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(54) METHOD AND SYSTEM FOR SPLIT-SCREEN VIDEO DISPLAY

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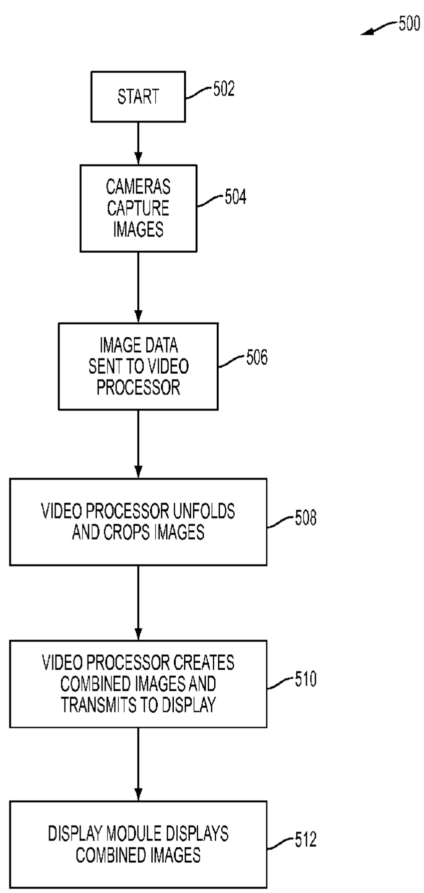
USPC **386/226**

(57) **ABSTRACT**

A system includes a first camera operable to capture omnidirectional images and send omnidirectional-image data representing the omnidirectional images, a second camera operable to capture narrow-view images and send narrow-view-image data representing the narrow-view images, a video processor coupled to the first camera and the second camera and operable to form combined-image data using at least part of the omnidirectional-image data and the narrow-view-image data, and a display module interoperably coupled to the video processor and operable to display combined images from the combined-image data. The combined images each comprise a narrow-view-display portion and an omnidirectional-display portion.



