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Discrete Single-hand Gestures for Wrist-worn Device Control

ABSTRACT

Interaction with wrist-worn devices is currently constrained to either voice control or opposing hand control through physical touch on the device screen, crown, or buttons. With one handed control involving full hand extension and hand clenching in a fist, these movements are not discrete. Traditional smartwatch placement on one hand is controlled using the other hand. This is a discrete, yet inconvenient mode of control, especially in situations where the other hand is involved in another function. Some technologies enable one-handed control with hand clenching into a fist / extending into an open palm. However, this isn't discrete or necessarily ergonomic. This disclosure describes discrete, finger-based, single-hand gestures for controlling wrist-based devices. The described gestures are performed using the hand on which the device is worn, with no involvement from the other hand. The gestures include movements for core inputs, e.g., navigation, scrolling, confirmation, selection, etc., within a menu. The described finger gestures are ergonomic and work well for repetitive actions. The gestures advantageously use a single hand and rely on the user's fine motor skills.

KEYWORDS

- Gesture recognition
- Single-hand gesture
- Finger gesture
- Wrist-worn device
- Smartwatch
- Fitness band
- Miniature radar
- Inertial measurement unit (IMU)
- Fine-motor recognition
- Menu navigation
- Menu confirmation
- Menu selection
- Listening window
- Activation action

BACKGROUND

Input gestures for smartwatches and other wrist-based devices are optimized for finger ergonomics and human factors to enhance recognition performance while ensuring comfort with repetitive usage. However, on-wrist interaction is currently constrained to either voice control or opposing hand control through physical touch on the watch screen, crown, or buttons. The smartwatch placed on one hand is controlled using the other hand. This is an inconvenient mode of control, especially in situations where the other hand is involved in another function such as holding a dog's leash, operating a steering wheel, etc. Some technologies [1] enable one-handed control with hand clenching into a fist / extending into an open palm. However, this isn't discrete or necessarily ergonomic.

Although some single-hand gestures for wrist devices exist, these rely on arm movements, which involve movements of large muscles, or wrist movements such as flexion, tilt, extension, clenching, etc., which strain the user. Arm movements are suboptimal for user interface navigation as they are not discrete, and wrist movements, when performed repeatedly (such as during UI navigation), can become strenuous.

DESCRIPTION

This disclosure describes discrete, finger-based, single-hand gestures for controlling wrist-based devices. The described gestures are performed using the hand on which the device is worn, with no involvement from the other hand. The gestures include movements for core inputs, e.g., navigation, scrolling, confirmation, selection, etc., within a menu. The described finger gestures are ergonomic and work well for repetitive actions. The gestures advantageously use a single hand and rely on the user's fine motor skills.

Confirmation gesture:

