

CLAIMS:

1. A portable electronic device (120) for a mixed reality, MR, headset (100) including a lens (110) through which a user wearing the MR headset can view real-world features and including a holder (121) configured to releasably retain the portable electronic device in a defined orientation relative to the lens, the portable electronic device (120) comprising:
 - a camera (122) configured to output video frames and arranged by the holder to view at least a portion of the lens of the MR headset;
 - a display device (1240) arranged to display information that is projected on the lens for reflection directly or indirectly toward the user's eyes and the camera of the MR headset;
 - a processor (1206) operationally connected to the camera and to the display device, and configured to perform operations comprising:
 - processing the video frames from the camera to identify locations of at least one real-world feature;
 - displaying information at locations on the display device; and
 - controlling at least one of the processing of the video frames and the displaying of the information on the display device, to at least partially reduce occurrence in the video frames of the information that is displayed by the display device.
2. The portable electronic device (120) of Claim 1, wherein the operations further comprise:
 - determining an amount of overlap occurring between: 1) the information that is displayed by the display device and occurring in the video frames from the camera; and 2) the locations of the real-world feature that are identified by processing of the video frames from the camera; and
 - initiating the controlling of at least one of the processing of the video frames and the displaying of the information on the display device based on the amount of overlap satisfying a defined rule.
3. The portable electronic device (120) of any of Claims 1 to 2, wherein the operations further comprise:
 - displaying a calibration pattern on the display device;

processing the video frames to determine a region of the video frames containing the graphical pattern;
ceasing display of the calibration pattern on the display device;
following cessation of display of the calibration pattern, processing the video frames to determine when a location of the real-world feature enters the region of the video frames; and
responsive to the location of the real-world feature entering the region of the video frames, initiating the controlling of at least one of the processing of the video frames and the displaying of the information on the display device.

4. The portable electronic device (120) of any of Claims 1 to 3, wherein the operations to control at least one of the processing of the video frames and the displaying of the information on the display device, further comprise:

determining when a display quality prioritization rule is satisfied; and
responsive to the display quality prioritization rule becoming satisfied, increasing a frequency at which the display device is repetitively refreshed to display the information and/or decreasing a frequency at which the video frames from the camera are processed to identify locations of the real-world feature.

5. The portable electronic device (120) of any of Claims 1 to 3, wherein the operations to control at least one of the processing of the video frames and the displaying of the information on the display device, further comprise:

determining when a camera video prioritization rule is satisfied; and
responsive to the camera video prioritization rule becoming satisfied, decreasing a frequency at which the display device is repetitively refreshed to display the information and/or increasing a frequency at which the video frames from the camera are processed to identify locations of the real-world feature.

6. The portable electronic device (120) of any of Claims 1 to 5, wherein the operations to control at least one of the processing of the video frames and the displaying of the information on the display device, further comprise:

repetitively alternating between displaying the information on the display device and ceasing display of the information on the display device, wherein the processing of the video frames is controlled to occur during first time durations while the

information is not displayed on the display device and controlled to not occur during second time durations while the information is displayed on the display device.

7. The portable electronic device (120) of Claim 6, wherein the operations to repetitively alternate between displaying the information on the display device and ceasing display of the information on the display device, further comprise:

determining when a display quality prioritization rule is satisfied; and
responsive to the display quality prioritization rule becoming satisfied, increasing a duty cycle of the second time duration during which the display device is repetitively refreshed to display the information relative to the first time duration during which the display device is repetitively refreshed not displaying the information.

8. The portable electronic device (120) of Claim 6, wherein the operations to repetitively alternate between displaying the information on the display device and ceasing display of the information on the display device, further comprise:

determining when a camera video prioritization rule is satisfied; and
responsive to the camera video prioritization rule becoming satisfied, decreasing a duty cycle of the second time duration during which the display device is repetitively refreshed to display the information relative to the first time duration during which the display device is repetitively refreshed not displaying the information.