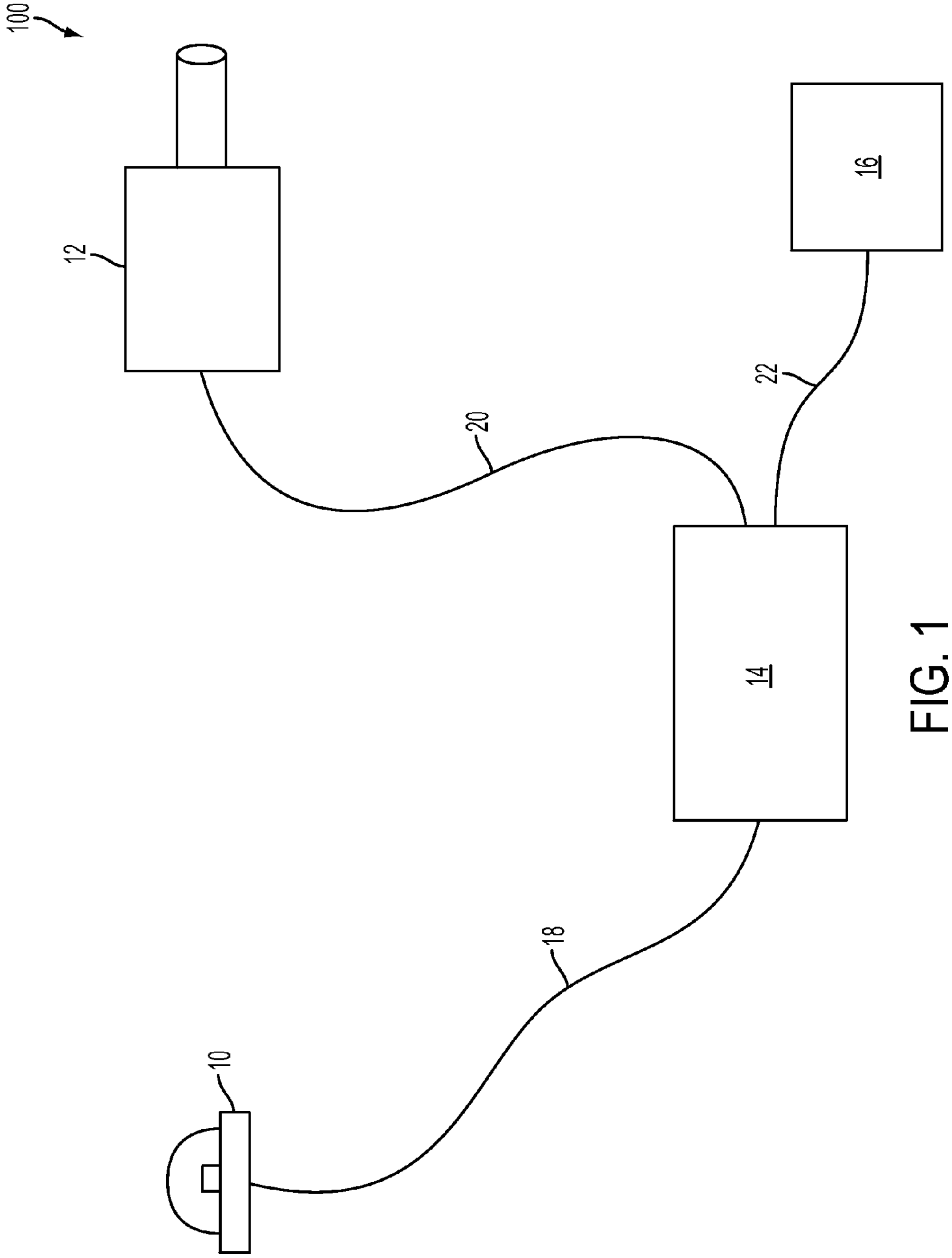


FIG. 1

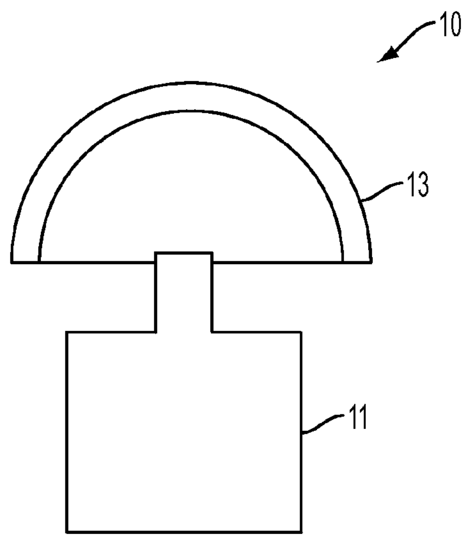


FIG. 2A

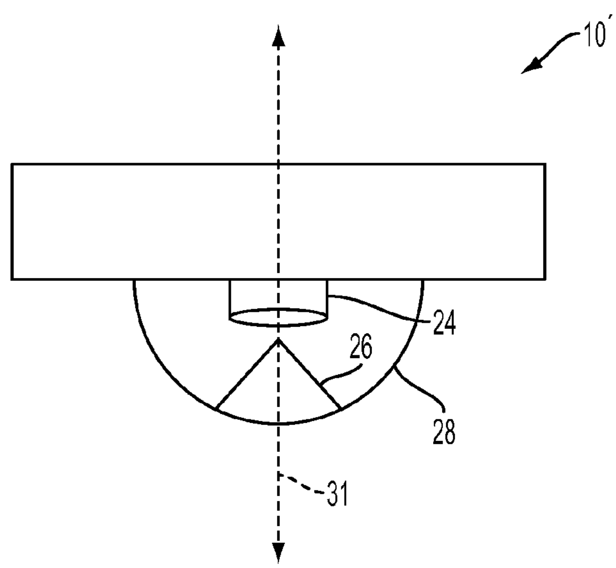


FIG. 2B

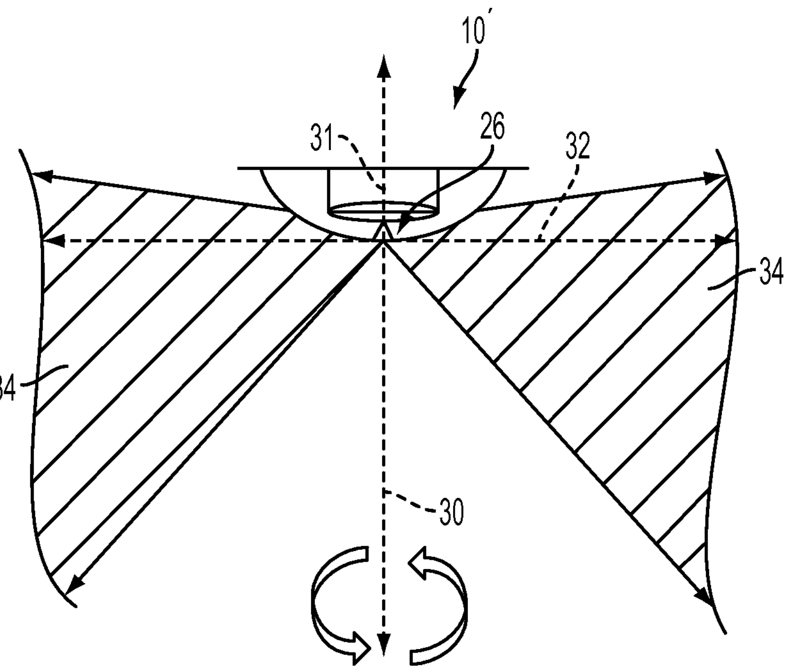


FIG. 3

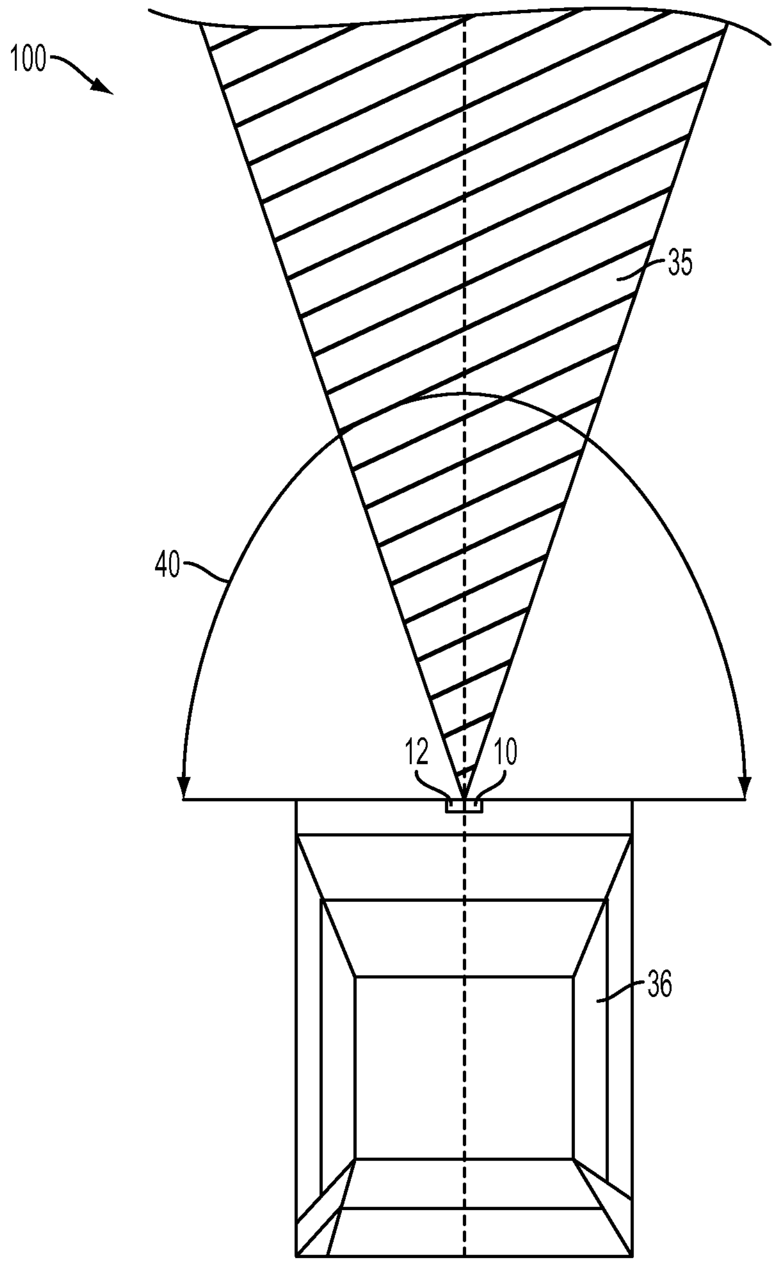


