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Managing Devices in a Device Ecosystem by Detecting Eye Gaze, Gestures, and User Medical Diagnostics

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MANAGING DEVICES IN A DEVICE ECOSYSTEM BY DETECTING EYE GAZE, GESTURES, AND USER MEDICAL DIAGNOSTICS

Abstract

A network of interconnected user devices and peripherals is used together in such a way that eye tracking, gestures, and medical diagnostics detected by one or more devices in the device ecosystem are used to control, manage, and interact with other devices in the ecosystem.

Users today often navigate a large number of computing devices, peripherals, and sensors, some of which may communicate with one another via the internet or via wireless communications protocol. The computing devices may include a desktop computer, laptop, tablet or handheld computer, a smart phone, a smart watch, an extended reality (for example augmented, virtual or mixed reality) headset, a heart rate monitor, a smart earing, a smart ring, and so forth. The peripherals may include a camera, microphone, speaker, keyboard, mouse, etc.

An example interconnected ecosystem of devices is depicted below in Figure 1. Figure 1 depicts a user with smart glasses, a smart phone, a laptop, a tablet computer, a smart speaker, a smart television, and a desktop computer with three monitors, a webcam, a keyboard, and a mouse.

FIG. 1
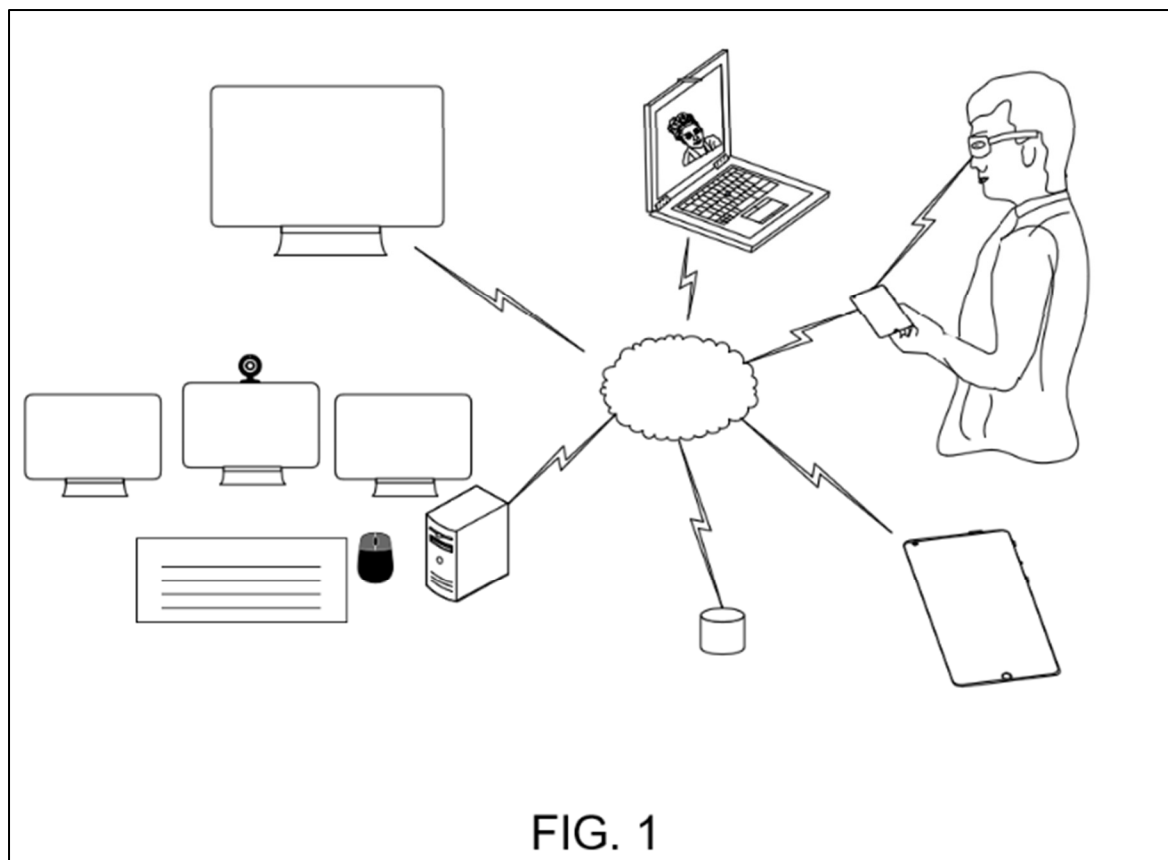
How to move fluidly between devices, peripherals and sensors without experiencing electronic clutter and confusion is a challenge. In examples, using devices together may create some frustration for a user that must, for example, determine whether a keyboard is set up to operate with a tablet device or a laptop computer.