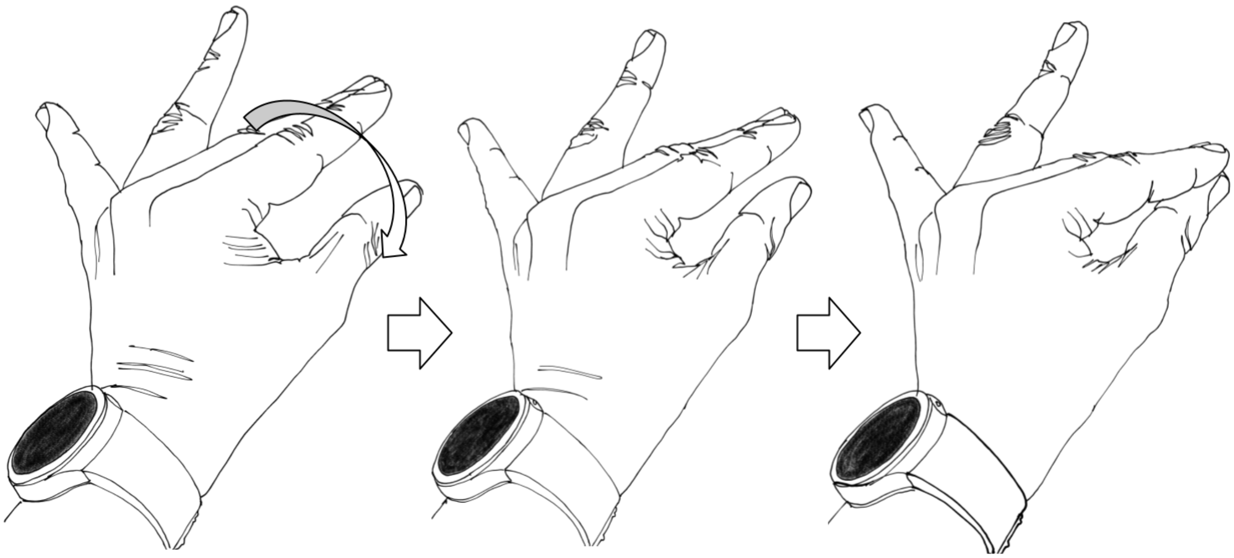

Fig. 1: A single-hand, finger-based, confirmation gesture

Fig. 1 illustrates a single-hand, finger-based, confirmation gesture. Two fingers, e.g., the index and middle fingers, are brought together to meet the thumb in a pinching gesture. The pinch resembles a pencil-like grip, or a modified OK sign (where the round of the OK sign is formed by the thumb and the index and middle fingers). Using two fingers to form the OK sign (as opposed to one) is easier for the hand muscles.

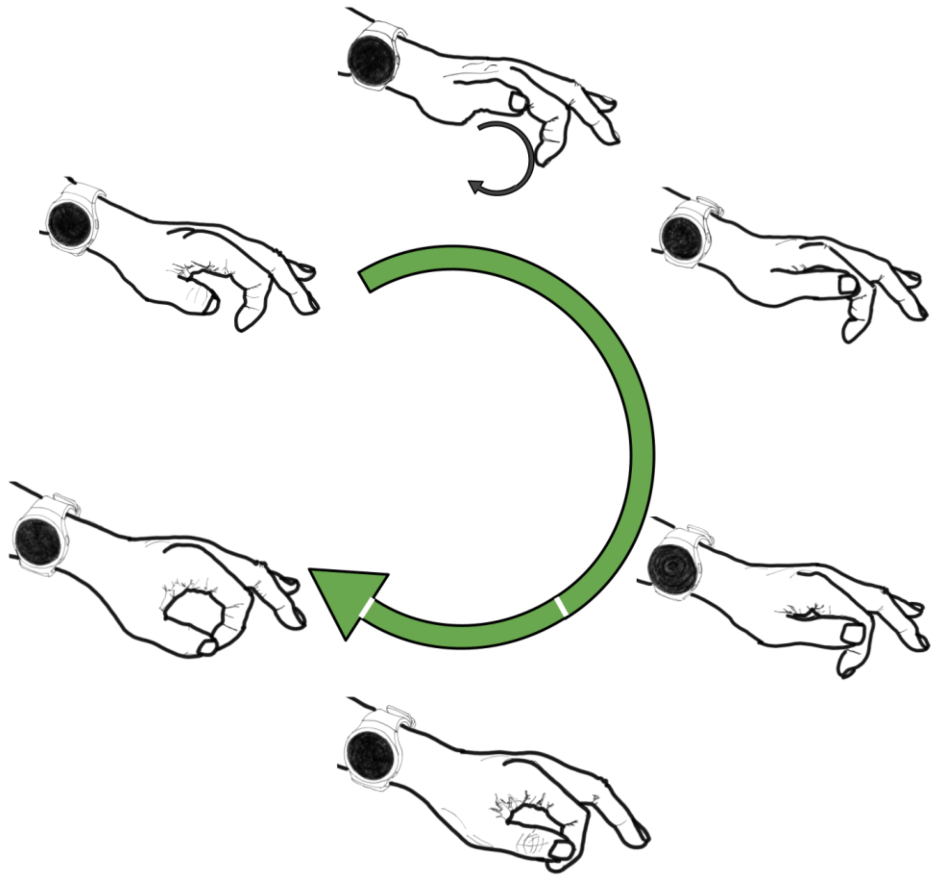

Fig. 2: A single-hand, finger-based, navigation gesture

Fig. 2 illustrates a single-hand, finger-based, navigation gesture. To perform this gesture, the user slides their thumb over an arched index finger, executing a circular motion. The circular motion is interpreted as a scroll through UI components.