FIG. 4A

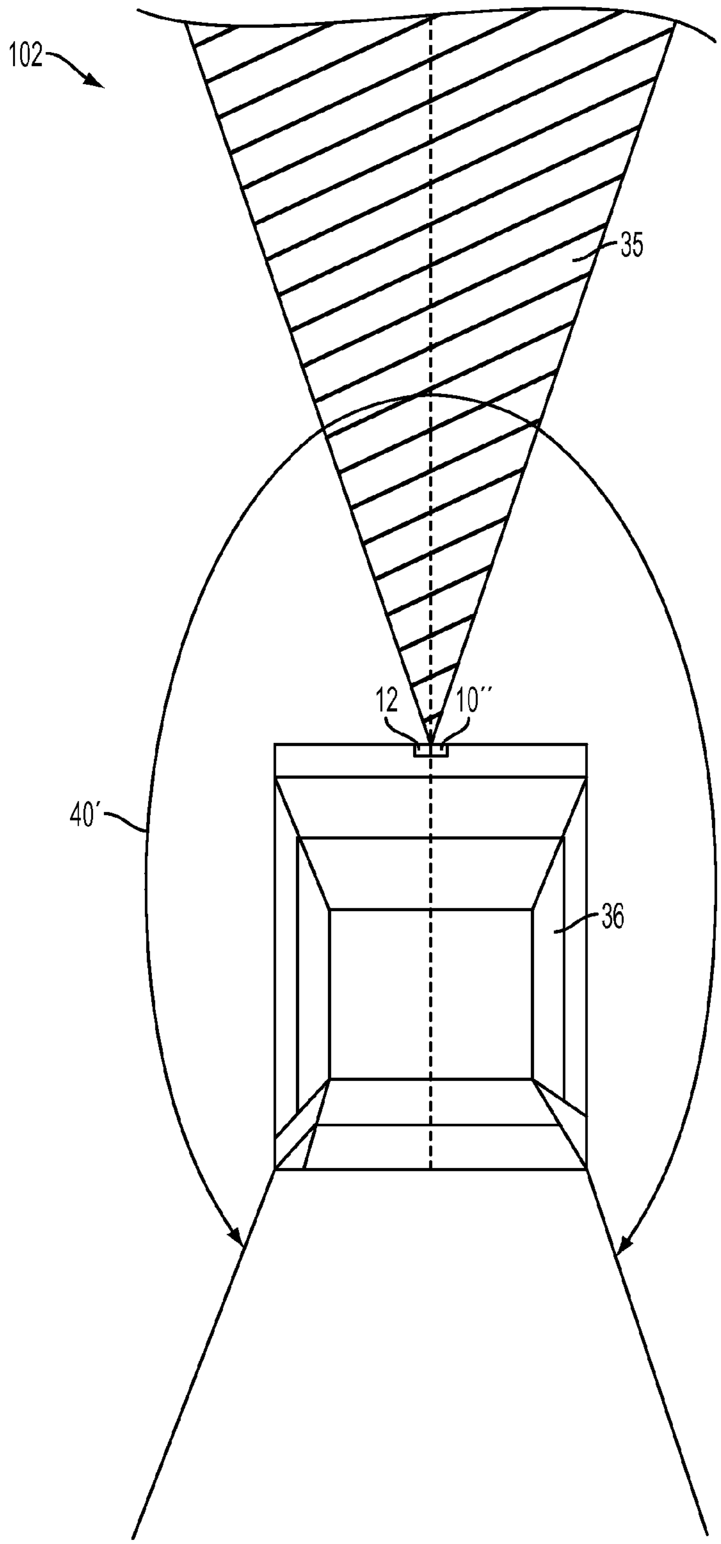


FIG. 4B

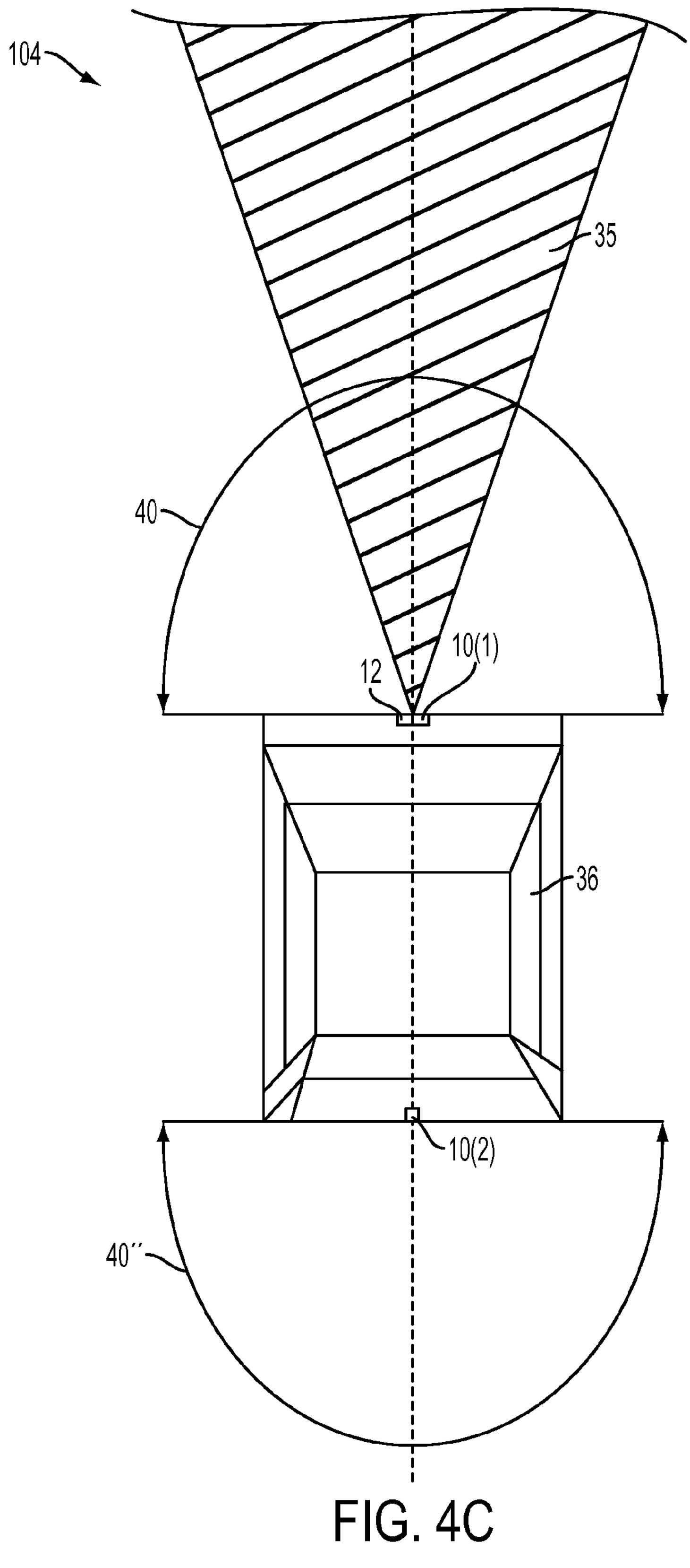


FIG. 4C

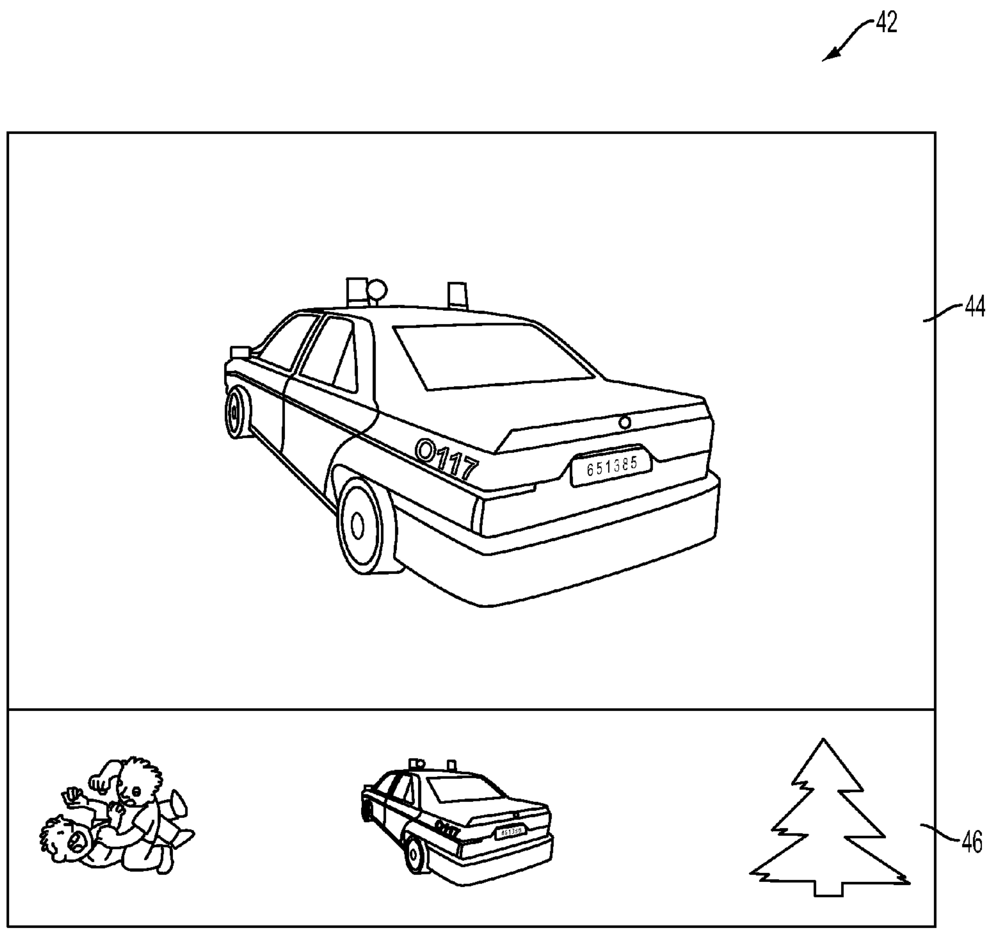


FIG. 5A

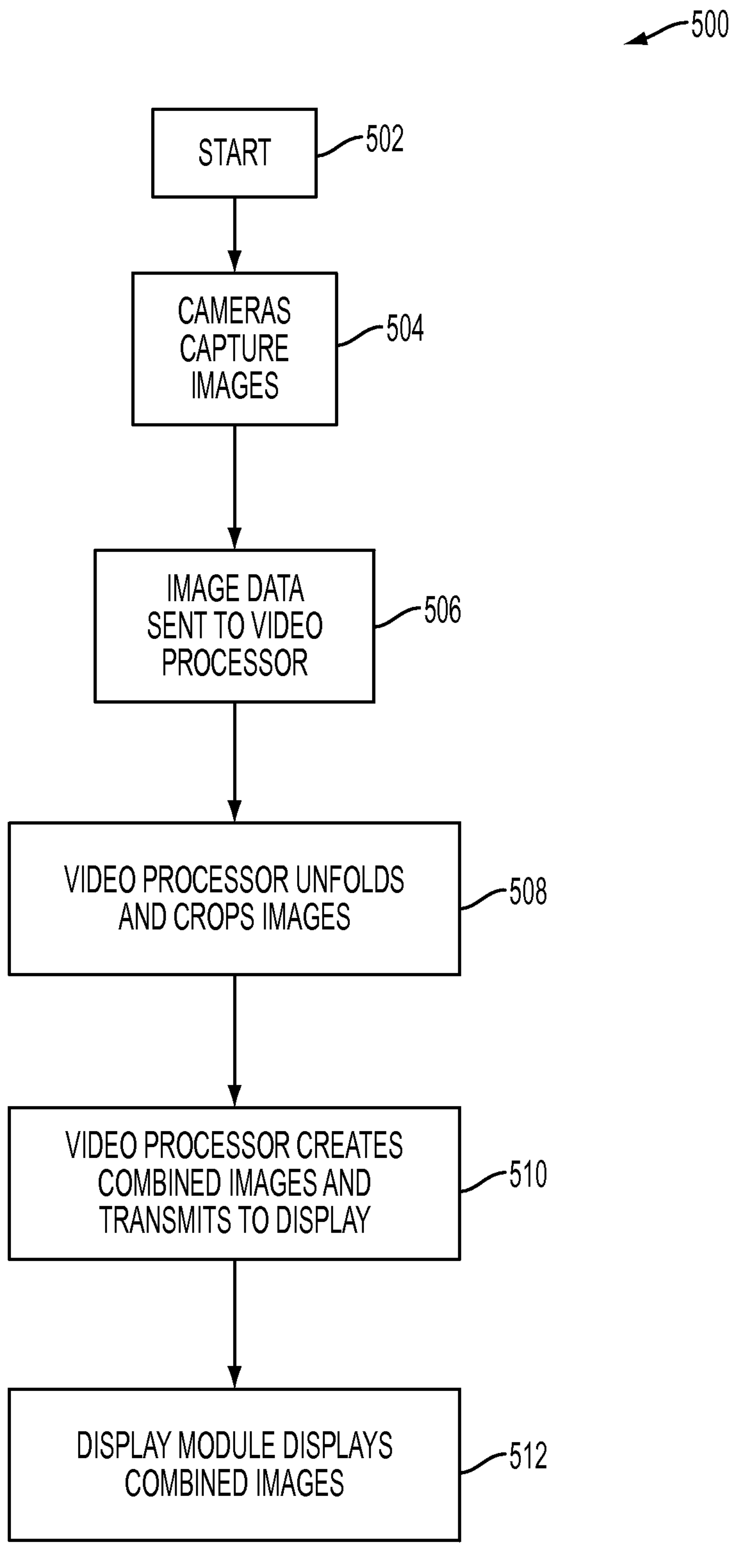

500
START
502
CAMERAS CAPTURE IMAGES
504
IMAGE DATA SENT TO VIDEO PROCESSOR
506
VIDEO PROCESSOR UNFOLDS AND CROPS IMAGES
508
VIDEO PROCESSOR CREATES COMBINED IMAGES AND TRANSMITS TO DISPLAY
510
DISPLAY MODULE DISPLAYS COMBINED IMAGES
512