Setting up monitors to work with a computing device, for example, is important to ensure seamless use of a computer or computing system. Monitor setup must be correct to locate and track a mouse cursor or a window moved around across the displays. Presently, when a user needs to set up new screens when using a new office desk or shared/rented workspace, the user must manually configure the monitor placement settings to specify which monitor will be a

primary or a secondary monitor. The user may also need to adjust the monitor settings to be left, right, up, or down.

It is possible to leverage an ecosystem of interconnected computing devices to make using those devices and/or moving between multiple devices more seamless, however.

Detecting a User's Gaze/Focus

Many possible sources of information can be used to determine the direction of, or what object is in a user's eye gaze or focus. For example, an eye gaze may be determined using a headset device, such as an augmented reality (AR) headset. Many AR headsets include an eye tracker that may illuminate an eye and record a reflected image from the eye with a camera.

Additional possible sources of eye gaze information can include inertial measurement unit (IMU) sensors including any combination of gyroscope or accelerometer that can track the direction that a head is pointing in space.

Other sources of information about where a user is gazing include external cameras that have the user within a field of view. The images may later be analyzed to determine the direction a head is pointing in, the direction of an eye gaze, or a gesture including one or both hands. In examples, that camera may be positioned on a laptop screen, a webcam, a camera from a smartphone or tablet, a conference center webcam, an outward facing camera from another user's AR or XR headset, or any other type of camera on any other type of device.

In examples, eye tracking capability may be integrated into a smart contact lens.

In examples, a user may be wearing an AR headset with a forward-facing camera that images a field of view in front of the user. That field of view of the camera can serve as a proxy for what a user is actually looking at. For example, if a smart speaker or a monitor may be seen in the front-facing camera's field of view, it may be assumed that the user is looking in the direction of one of those example objects.

In examples, it may be possible to determine if a user is focusing on something that their eye is gazing at. Focus may be determined based on, for example, length of time that a user focuses on in the direction of an object.

Controlling a User Device Using Eye Gaze/Focus

The ecosystem of devices and sensors may be used to help a user configure and/or manage monitors, cursors, and active windows in a display.

In examples, it may be possible to use images taken using a forward-facing AR headset to automatically set up monitors when using a new workstation. Monitor settings may include setting primary and secondary monitors, monitor positions, and monitor orientations. For example, it may be determined using a forward-facing camera on an AR headset that a user has two monitors in a field of view, a smaller one on the left and a larger one on the right. Upon determining that these monitors are connected to a computer, the display for the computer may be set up so that the larger monitor is on the right of the smaller monitor. The forward-facing

camera may further determine that the larger monitor on the left is oriented in portrait mode, and set the display settings accordingly. In examples, it may be further determined that the larger monitor is the primary monitor. By configuring the monitors automatically, this may save the user the friction of needing to fumble with settings to set up a computer with a work station/area.

User eye gaze and/or focus information may be further used to determine which monitor is the primary monitor. The monitor that the user is looking at, or the one that they are looking at the most may become the primary monitor, for example.