9. The portable electronic device (120) of any of Claims 1 to 8, wherein:

the operations further comprise processing the video frames from the camera to identify a region of the display device that displays a portion of information which occurs in the video frames at least partially overlapping a location of the real-world feature, and

the operations to control at least one of the processing of the video frames and the displaying of the information on the display device, further comprise:
repetitively alternating between displaying the portion of the information within the region of the display device and ceasing display of the portion of the information within the region of the display device, wherein the processing

of the video frames is controlled to occur during first time durations while the portion of the information is not displayed within the region of the display device and controlled to not occur during second time durations while the portion of the information is displayed within the region of the display device.

10. The portable electronic device (120) of Claim 9, wherein the operations to repetitively alternate between displaying the portion of the information within the region of the display device and ceasing display of the portion of the information within the region of the display device, further comprise:

- determining when a display quality prioritization rule is satisfied; and
- responsive to the display quality prioritization rule becoming satisfied, increasing a duty cycle of the second time duration during which the region of the display device is repetitively refreshed to display the portion of the information relative to the second time duration during which the region of the display device is repetitively refreshed not displaying the portion of the information.

11. The portable electronic device (120) of Claim 9, wherein the operations to repetitively alternate between displaying the portion of the information within the region of the display device and ceasing display of the portion of the information within the region of the display device, further comprise:

- determining when a camera video prioritization rule is satisfied; and
- responsive to the camera video prioritization rule becoming satisfied, decreasing a duty cycle of the second time duration during which the region of the display device is repetitively refreshed to display the portion of the information relative to the second time duration during which the region of the display device is repetitively refreshed not displaying the portion of the information.

12. The portable electronic device (120) of any of Claims 1 to 11, wherein:
the operations further comprise processing the video frames from the camera to
identify a region of the video frames that contains the information; and
the operations to control at least one of the processing of the video frames and the displaying of the information on the display device, further comprise:

processing the region of the video frames identified as containing the information at a lower frequency than another region of the video frames that does not contain the information, to identify the locations of the real-world feature.

13. The portable electronic device (120) of any of Claims 1 to 12, wherein:
the operations further comprise processing the video frames from the camera to identify a region of the display device that displays a portion of information and which at least partially overlaps a location of the real-world feature in the video frames, and
the operations to control at least one of the processing of the video frames and the displaying of the information on the display device, further comprise:
performing at least one of: decreasing brightness of the region of the display device; decreasing contrast of the region of the display device; determining a primary color of the real-world feature and selecting a color of the information that is displayed in the region of the display device to differentiate from the primary color of the real-world feature.
14. The portable electronic device (120) of any of Claims 1 to 13, wherein:
the operations further comprise processing the video frames from the camera to identify a region of the display device that displays a portion of information and which at least partially overlaps a location of the real-world feature in the video frames, and
the operations to control at least one of the processing of the video frames and the displaying of the information on the display device, further comprise:
performing at least one of: increasing brightness of another region of the display device that does not overlap a location of the real-world feature in the video frames; increasing contrast of the other region of the display device; and determining a primary color of the real-world feature and selecting a color of the information that is displayed in the other region of the display device to differentiate from the primary color of the real-world feature.
15. The portable electronic device (120) of any of Claims 1 to 14, wherein:

the operations further comprise identifying a region of the display device at which the user's eyes are presently directed, and

the operations to control at least one of the processing of the video frames and the displaying of the information on the display device, further comprise:

performing at least one of: decreasing brightness of the region of the display device; decreasing contrast of the region of the display device; determining a primary color of the real-world feature and selecting a color of the information that is displayed in the region of the display device to differentiate from the primary color of the real-world feature; increasing brightness of another region of the display device that does not overlap a location of the real-world feature in the video frames; increasing contrast of the other region of the display device; determining a primary color of the real-world feature and selecting a color of the information that is displayed in the other region of the display device to differentiate from the primary color of the real-world feature.