FIG. 5B

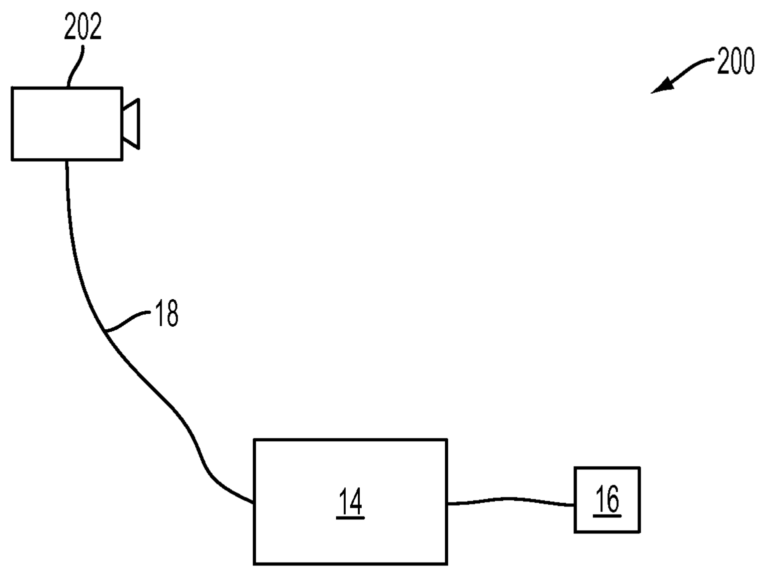


FIG. 6A

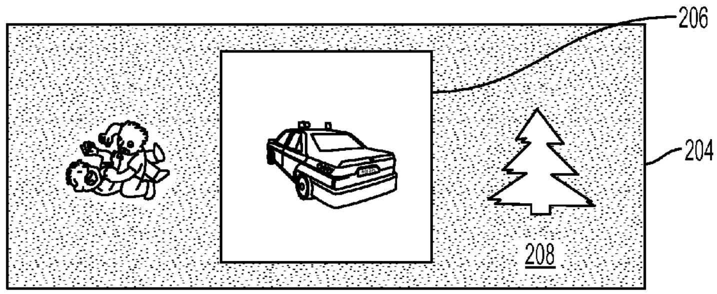


FIG. 6B

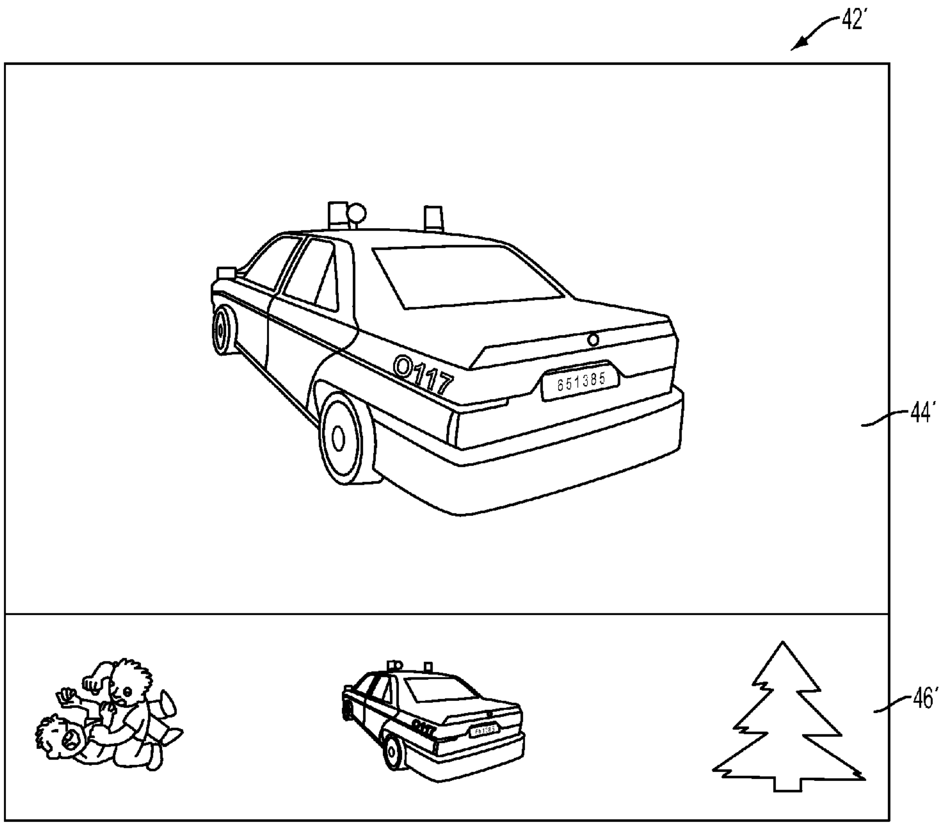


FIG. 6C

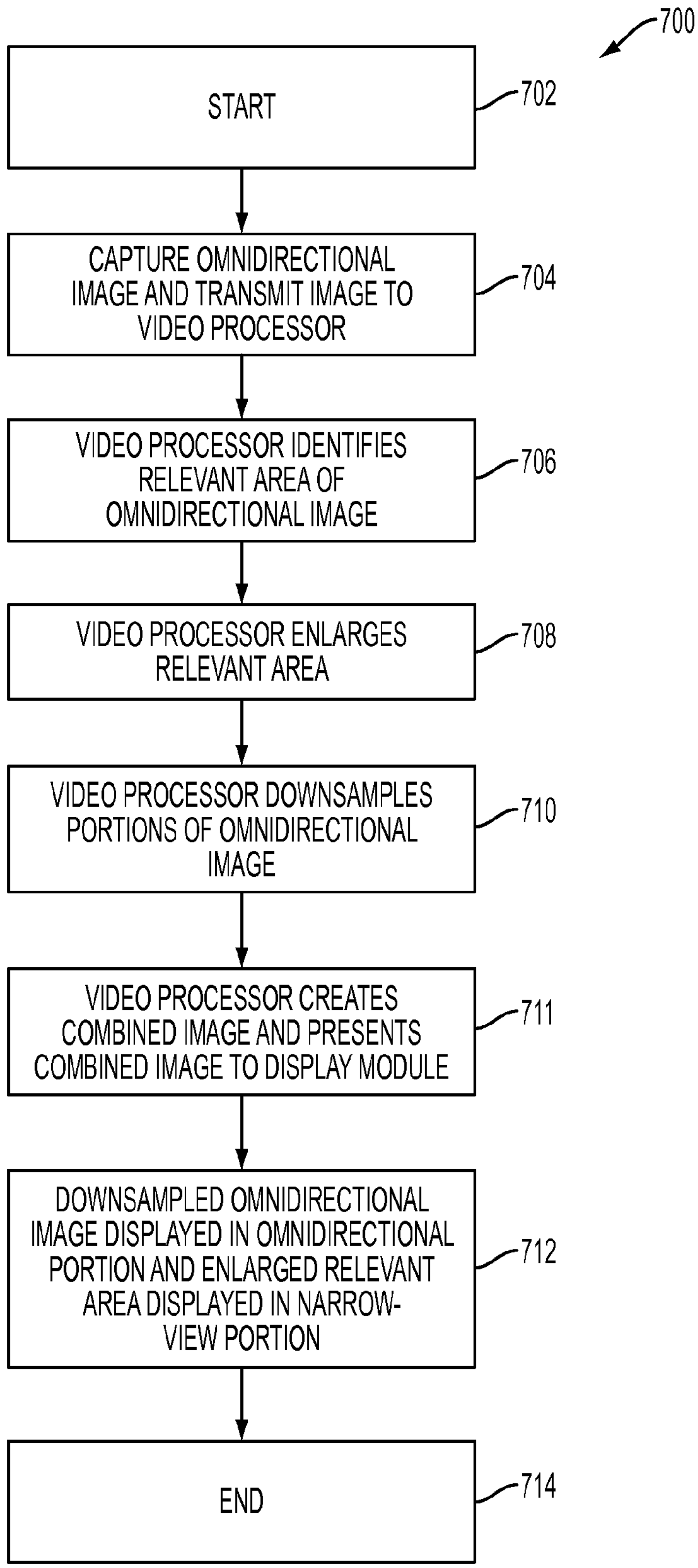

700
START
702
CAPTURE OMNIDIRECTIONAL IMAGE AND TRANSMIT IMAGE TO VIDEO PROCESSOR
704
VIDEO PROCESSOR IDENTIFIES RELEVANT AREA OF OMNIDIRECTIONAL IMAGE
706
VIDEO PROCESSOR ENLARGES RELEVANT AREA
708
VIDEO PROCESSOR DOWNSAMPLES PORTIONS OF OMNIDIRECTIONAL IMAGE
710
VIDEO PROCESSOR CREATES COMBINED IMAGE AND PRESENTS COMBINED IMAGE TO DISPLAY MODULE
711
DOWNSAMPLED OMNIDIRECTIONAL IMAGE DISPLAYED IN OMNIDIRECTIONAL PORTION AND ENLARGED RELEVANT AREA DISPLAYED IN NARROW-VIEW PORTION
712
END
714

FIG. 7

METHOD AND SYSTEM FOR SPLIT-SCREEN VIDEO DISPLAY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 13/109,557, filed on May 17, 2011. U.S. patent application Ser. No. 13/109,557 claims priority from U.S. Provisional Patent Application No. 61/345,663, filed May 18, 2010, entitled METHOD AND SYSTEM FOR SPLIT-SCREEN VIDEO DISPLAY. U.S. patent application Ser. No. 13/109,557 and U.S. Provisional Patent Application No. 61/345,663 are incorporated herein by reference. In addition, this patent application incorporates by reference U.S. patent application Ser. No. 12/362,381 filed Jan. 29, 2009, entitled OMNIDIRECTIONAL CAMERA FOR USE IN POLICE CAR EVENT RECORDING and U.S. patent application Ser. No. 12/188,273 filed Aug. 8, 2008, entitled COMBINED WIDE-ANGLE/ZOOM CAMERA FOR LICENSE-PLATE IDENTIFICATION.

BACKGROUND

[0002] 1. Field of the Invention

[0003] In general, this patent application relates to video-recording devices and more particularly, but not by way of limitation, to systems that include split-screen video displays for use with law-enforcement vehicles.

[0004] 2. History of the Related Art

[0005] Cameras and other video-recording devices have long been used to capture still images and video. In general, cameras include an enclosed hollow portion with an opening or aperture at one end to allow light to enter and a recording surface for capturing the light at another end. In addition, cameras often have a lens positioned in front of the aperture along an optical axis to gather incoming light and focus all or part of an image onto the recording surface.

[0006] Use of dashboard cameras in police vehicles has been known for years and is an integral part of a police department's evidence-gathering capability. One limitation of conventional cameras is a limited field of vision. Fields of view vary from camera to camera but, in general, most cameras have a field of view that ranges from a few degrees to, at most, 180°.

[0007] To overcome the limited field of view, surveillance cameras used for monitoring large areas are oftentimes mounted to mechanisms adapted to enable the camera to pan, tilt, and zoom in order to move objects into the camera's field of view. One type of camera, called an omnidirectional camera, has been used to monitor large areas without a need for mechanisms to enable pan, tilt, and zoom.

[0008] Some omnidirectional cameras may be adapted to capture images from all directions (i.e., a full sphere). However, many omnidirectional cameras do not capture a full sphere of images, but rather capture 360 degrees of images along a single axis with the field of view being limited angularly above and below the axis. As referred to herein, an omnidirectional camera is a camera adapted to capture omnidirectional images. The omnidirectional camera is adapted to capture wide-angle images from a wide-angle field of view up to and including 360-degree images from a 360-degree field of view. An omnidirectional image may be a wide-angle image, for example, of 130-190° from a wide-angle field of view, for example, of 130-360°. In some cases, the omnidirectional camera may have a field of view ranging from on the order of 180°, 190°, 200°, 210°, 220°, 230°, 240°, 250°, 260°, 270°, 280°, 290°, 300°, 310°, 320°, 330°, 340°, 350°, or 360° and the omnidirectional images may be less than or equal to a omnidirectional-camera field of view.

[0009] More recently, dual-lens devices have been developed that combine a narrow-view lens and an omnidirectional lens. These dual-lens devices typically allow recording of up to 360 degrees of images at a plurality of different resolutions. However, display of the output from such dual-lens devices in a way that eliminates unimportant portions of images remains problematic.

SUMMARY OF THE INVENTION

[0010] A system includes a first camera operable to capture omnidirectional images and send omnidirectional-image data representing the omnidirectional images, a second camera operable to capture narrow-view images and send narrow-view-image data representing the narrow-view images, a video processor coupled to the first camera and the second camera and operable to form combined-image data using at least part of the omnidirectional-image data and the narrow-view-image data, and a display module interoperably coupled to the video processor and operable to display combined images from the combined-image data. The combined images each comprise a narrow-view-display portion and an omnidirectional-display portion.

[0011] A method includes concurrently capturing omnidirectional images and narrow-view images, storing data representing the captured omnidirectional images as omnidirectional-image data, storing data representing the captured narrow-view images as narrow-view-image data, removing data representing an unimportant portion of the narrow-view images to create cropped narrow-view-image data, creating combined-image data using the cropped narrow-view-image data and at least part of the omnidirectional-image data, and displaying combined images from the combined-image data.