In examples, it may be possible to use the ecosystem of devices to determine if a user is gazing at an electronic device or a peripheral. For example, the eye tracker or a forward-facing camera of an AR headset may be used to determine what a user is looking at. Upon determining that a user is looking at one monitor in a multi monitor setup, for example, a cursor may be moved to that monitor. In other examples, however, an advertisement may be placed on the monitor that the user is looking at.

For example, if a user is looking around the display of a monitor, it may be determined that the user is actively focusing on that monitor. In examples, a determination that the user is focusing on the monitor could initiate an action to move the cursor to that monitor display.

In other examples, it may be determined that a user is gazing or focusing in a particular region of a screen. The cursor could then be moved to that area of the screen, or advertisements could be placed there.

In examples, the user gaze and/or focus information may be used to switch one or more computer monitors between an energy saving mode and a nominal mode. For example, if there are two computer monitors, the gaze and/or focus information may be used to place a monitor the user is presently watching in a nominal mode (possibly transitioning from an energy saving mode), or a monitor the user is not presently watching in an energy saving mode (possibly transitioning from a nominal mode).

In examples, the user gaze and/or focus information may be used to determine what information gets displayed on a monitor. For example, the gaze/and or focus information may be used to determine whether a slide presentation or notes are displayed on a monitor based on whether the user is looking at it. In examples, if a user is not looking at a monitor, the display may be turned off to keep the information that would be displayed for that user private.

In examples, the user gaze and/or focus information may be used to determine which window in a display to activate or select.

In examples, the user gaze and/or focus information may be used to determine which object in a window or in a display to select.

In examples, the user gaze and/or focus information may be used to initiate actions on a device. For example, a user may engage with an ecosystem of devices that include a smartphone, a smart speaker, and one of the devices to determine a gaze and/or focus of the user described above.

When a voicemail is received via the smartphone, the smart speaker may light up in response. When the user turns a gaze towards the smart speaker, the speaker may play the contents of the voicemail.

In examples, a user may receive a text message on a smartphone or a smart speaker. When the user turns a gaze towards a keyboard, which may be coupled to a tablet computer, a smart speaker, or any other user device in the device ecosystem, the detected user gaze and/or focus may initiate activating the keyboard to allow the user to type a reply.

In examples, the user gaze and/or focus information may be used to connect a computing device or a peripheral to another computing device. For example, upon determining that a user's gaze is directed at a set of earphones, an offer to connect that set of earphones to another user device, such as an AR headset or a smartphone, for example, may be initiated.

In examples, the user gaze and/or focus information may be used to allow the use of a peripheral, for example a keyboard or a mouse, to interact with real-world objects outside the display area. For example, a user may click on a tree to initiate a search for the tree type.

Controlling a User Device Using a Gesture

In examples, the ecosystem of devices may enable the detection of a user gesture, such as a hand gesture. For example, a front facing camera on an AR headset or a webcam may include a user's hands in a field of view. A model may be used to detect the hand gestures from the camera frames. Those gestures may be used to control a user device in communication with the camera.

For example, a user may receive a phone call. Instead of pulling the smartphone out of a pocket and making a swipe gesture on a touch screen, the user may make a swipe motion with a finger through the air. A camera, for example a forward-facing camera of an AR headset, may detect this gesture, which may be interpreted by a processor in the ecosystem of devices as a swipe gesture. This may initiate answering the phone call.

Controlling a User Device Using a Detected User Condition

In examples, the ecosystem of devices may enable the detection of a user condition. For example, a smart earring, a pulse oximeter, or a heart rate monitor may each monitor a user medical diagnostic.

In examples, determining that a user medical diagnostic has changed, for example a heart rate has gone up, may prompt an action may be taken with respect to a device. For example, a smartphone may generate an announcement using a speaker to indicate that a user has entered heartrate zone 3.

Summary

In examples, the software that identifies the user gaze and/or focus, the user gesture, or the change in user medical condition may run on a user device, for example an AR headset or smartphone, or on a server. In examples, the software that takes an action based on the user gaze and/or focus information, user gesture, or change in user medical condition may also run on a client device or a server.