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(54) Title: APPARATUS AND SYSTEM FOR IMAGING IN VIDEO CALLS

(57) Abstract: Apparatus and system for facilitating video communication between two devices which enable, among other things, maintenance of eye contact.

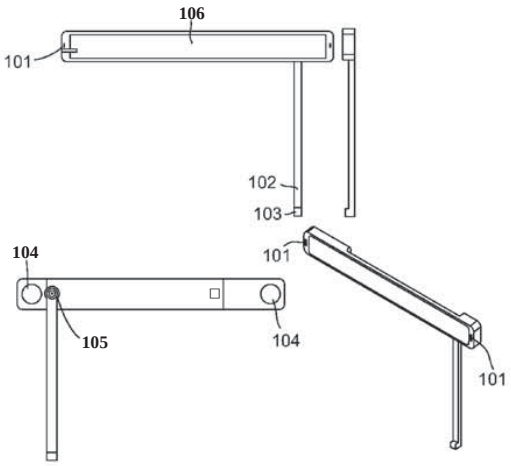
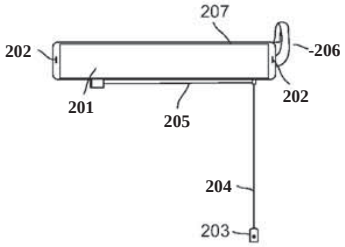


FIG. 1



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APPARATUS AND SYSTEM FOR IMAGING IN VIDEO CALLS

Field

One or more embodiments relate to imaging in applications such as, for example and without limitation, video conferencing.

Background

Many personal video conferencing systems are problematic because they make it difficult for a user (a "local person") and a participant (a "remote person") to maintain eye contact. This is problematic because eye contact is important for telepresence and effective communication. In typical prior art video conferencing systems, cameras are located on a side or a top of a viewing screen so that, when a user follows his/her instincts to look at a participant's eyes, the image of the user's eyes results in disrupted eye contact between the user and the participant. Such prior art video conferencing systems are further problematic because they do not enable gaze awareness —gaze awareness is an ability to tell what someone is looking at by watching the direction of his/her eyes. In face-to-face communication, gaze awareness and eye contact are important because gaze awareness and eye contact serve, among other things, as signals for turn-taking in a conversation. In addition, gaze awareness and eye contact express attributes such as attentiveness, confidence and cooperativeness. For example, people using increased eye contact get more help from others, generate more learning as teachers, and have better success in job interviews.

Several attempts have been made to create gaze awareness with videoconferencing systems using specialized hardware (see an article by J. Gemmell et al. entitled "Gaze Awareness for Video-conferencing: a Software Approach" in IEEE MultiMedia, pp. 26-35, Oct-Dec 2000). The article states: "Among the hardware techniques that support gaze-aware videoconferencing systems are half-silvered mirrors and pinhole cameras in displays. The Virtual Space and Hydra systems support gaze awareness by deploying a small display and camera for each party. If you place the display far enough away from users, they're unlikely to notice the angle between the camera and the display images."

In addition to the problems discuss above, these personal video conferencing systems are typically used under ambient conditions that include poor and mixed-color

lighting, distracting backgrounds and noisy soundscapes. This is problematic not only because poorly lit images do not look good, but also that poorly lit images are noisy, which noisy images produce video stutter during Internet transmission.

Lastly, these personal video conferencing systems are problematic because traditional webcams have a wide angle lens that is oriented in a landscape mode. As a result, when a user is positioned close to the webcam, his/her face is distorted by the wide angle lens.

Summary

One or more embodiments solve one or more of the above-identified problems. In particular, one or more such embodiments provide one or more of the following during a video call and/or a video conference: (a) improved eye contact between a user and a participant; (b) improved gaze awareness between the user and the participant; (c) an improved user image with respect to lighting even where the user is in a poorly-lit ambient; (d) an improved user image wherein background in the user ambient is muted; (e) an improved user image wherein lens distortion is reduced; and (f) reduced or eliminated video stutter for the user image which results in improved Internet communication.

Brief Description of the Drawings

FIG. 1 shows orthogonal views of an embodiment that includes a camera module disposed at the tip of a transparent arm, an illuminator, a microphone and a magnetic coupler.

FIG. 2 shows a front view of another embodiment that includes a camera module disposed at the tip of an ultra-thin, displaceable arm, a USB cable and a magnetic coupler.

FIG. 3 shows orthogonal views of an embodiment that includes a camera module disposed at the tip of an ultra-thin camera module arm, an illuminator, a USB cable, and a carrying case capable of holding the camera module, the camera module arm, the illuminator, and the USB cable.

FIG. 4 shows an embodiment in use where the embodiment is mounted on a laptop computer for use in a video call or video conference.

FIG. 5 shows orthogonal views of an embodiment that includes a camera module disposed at the tip of an ultra-thin, displaceable camera module arm, and a data port coupler.

FIG. 6 shows orthogonal views of an embodiment that includes a camera module and an illuminator mounted on a fixture housing, a retractable, flexible camera module arm attached to the fixture housing, wherein the fixture housing is capable of storing the camera module arm.

FIG. 7 shows orthogonal views of an embodiment that includes a camera module disposed at the tip of an ultra-thin camera module arm, the camera module arm being built into a tablet device and being capable of rotating onto a display screen of the tablet, and an illuminator built into a display screen bezel of the tablet.

FIG. 8 shows two embodiments in use during a video call or video conference.

FIG. 9 shows an embodiment that includes a miniature camera module disposed on a retractable camera module arm that moves behind a mobile device wherein the retractable camera module arm is fabricated using nitinol and a magnet wire harness.

FIG. 10 shows an embodiment that includes a miniature camera module attached to on an ultra-thin, retractable, camera module arm that moves onto a top bezel of a mobile device.

FIG. 11 shows an MIPI mobile device interface flex PCB ("printed circuit board") with shielding used to fabricate one or more embodiments: (a) disposed in a flat configuration (i.e., with a BGA sensor module at the bottom before being folded and attached to nitinol wires; and (b) in a folded position where it is connected to a camera module.

FIG. 12 is a schematic of camera imager support electronics used to fabricate one or more embodiments, which electronics may be positioned near an imager in the camera module to reduce conductor count in a transparent or ultra-thin camera module arm connected to the camera module.

FIG. 13 illustrates the quantum efficiency of an imager spectral filter having an IR notch near 810nm overlaid with the imager's spectral sensitivity curves.

FIG. 14 is a graph that indicates gaze angles useful in maintaining eye contact.

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