[0012] A system includes an omnidirectional sensor operable to capture images and create therefrom image data, a video processor operable to create, from at least part of the image data, combined-image data includes narrow-view-image data and non-narrow-view-image data, and a display module interoperably coupled to the video processor and operable, using the combined-image data, to display combined images includes narrow-view images and non-narrow-view images. The displayed narrow-view images comprise an enlarged version of a portion of images represented by the image data.

[0013] A method includes capturing omnidirectional images, enlarging a relevant area of the omnidirectional images via a video processor, the enlarging resulting in enlarged relevant-area images, downsampling and cropping the omnidirectional images via the video processor, the downsampling resulting in downsampled cropped omnidirectional images, combining the enlarged-relevant-area images and the downsampled cropped omnidirectional images into combined images via the video processor, and displaying the combined images via a display module.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

[0015] FIG. **1** is a block diagram of a dual-camera system;

[0016] FIG. **2**A is a side elevation view of an omnidirectional camera;

[0017] FIG. **2**B is a side elevation view of another omnidirectional camera;

[0018] FIG. **3** is an illustrative field of view (FOV) of an omnidirectional camera;

[0019] FIG. **4**A is a top view of a dual-camera system;

[0020] FIG. **4**B is a top view of another dual-camera system;

[0021] FIG. **4**C is a top view of another dual-camera system;

[0022] FIG. **5**A is a detailed view of a combined image;

[0023] FIG. **5**B is a flow diagram illustrating a process for operation of the camera system of FIG. **1**;

[0024] FIG. **6**A is a block diagram of a single-camera system;

[0025] FIG. **6**B is a detailed view of an image captured by the camera system of FIG. **6**A;

[0026] FIG. **6**C is a detailed view of a modified image displayed by display module of the camera system shown in FIG. **6**A; and

[0027] FIG. **7** is a flow diagram illustrating a process for operation of the camera system of FIG. **6**A.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS OF THE INVENTION

[0028] Various embodiments of the present invention will now be described more fully with reference to the accompanying drawings. The invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, the embodiments are provided so that this disclosure will be thorough and will fully convey the scope of the invention to those skilled in the art.

[0029] FIG. **1** is a block diagram of a dual-camera system. In FIG. **1**, a dual-camera system **100** includes an omnidirectional camera **10**, a narrow-view camera **12**, a video processor **14**, and a display module **16**. The omnidirectional camera **10** is coupled to the video processor **14** by way of a connection **18**. In a typical embodiment, the omnidirectional camera **10** is a front-facing camera equipped with a fish-eye lens and has a field of view of at least 90 degrees. However, the omnidirectional camera **10** can be any type of omnidirectional camera such as, for example, a conical mirror camera, and typically has a field of view of at least 180 degrees. Although the dual-camera system **100** is depicted by way of example as including a single omnidirectional camera **10**, a dual-camera system in accordance with principles of the invention can incorporate any number of omnidirectional cameras **10** arranged in any orientation such as, for example, a front-facing omnidirectional camera and a rear-facing omnidirectional camera. The narrow-view camera **12** is coupled to the video processor **14** by way of a connection **20**.

[0030] In a typical embodiment, the narrow-view camera **12** has a field of view, for example, of approximately 10-50°; however, a camera that has any appropriate field of view may be used. Although the omnidirectional camera **10** and the narrow-view camera **12** are depicted by way of example as being connected to the video processor **14** via the connections **18** and **20**, it is also contemplated that the omnidirectional camera **10** and the narrow-view camera **12** could be wirelessly connected to the video processor **14**.

[0031] In a typical embodiment, the omnidirectional camera **10** and the narrow-view camera **12** are placed in close proximity to one another so that the points of view of the omnidirectional camera **10** and of the narrow-view camera **12** are at least approximately the same. The video processor **14** may be, for example, a stand-alone unit or contained within the same housing as one or both of the narrow-view camera **12** and the omnidirectional camera **10**. The video processor **12** receives image data from both of the narrow-view camera **12** and the omnidirectional camera **10**. The display module **16** is coupled to the video processor **14** by way of a connection **22**. In a typical embodiment, the display module **16** includes a video display that simultaneously displays images captured by the omnidirectional camera **10** and the narrow-view camera **12** and processed by the video processor **14**. Although the display module **16** is depicted by way of example as being connected to the video processor **14** via the connection **22**, the display module **16** could be wirelessly connected to the video processor **14**.

[0032] FIG. **2**A is a side elevation view of a typical omnidirectional camera. In FIG. **2**A, an omnidirectional camera **10** includes a sensor **11** and a lens **13**. In a typical embodiment, the lens **13** is a fish-eye lens and has a field of view of approximately 180 degrees; however, lenses having different fields of view may be used. In addition, any lens adapted to focus omnidirectional images, such as, for example, a wide-angle lens, a super-wide-angle lens, a full-circle lens, a spherical mirror-type lens, a conical minor-type lens, or other lens or minor configuration capable of focusing omnidirectional images may be employed in place of the lens **13**. In a typical embodiment, the omnidirectional camera **10** outputs image data to a display module or a video processor.

[0033] FIG. **2**B is a side elevation view of another omnidirectional camera. In FIG. **2**B, an omnidirectional camera **10'** includes a sensor **24** arranged relative to an external mirror **26** and a dome **28**, the dome **28** being concave relative to the sensor **24**. The dome **28** and the minor **26** in combination are adapted to allow light to pass therethrough. In some embodiments, the dome **28** may be convex relative to the sensor **24**, the dome **28** and mirror **26** in combination being adapted to reflect light towards the sensor **24**. A resulting omnidirectional image captured by the omnidirectional camera **10'** may be, for example, a 360-degree image of a scene surrounding the omnidirectional camera **10'**, wherein 360 degrees is relative to a centerline **31** of the camera **24**. In some embodiments, the omnidirectional camera **10'** may be a high-definition camera such as, for example, a camera having a sensor adapted to capture images on the order of several Megapixels. The omnidirectional camera **10'** may be used interchangeably with the omnidirectional camera **10** in various embodiments. In a typical embodiment, the omnidirectional cameral **10'** output image data to a display module or a video processor.

[0034] FIG. **3** is an illustrative field of view (FOV) of the omnidirectional camera **10'**. For descriptive purposes, a coordinate system has been superimposed about the omnidirectional camera **10'**. The coordinate system has an optical axis **30** shown running vertically along the centerline **31** of the omnidirectional camera **10'** and a horizontal axis **32** perpendicular thereto and passing through the minor **26**.

[0035] In general, the FOV of a camera is the area of a scene around the camera that can be captured by the camera. The FOV **34** of the omnidirectional camera **10'** along the horizontal axis **32** is shown. The FOV **34** extends both above and below the horizontal axis **32**. For example, in the embodiment shown, the FOV **34** extends approximately 10 degrees above the horizontal axis **32** and approximately 45 degrees below the horizontal axis **32**.

[0036] In various embodiments, the FOV **34** may extend more than or less than **10** degrees above the horizontal axis **32** and/or may extend more than or less than **45** degrees below the horizontal axis **32**. Although FIG. **3** shows the FOV **34** along one axis, the full FOV of the omnidirectional camera **10'** may include all 360 degrees of rotation about the optical axis **30**. The entire panorama of the omnidirectional camera **10'** would then be a 55°×360° FOV, where the 55 degrees represents the size of the angle relative to the horizontal axis **32**. In typical embodiments, a FOV of the omnidirectional camera **10** and the FOV **34** of the omnidirectional camera **10'** would be similar.

[0037] FIG. **4**A is a top view of the dual-camera system **100** in an illustrative environment. During operation, the omnidirectional camera **10** and the narrow-view camera **12** are positioned, for example, on a dashboard of a police vehicle **36**. In a typical embodiment, the narrow-view camera **12** is oriented to capture images in front of the police vehicle **36** as shown by a field of view **35** and output image data representing the captured images. The omnidirectional camera **10** is oriented to have a similar point of view as that of the narrow-view camera **12**. A field of view of the omnidirectional camera **10** is illustrated by arrows **40**. The omnidirectional camera **10** captures images of objects in front of the police vehicle **36** as well as objects on the sides of the police vehicle **36** that are outside the field of view **35** of the narrow-view camera **12**.