16. A method by a portable electronic device (120) for a mixed reality, MR, headset (100) including a lens (110) through which a user wearing the MR headset can view real-world features and including a holder (121) configured to releasably retain the portable electronic device in a defined orientation relative to the lens, wherein a display device of the portable electronic device is arranged to display information that is projected on the lens for reflection directly or indirectly toward the user's eyes and a camera of the portable electronic device, the method comprising:

processing (400) the video frames from the camera of the portable electronic device to identify locations of at least one real-world feature;

displaying (402) information at locations on the display device of the portable electronic device; and

controlling (404) at least one of the processing of the video frames and the displaying of the information on the display device, to at least partially reduce occurrence in the video frames of the information that is displayed by the display device.

17. The method of Claim 16, further comprising:

determining (500) an amount of overlap occurring between: 1) the information that is displayed by the display device and occurring in the video frames from the

camera; and 2) the locations of the real-world feature that are identified by processing of the video frames from the camera; and
initiating (502) the controlling of at least one of the processing of the video frames and the displaying of the information on the display device based on the amount of overlap satisfying a defined rule.

18. The method of any of Claims 16 to 17, further comprising;
displaying (600) a calibration pattern on the display device;
processing (602) the video frames to determine a region of the video frames containing the graphical pattern;
ceasing (604) display of the calibration pattern on the display device;
following cessation of display of the calibration pattern, processing (606) the video frames to determine when a location of the real-world feature enters the region of the video frames; and
responsive to the location of the real-world feature entering the region of the video frames, initiating (608) the controlling of at least one of the processing of the video frames and the displaying of the information on the display device.
19. The method of any of Claims 16 to 18, wherein controlling at least one of the processing of the video frames and the displaying of the information on the display device, further comprises:
determining (700) when a display quality prioritization rule is satisfied; and
responsive to the display quality prioritization rule becoming satisfied,
increasing (702) a frequency at which the display device is repetitively refreshed to display the information and/or decreasing a frequency at which the video frames from the camera are processed to identify locations of the real-world feature.
20. The method of any of Claims 16 to 18, wherein controlling at least one of the processing of the video frames and the displaying of the information on the display device, further comprises:
determining (704) when a camera video prioritization rule is satisfied; and
responsive to the camera video prioritization rule becoming satisfied,
decreasing (706) a frequency at which the display device is repetitively

refreshed to display the information and/or increasing a frequency at which the video frames from the camera are processed to identify locations of the real-world feature.

21. The method of any of Claims 16 to 20, wherein controlling at least one of the processing of the video frames and the displaying of the information on the display device, further comprises:

repetitively alternating between displaying the information on the display device and ceasing display of the information on the display device, wherein the processing of the video frames is controlled to occur during first time durations while the information is not displayed on the display device and controlled to not occur during second time durations while the information is displayed on the display device.

22. The method of Claim 21, wherein repetitively alternating between displaying the information on the display device and ceasing display of the information on the display device, further comprises:

determining (800) when a display quality prioritization rule is satisfied; and responsive to the display quality prioritization rule becoming satisfied, increasing (802) a duty cycle of the second time duration during which the display device is repetitively refreshed to display the information relative to the first time duration during which the display device is repetitively refreshed not displaying the information.

23. The method of Claim 21, wherein repetitively alternating between displaying the information on the display device and ceasing display of the information on the display device, further comprises:

determining (804) when a camera video prioritization rule is satisfied; and responsive to the camera video prioritization rule becoming satisfied, decreasing (806) a duty cycle of the second time duration during which the display device is repetitively refreshed to display the information relative to the first time duration during which the display device is repetitively refreshed not displaying the information.

