able to exercise greater creativity in generating and displaying altered images that are not only creative, but also aesthetically pleasing. In this manner, the user may experience greater satisfaction when viewing such images, thereby improving the user's experience when interacting with electronic devices, such as devices **10** or **50**.

Moreover, the technical effects of the present disclosure include, among other things, enabling electronic devices with various processing capabilities to apply the same general image alteration effects. That is, while some electronic devices at certain times may lack the device processing resources to apply a full-quality version of an image alteration effect in real time, the same electronic devices may be capable of applying a reduced-quality version of the same image alteration effect in real time. Likewise, even if one electronic device is only capable of a applying a reduced-quality version of an image alteration effect or has varied in applying full and reduced-quality versions of an image alteration effect, another electronic device may be capable of applying the full-quality version. As such, by associating the device operation events occurring when image data is originally captured on a first electronic device, a second electronic device may be able to apply a full-quality version of an image alteration effect to such image data according to the associated device operation events.

The specific embodiments described above have been shown by way of example, and it should be understood that these embodiments may be susceptible to various modifications and alternative forms. It should be further understood that the claims are not intended to be limited to the particular forms disclosed, but rather to cover all modifications, equivalents, and alternatives falling within the spirit and scope of this disclosure.

What is claimed is:

1. An electronic device comprising:

a data processing circuit to improve digital image altering capability of an electronic based device, the data processing circuit configured to:

receive image data;

detect the occurrence of a device operation event that comprises at least one of an audio event, a motion event, a location event, or an image event;

modify the image data with an image alteration effect to construct a first altered image data in response to the detection of the occurrence of the device operation event;

display the first altered image data on a user display in real-time responsive to the occurrence of the device operation event, wherein the first altered image data is constructed by using a full-quality version of the image alteration effect associated with the device operation event when currently available device processing resources of the electronic device exceed a threshold or a reduced-quality version of the image alteration effect associated with the device operation event when the currently available device processing resources of the electronic device do not exceed the threshold;

automatically apply, after generation of the first altered image data with the reduced-quality version of the image alteration effect associated with the device operation event, the full-quality version of the image alteration effect to the received image data to create a second altered image data after the currently available device processing resources shifts from not exceeding the threshold to exceeding the threshold; and

store the second altered image data.

2. The electronic device of claim **1**, wherein the data processing circuitry is configured to vary between using the full-quality version of the image alteration effect and the reduced-quality version of the image alteration effect as the currently available device processing resources change in real time.

3. The electronic device of claim **1**, wherein the image alteration effect comprises at least one of a sepia effect, a black and white effect, a glow effect, a colored pencil effect, a thermal camera effect, an x-ray effect, a pop art effect, a comic book effect, a bulge effect, a dent effect, a twirl effect, a squeeze effect, a mirror effect, a light tunnel effect, a fisheye effect, a stretch effect, a water reflection effect, a spiral effect, a depth-changing effect, a brush-stroke effect, or a night-vision effect, or some combination thereof.

4. The electronic device of claim **1**, further comprising at least one of audio analysis logic configured to analyze an audio signal played back from audio data stored on the electronic device or to analyze an external audio signal received by an audio input device, a motion sensing device configured to detect motion experienced by the electronic device, a positioning device configured to detect a geographic position of the electronic device, or an imaging subsystem configured to detect one or more imaging properties, or some combination thereof;

wherein the data processing circuitry is further configured to detect the occurrence of the audio event, the motion event, the location event, or the imaging event based upon data provided by the audio analysis logic, the motion sensing device, the positioning device, or the imaging subsystem, respectively.

5. A method, comprising:

improving digital image altering capability of an electronic based device by performing at least the following:

receiving image data onto the electronic device;

detecting a device operation event configured to trigger alteration of the image data using the electronic device;

determining an amount of processing bandwidth available to the electronic device;

applying, on the electronic device, in real-time a full-quality version or one or more reduced-quality versions of an image alteration effect to the image data upon detection of the device operation event to alter the image data, wherein applying the full-quality version or the one or more reduced-quality versions of the image alteration effect comprises:

applying the one or more reduced-quality versions of the image alteration effect to the image data when the available processing bandwidth is below a first threshold to construct a first altered image data;

applying the full-quality version of the image alteration effect to the image data when the available processing bandwidth is not below the first threshold to construct the first altered image data; and

displaying the first altered image data on a display of the electronic device;

automatically applying the full-quality version of the image alteration effect to the image data to create a second altered image data once the available processing bandwidth transitions from below the first threshold to not below the first threshold when the first altered image data is constructed with the one or more reduced-quality versions of the image alteration effect, wherein the image alteration effect is associated with the device operation event; and

storing the second altered image data.

6. The method of claim **5**, wherein the full-quality version and the one or more reduced-quality versions of the image alteration effect are variably applied in real time in response to changes in the available processing bandwidth.

7. The method of claim **5**, further comprising, after the altered image data is displayed on the display:

displaying the second altered image data; and

encoding the second altered image to obtain an image file.

8. The method of claim **5**, wherein applying either the full-quality version or the one or more reduced-quality versions of the image alteration effect comprises:

applying a first reduced-quality version of the image alteration effect to the image data when the available processing bandwidth is below the first threshold but not below a second threshold; and

applying a second reduced-quality version of the image alteration effect to the image data when the available processing bandwidth is below the second threshold.