[0038] FIG. **4**B is a top view of another dual-camera system in an illustrative environment. In FIG. **4**B, a system **102** includes an omnidirectional camera **10"** that has a field of view that is greater than the 180 degrees illustrated in the system **100** of FIG. **4**A. The field of view of the omnidirectional camera **10"** is illustrated by arrows **40'**. Similarly to the system **100**, the narrow-view camera **12** and the omnidirectional camera **10"** are placed in close proximity to each other such as, for example, on the dashboard of the police vehicle **36**. In a typical embodiment, the narrow-view camera **12** is oriented to capture images in front of the police vehicle as shown by the field of view **35** and output image data representing the captured images.

[0039] FIG. **4**C is a top view of another dual-camera system in an illustrative environment. In FIG. **4**C, a system **104** includes omnidirectional cameras **10**(**1**) and **10**(**2**). Those having skill in the art will recognize that the number of omnidirectional or narrow-view cameras in a given system need not be limited to any particular number and that a plurality of either type of camera as dictated by design considerations may be used. The omnidirectional camera **10**(**1**) is shown arranged in a front-facing orientation while the omnidirectional camera **10**(**2**) is shown arranged in a rear-facing orientation relative to the police vehicle **36**.

[0040] A field of view of the front-facing omnidirectional camera **10**(**1**) is shown by the arrows **40**. A field of view of the rear-facing omnidirectional camera **10**(**2**) is shown by arrows **40"**. The inclusion of the rear-facing omnidirectional camera **10**(**2**) allows the system **104** to obtain a full **360** degrees of coverage. In similar fashion to the system **100**, the narrow-view camera **12** and the omnidirectional camera **10**(**1**) are placed in close proximity to each other such as, for example, on the dashboard of the police vehicle **36**. In a typical embodiment, the narrow-view camera **12** is oriented to capture images occurring directly in front of the police vehicle as shown by the field of view **35** and output image data representing the captured images. In some embodiments, a second narrow-view camera that is rear-facing may also be employed. Output of cameras facing different directions such as, for example the omnidirectional cameras **10**(**1**) and **10**(**2**), can be displayed simultaneously or sequentially in an automated fashion or responsive to user input.

[0041] FIG. **5**A is a detailed view of a combined image displayable via the display module **16**. In FIG. **5**A, a combined image **42** includes a narrow-view portion **44** and an omnidirectional portion **46**. In a typical embodiment, the narrow-view portion **44** includes, for example, about 85% of the total viewable area of the combined image **42**. The narrow-view portion **44** typically has a standard resolution of D1. The term D1 is commonly understood to represent a resolution of approximately 720×480. However, the narrow-view portion **44** may have a high-definition resolution such as, for example, 720p or 1080i. The narrow-view portion **44** typically includes at least part of an image captured by the narrow-view camera **12**. The omnidirectional portion **46** includes, for example, a lower 15% of the area of the combined image **42**; however, the size and positioning of the omnidirectional portion **46** may be altered as needed for particular applications. The omnidirectional portion **46** typically includes at least part of an image captured by an omnidirectional camera such as, for example, the omnidirectional camera **10**.

[0042] FIG. **5**B is a flow diagram illustrating a process for operation of the camera system of FIG. **1**. Referring now to FIGS. **1**, **5**A, and **5**B, a process **500** begins at step **502**. At step **504**, the omnidirectional camera **10** and the narrow-view camera **12** each capture images and create image data representing the captured images. At step **506**, the image data are transmitted to the video processor **14**.

[0043] At step **508**, the video processor **14** digitally unfolds and crops the image data received by the video processor **14** from the omnidirectional camera **10**. Unfolding may be performed in an effort to minimize edge distortion caused by the use of, for example, a fish-eye lens. Cropping may be performed to remove undesired or unimportant image portions. In another option, analog unfolding may be accomplished through use of a special lens designed to correct edge distortion. In order to minimize unacceptable image resolution post-unfolding, the omnidirectional camera **10** may capture images at a greater resolution than that of images captured by the narrow-view camera **12**. In some embodiments, one or both of unfolding and cropping of the output by the omnidirectional camera **10** may not be performed.

[0044] In a typical embodiment, step **508** also includes cropping by the video processor of image data from the narrow-view camera **12** that contain irrelevant or unimportant information such as, for example, data representing a hood of a police vehicle. Cropping of the image data from the narrow-view camera **12** is performed so that irrelevant image portions are not displayed. In other words, a portion of a captured image that would otherwise be displayed and that often contains irrelevant image portions may be discarded and not displayed without loss of useful information.

[0045] At step **510**, the video processor creates combined images **42** and transmits data representing the combined images **42** to the display module **16**. The combined images **42** are composed of narrow-view portions **44** and omnidirectional portions **44**. At step **512**, the display module displays the combined images **42**. The omnidirectional portions **46** can be thought of as being displayed in place of a portion of images output from the narrow-view camera **12** that are considered unimportant. In some embodiments, data representing the narrow-view portion **44** and the omnidirectional portion **46** are transmitted from the video processor **14** to the display module **16** as separate data streams and are displayed by the display module **16** as separate images to form the combined image **42**, while in other embodiments, a single combined-image data stream is employed.

[0046] FIG. **6**A is a block diagram of a single-camera system. In FIG. **6**A, a single-camera system **200** includes the video processor **14**, the display module **16**, and a sensor **202**. The display module **16** is coupled to the video processor **14** by way of the connection **22**. The sensor **202** is coupled to the video processor **14** by way of the connection **18**. The sensor **202** may be any appropriate video sensor but is typically a 20-40 megapixel sensor. In a typical embodiment, the sensor **202** has a field of view of approximately 180 degrees; however, fields of view up to and including 360 degrees may also be utilized.

[0047] FIG. **6**B is a detailed view of an image captured by a sensor such as the sensor **202**. In FIG. **6**B, an omnidirectional image **204** captured by the sensor **202** includes a relevant area **206** as well as portions of the omnidirectional image **204** that are not within the relevant area **206** as illustrated by a shaded area **208**. In some embodiments, the shaded area **208** includes all or part of the relevant area **206**. In a typical embodiment, the relevant area **206** may be, for example, the area directly in front of a police vehicle or areas including license plates.

[0048] FIG. **6**C is a detailed view of a modified image displayed by the display module **16** of the camera system **200**. In FIG. **6**C, a modified image **42'** includes a narrow-view portion **44'** and an omnidirectional portion **46'**. The narrow-view portion of **44'** is an enlarged version of the relevant area **206** and the omnidirectional portion **46'** is a cropped version of the shaded area **208**. In some embodiments, the cropped omnidirectional portion **46'** is also downsampled.

[0049] Referring now to FIGS. **6**A-**6**C, during operation, the sensor **202** captures the omnidirectional image **204** at very high resolution such as, for example, 20-40 megapixels. Data representing the omnidirectional image **204** is transmitted from the sensor **202** to the video processor **14** via the connection **18**. The video processor **14** identifies and enlarges the relevant area **206**, the enlargement thereof resulting in the narrow-view portion **44'**. The video processor **14** also crops the shaded area **208**, thereby forming a cropped version thereof (i.e., the omnidirectional portion **46'**). As noted above, in some embodiments, the shaded area **208** includes all or part of the relevant area **206**. The display module **16** displays the narrow-view portion **44'** and the cropped version of the shaded area **208** (i.e., the omnidirectional portion **46'**). In this sense, the system **200** creates data representing the narrow-view portion **44'** via what is sometimes referred to as digital zoom.