24. The method of any of Claims 16 to 23, further comprising processing (900) the video frames from the camera to identify a region of the display device that displays a portion of information which occurs in the video frames at least partially overlapping a location of the real-world feature, and wherein controlling at least one of the processing of the video frames and the displaying of the information on the display device, further comprises: repetitively alternating (902) between displaying the portion of the information within the region of the display device and ceasing display of the portion of the information within the region of the display device, wherein the processing of the video frames is controlled to occur during first time durations while the portion of the information is not displayed within the region of the display device and controlled to not occur during second time durations while the portion of the information is displayed within the region of the display device.
25. The method of Claim 24, wherein repetitively alternating between displaying the portion of the information within the region of the display device and ceasing display of the portion of the information within the region of the display device, further comprises: determining when a display quality prioritization rule is satisfied; and responsive to the display quality prioritization rule becoming satisfied, increasing a duty cycle of the second time duration during which the region of the display device is repetitively refreshed to display the portion of the information relative to the second time duration during which the region of the display device is repetitively refreshed not displaying the portion of the information.
26. The method of Claim 24, wherein repetitively alternating between displaying the portion of the information within the region of the display device and ceasing display of the portion of the information within the region of the display device, further comprises: determining when a camera video prioritization rule is satisfied; and responsive to the camera video prioritization rule becoming satisfied, decreasing a duty cycle of the second time duration during which the region of the display device is repetitively refreshed to display the portion of the information relative

to the second time duration during which the region of the display device is repetitively refreshed not displaying the portion of the information.

27. The method of any of Claims 16 to 26,
further comprising processing (1000) the video frames from the camera to identify a region of the video frames that contains the information, and
wherein controlling at least one of the processing of the video frames and the displaying of the information on the display device, further comprises:
processing (1002) the region of the video frames identified as containing the information at a lower frequency than another region of the video frames that does not contain the information, to identify the locations of the real-world feature.
28. The method of any of Claims 16 to 27,
further comprising processing (1100) the video frames from the camera to identify a region of the display device that displays a portion of information which at least partially overlaps a location of the real-world feature in the video frames, and
wherein controlling at least one of the processing of the video frames and the displaying of the information on the display device, further comprises:
performing (1102) at least one of: decreasing brightness of the region of the display device; decreasing contrast of the region of the display device; and determining a primary color of the real-world feature and selecting a color of the information that is displayed in the region of the display device to differentiate from the primary color of the real-world feature.
29. The method of any of Claims 16 to 28,
further comprising processing (1200) the video frames from the camera to identify a region of the display device that displays a portion of information which at least partially overlaps a location of the real-world feature in the video frames, and
wherein controlling at least one of the processing of the video frames and the displaying of the information on the display device, further comprises:
performing (1202) at least one of: increasing brightness of another region of the display device that does not overlap a location of the real-world feature in the video frames; increasing contrast of the other region of the display

device; determining a primary color of the real-world feature and selecting a color of the information that is displayed in the other region of the display device to differentiate from the primary color of the real-world feature.

30. The method of any of Claims 16 to 29:
further comprising identifying a region of the display device at which the user's eyes are presently directed, and
wherein controlling at least one of the processing of the video frames and the displaying of the information on the display device, further comprises:
performing at least one of: decreasing brightness of the region of the display device; decreasing contrast of the region of the display device; determining a primary color of the real-world feature and selecting a color of the information that is displayed in the region of the display device to differentiate from the primary color of the real-world feature; increasing brightness of another region of the display device that does not overlap a location of the real-world feature in the video frames; increasing contrast of the other region of the display device; determining a primary color of the real-world feature and selecting a color of the information that is displayed in the other region of the display device to differentiate from the primary color of the real-world feature.
31. A computer program product for a portable electronic device (120) for a mixed reality, MR, headset (100) having a lens (110) through which a user wearing the MR headset can view real-world features, wherein a display device of the portable electronic device is arranged to display information that is projected on the lens for reflection directly or indirectly toward the user's eyes and a camera of the portable electronic device, the computer program product comprising:
a non-transitory computer readable medium (1210) storing program code (1212) executable by a processor of the portable electronic device to perform operations comprising:
processing the video frames from the camera of the portable electronic device to identify locations of at least one real-world feature;

displaying information at locations on the display device of the portable electronic device; and
controlling at least one of the processing of the video frames and the displaying of the information on the display device, to at least partially reduce occurrence in the video frames of the information that is displayed by the display device.

32. The computer program product of Claim 31, further comprising performing the operations of any of Claims 17 to 30.