9. The system of claim **1**, wherein the motion event includes detecting rotational motion of the electronic device.

10. A system comprising:

a first electronic device to improve digital image altering capability, the first electronic device configured to:

capture image data using an image subsystem;

store the image data as an image file associated with one or more indications of one or more device operation events that occurred while the image data was captured, wherein the one or more device operation events comprise at least one of an audio event, a motion event, a location event, or an image event; and

construct a plurality of altered image data by modifying the image data with a plurality of altered image effects based on available processing resources and in response to detecting the one or more device operation events; and

a second electronic device configured to:

receive the image file;

display in real-time to the received image file, in succession and on an electronic display associated with the second electronic device, a plurality of different versions of the image file corresponding to the altered image data, wherein each different version of the image file corresponding to one of the

altered image data is generated by applying a full-quality version of one of the image alteration effects to the image file based at least in part on the one or more indications of the one or more device operation events associated with the image file;

receive a user selection of one of the plurality of different versions of the image file; and

store a second image file based on the user selected version of the image file;

wherein the second image file is created by automatically applying the user selected image alteration effects based in part on the one or more device operation events.

11. The system of claim **10**, wherein the first electronic device is further configured to apply a reduced-quality version of one or more of the plurality of image alteration effects to the image data to produce a first altered image data of the plurality of the alter image data and to display the first altered image data of the plurality of the alter image data on an electronic display of the first electronic device.

12. The system of claim **10**, wherein the first electronic device is further configured to apply either the full-quality version or a reduced-quality version of one or more of the plurality of image alteration effects to the image data to produce a first altered image data of the plurality of the alter image data and to display the first altered image data of the plurality of the alter image data on an electronic display of the first electronic device, wherein the first electronic device is configured to apply the full-quality version when the currently available device processing resources of the first electronic device exceed a threshold and apply the reduced-quality version otherwise.

13. The system of claim **10**, wherein the second electronic device is configured to apply a full-quality version of an analysis of an audio stream associated with the image file to determine a refined indication of one of the one or more indications of the device operation events.

14. An apparatus comprising:

a user display;

a memory coupled to the user display, wherein the memory include instructions encoded thereon when executed by at least one processor, causes the apparatus to:

receive image data at the memory;

detect an occurrence of a device operation event associated with the image data, the device operation event including at least one of an audio event, a motion event, a location event, or an image event;

apply, in response to the detection of the device operation event, a full-quality version of an image alteration effect associated with the device operation event to construct a first altered image data when currently available device processing resources of the apparatus exceeds a threshold;

apply, in response to the detection of the device operation event, a reduced-quality version of the image alteration effect to construct the first altered image data when the currently available device processing resources are less-than-or-equal-to the threshold;

display the first altered image data on the user display in real-time;

automatically apply, after display of the first altered image data and after the currently available device processing resources are determined to change from less-than-or-equal-to the threshold to greater-than the threshold, the full-quality version of the image alteration effect to the received image data to create a second altered image data; and

store the second altered image data.

15. The apparatus of claim **14**, wherein the instructions when executed by the at least one processor further causes the apparatus to:

apply the reduced-quality version of the image alteration effect to construct the first altered image data when the currently available device processing resources are less-than-or-equal-to the threshold but not below a second threshold; and

apply a second reduced-quality version of the image alteration effect to construct the first altered image data when the currently available device processing resources are below the second threshold.

16. The apparatus of claim **14**, wherein the full-quality version of the image alteration effect comprises vertex transformation calculations and the reduced-quality version of the image alteration effect comprises fewer vertex transformation calculations than the full-quality version of the image alteration effect.

17. The apparatus of claim **16**, wherein the reduced-quality version of the image alteration effect comprises one-quarter or fewer the vertex transformation calculations of the full-quality version of the image alteration effect.

18. The apparatus of claim **14**, wherein the full-quality version of the image alteration effect comprises an attenuated water ripple effect and the reduced-quality version of the image alteration effect comprises a sine-wave-based water ripple effect without attenuation.

19. The apparatus of claim **14**, further comprising a motion sensor, wherein the motion event includes the motion sensor detecting rotational motion of the apparatus.

20. A method comprising:

receiving, by an electronic device, image data;

detecting, by the electronic device, an occurrence of a device operation event associated with the image data, the device operation event including at least one of an audio event, a motion event, a location event, or an image event;

applying, by the electronic device and in response to the detection of the device operation event, a full-quality version of an image alteration effect associated with the device operation event to construct a first altered image data when currently available device processing resources of the electronic device exceeds a threshold;

applying, by the electronic device and in response to the detection of the device operation event, a reduced-quality version of the image alteration effect to construct the first altered image data when the currently available device processing resources are less-than-or-equal-to the threshold;

displaying in real-time the first altered image data on a user display of the electronic device;

automatically applying, by the electronic device, after display of the first altered image data and after the currently available device processing resources are determined to change from less-than-or-equal-to the threshold to greater-than the threshold, the full-quality version of the image alteration effect to the received image data to create a second altered image data; and

store the second altered image data within memory of the electronic device.

21. The method of claim **20**, further comprising

applying, by the electronic device, the reduced-quality version of the image alteration effect to construct the first altered image data when the currently available

device processing resources are less-than-or-equal-to the threshold but not below a second threshold; and

applying, by the electronic device, a second reduced-quality version of the image alteration effect to construct the first altered image data when the currently available device processing resources are below the second threshold.

22. The method of claim **20**, wherein the indication of the device operation event is stored in metadata associated with the image file.

23. The method of claim **20**, wherein the motion event includes the motion sensor detecting rotational motion of the electronic device.

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