[0050] The video processor **14** also typically downsamples at least portions of data representing the omnidirectional image **204** not within the relevant area **206** (e.g., the shaded area **208**). In other embodiments, both data representing the relevant area **206** and the shaded area **208** are downsampled. Downsampling reduces the amount of data needed to be displayed and, in some cases, transferred between components of the system **200**. The shaded area **208** need not necessarily include all of the omnidirectional image **204** other than the relevant area **206**. Regardless of whether only the shaded area **208** or both the shaded area **208** and the relevant area **206** are downsampled, one or both of the relevant area **206** and the enlarged version of the relevant area **206** may be retained so as to be available to be presented to and displayed by the display module **16**. In another option, downsampling may be performed by the sensor **202**, thereby reducing the amount of data that must be transmitted from the sensor **202** to the video processor **14**.

[0051] The video processor **14** typically transmits data representing the combined image **42'** to the display module **16** as a single data stream. As illustrated, the combined image **42'** includes the narrow-view portion **44'** and the omnidirectional portion **46'**. The display module **16** displays at least part of the omnidirectional image **204** or a downsampled version thereof in the omnidirectional portion **46'** of the display module **16**. In similar fashion, the display module **16** displays the relevant area **206** or an enlarged version thereof in the narrow-view portion **44'**. In this way, more-relevant images are in some embodiments presented at a relatively higher resolution, while less relevant images are presented at a relatively lower resolution.

[0052] In other embodiments, the combined image **42'** is created by the display module **16** from a first video stream containing, for example, the enlarged version of the relevant area **206** and a second video stream containing, for example, all or part of a downsampled version of the omnidirectional image **204**. In such embodiments, the video processor **14** presents a first video stream to the display module **16** containing the enlarged version of the relevant area **206**. The video processor **14** also presents a second video stream containing all or part of the downsampled version of the omnidirectional portion **204**.

[0053] FIG. **7** is a flow diagram illustrating a process of operation of the camera system **200**. In FIG. **7**, a process **700** starts at step **702**. From step **702**, execution proceeds to step **704**. At step **704**, the sensor **202** captures an omnidirectional image and transmits the data representing the captured omnidirectional image to the video processor **14**. From step **704**, execution proceeds to step **706**. At step **706**, the video processor **14** identifies the relevant area **206**. From step **706**, execution proceeds to step **708**. At step **708**, the video processor **14** enlarges the relevant area **206** to create an enlarged version thereof; however, in some embodiments, step **708** may not be performed such that the relevant area **206** is not enlarged. From step **708**, execution proceeds to step **710**.

[0054] At step **710**, the video processor **14** optionally downsamples at least portions of the omnidirectional image **204**, such as those within the shaded area **208**. At step **711**, the video processor creates a combined image **42'** that includes the enlarged version of the relevant area **206** and at least part of the downsampled portions of the omnidirectional image **204** and presents the combined image **42'** to the display module **16**. In another option, the combined image **42'** may be created by the display module **16** from a first video stream containing the enlarged version of the relevant area **206** and a second video stream containing at least part of the downsampled portions of the omnidirectional image **204**.

[0055] At step **712**, the display module **16** displays the combined image **42'**. In other words, the display module **16** displays the enlarged version of the relevant area **206** in the narrow-view portion **44'** and at least part of the downsampled portions of the omnidirectional image **204** in the omnidirectional portion **46'**. The process ends at step **714**. Various steps of the process **700** may be performed concurrently or in a different order than described above without departing from principles of the invention.

[0056] Although various embodiments of the method and apparatus of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth herein. For example, although the omnidirectional camera **10** and the narrow-view camera **12** are described herein as separate units, a system could contain both the omnidirectional camera **10** and the narrow-view camera **12** in a single housing. Furthermore, components may have different functions from those described herein. In particular, functions described herein as being performed by the video processor **14** may, in various embodiments, be performed by one or both of the omnidirectional camera **10** or the narrow-view camera **12**. The system **100** and the system **200** and the displayed images **42** and **42'** are only examples of split-screen displayed images that could be created by various embodiments. It is intended that the specification and examples be considered as illustrative only. For example, either of the system **100** or the system **200** could be used to display either or both of the combined image **42** or the combined image **42'** or other configurations of combined images in accordance with principles of the invention. In addition, regardless of whether operations performed by the video processor **14** are described as being performed on images or image data, it will be understood that the operations are digital operations performed on image data.

1-16. (canceled)

17. A system comprising:

a first camera operable to capture omnidirectional images and send an omnidirectional-image data stream representing the omnidirectional images;

a second camera operable to capture narrow-view images and send a narrow-view-image data stream representing the narrow-view images;

a video processor coupled to the first camera and the second camera and operable to:

identify a relevant image portion of at least one of the omnidirectional-image data stream and the narrow-view-image data stream and remove image data that is not contained within the relevant image portion; and

replace the removed image data with a combined-image data stream, the combined-image data stream comprising other image data selected from one or more of the omnidirectional-image data stream and the narrow-view-image data stream;

a display module interoperably coupled to the video processor and operable to display combined images from the combined-image data stream; and

wherein the combined images each comprise a narrow-view-display portion and an omnidirectional-display portion.

18. The system of claim **17**, wherein the removed image data comprises image data selected from the omnidirectional-image data.

19. The system of claim **17**, wherein the removed image data comprises image data selected from the narrow-view-image data.

20. The system of claim **17**, wherein the omnidirectional-display portion is displayed in place of a portion of the narrow-view images.

21. The system of claim **17**, wherein the narrow-view images are captured at a greater resolution than the omnidirectional images.

22. A method comprising:

concurrently capturing omnidirectional images and narrow-view images;

storing data representing the captured omnidirectional images as omnidirectional-image data;

storing data representing the captured narrow-view images as narrow-view-image data;

identifying, by a video processor, a relevant image portion in the narrow-view-image data;

removing from the narrow-view-image data, by the video processor, image data that is not contained within the relevant image portion, the removing yielding modified narrow-view-image data;

replacing the removed image data with combined-image data, the combined image data comprising image data selected from the omnidirectional-image data; and

displaying combined images from the combined-image data.

23. The method of claim **22**, wherein the combined-image data is created by the video processor using the modified narrow-view-image data and at least part of the omnidirectional-image data.

24. The method of claim **22**, wherein the omnidirectional images are captured at a greater resolution than the narrow-view images.

25. The method of claim **22**, wherein:

the removed image data comprises image data selected from the narrow-view-image data; and

at least a portion of the omnidirectional images are displayed in place of the removed image data.

26. The method of claim **22**, wherein the removed image data comprises image data selected from the omnidirectional-image data.

27. The method of claim **22**, wherein the storing steps are performed concurrently.

28. A method comprising:

capturing omnidirectional images;

identifying, via a processor, one or more relevant areas of the omnidirectional images;

enlarging at least one relevant area of the one or more relevant areas;

downsampling and modifying the omnidirectional images via the video processor, the downsampling resulting in downsampled modified omnidirectional images;

wherein the modifying comprises removing, from the omnidirectional images, image data that is not contained within the one or more relevant areas;

combining, via the video processor, images corresponding to the enlarged at least one relevant area and the downsampled modified omnidirectional images into combined images; and

displaying, via a display, module the combined images.

29. The method of claim **28**, wherein the displaying comprises displaying the images corresponding to the enlarged at least one relevant area at a higher resolution than the down-sampled cropped omnidirectional images.

30. The method of claim **28**, comprising digitally unfolding the omnidirectional images via the video processor.

31. A computer-program product comprising a non-transitory computer-usable medium having computer-readable program code embodied therein, the computer-readable program code adapted to be executed to implement a method comprising:

concurrently capturing omnidirectional images and narrow-view images;

storing data representing the captured omnidirectional images as omnidirectional-image data;

storing data representing the captured narrow-view images as narrow-view-image data;

identifying, by a video processor, a relevant image portion in the narrow-view-image data;

removing from the narrow-view-image data, by the video processor, image data that is not contained within the relevant image portion, the removing yielding modified narrow-view-image data;

replacing the removed image data with combined-image data, the combined image data comprising image data selected from the omnidirectional-image data; and

displaying combined images from the combined-image data.

32. The computer-program product of claim **31**, wherein the removed image data comprises image data selected from the omnidirectional-image data.

33. The computer-program product of claim **31**, wherein the removed image data comprises image data selected from the narrow-view-image data.

34. The computer-program product of claim **31**, wherein the narrow-view images are captured at a greater resolution than the omnidirectional images.

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