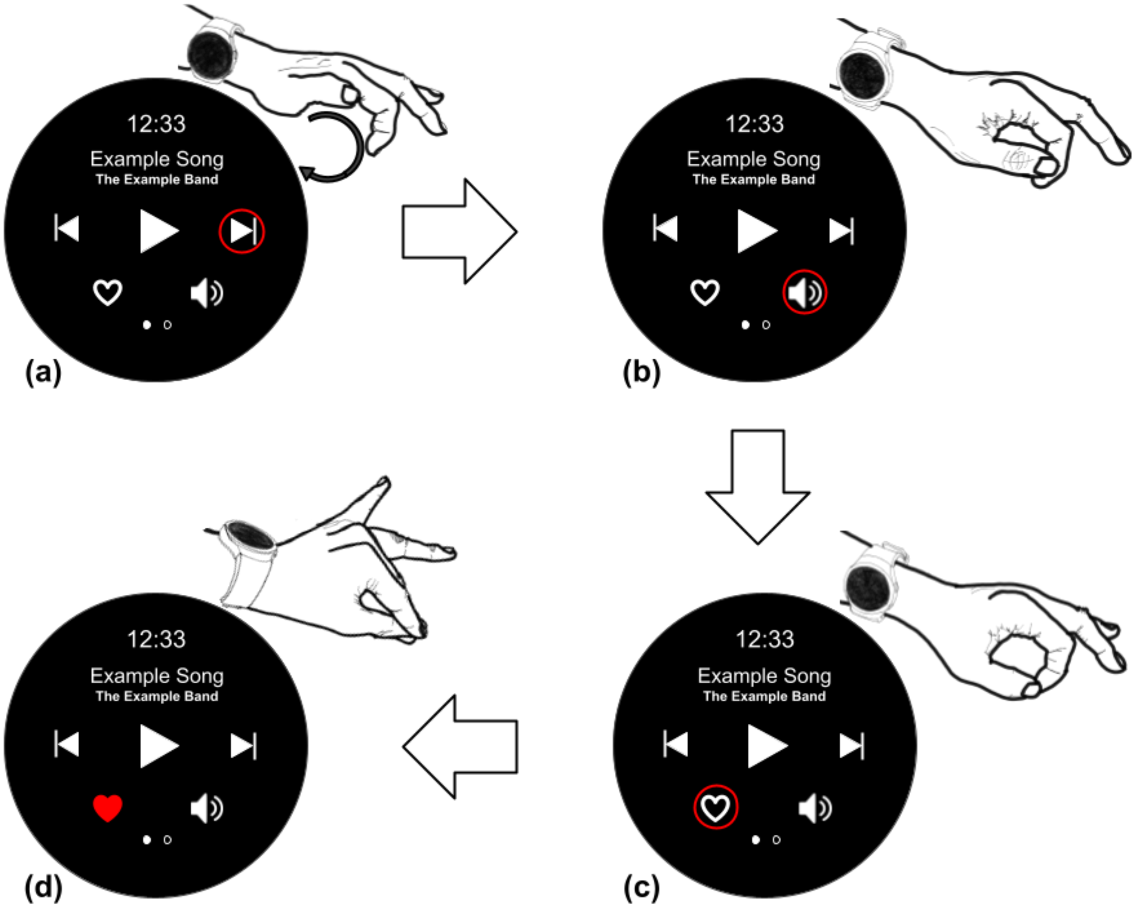

Fig. 3: Scrolling through a menu and selecting a menu item with single-hand gestures

For example, as illustrated in Fig. 3, as the user scrolls their thumb over their index finger, they navigate through the UI components next-track (Fig. 3a), volume-control (Fig. 3b), and set-favorite (or like-track, Fig. 3c). As the user scrolls, screen elements highlight (red circle) to show an active icon. When the user reaches a menu item of interest (set-favorite, the heart button, Fig. 3c), they form the confirm gesture (Fig. 3d), the two-finger pinch illustrated in Fig. 1, resulting in the menu item being selected (the heart button is filled and the track is set as a favorite).

The direction of thumb movement maps to clockwise or counterclockwise scrolling direction. For example, on the left hand, the thumb moving downward on the index finger maps to clockwise scrolling, while the thumb moving upward on the index finger maps to counterclockwise scrolling.

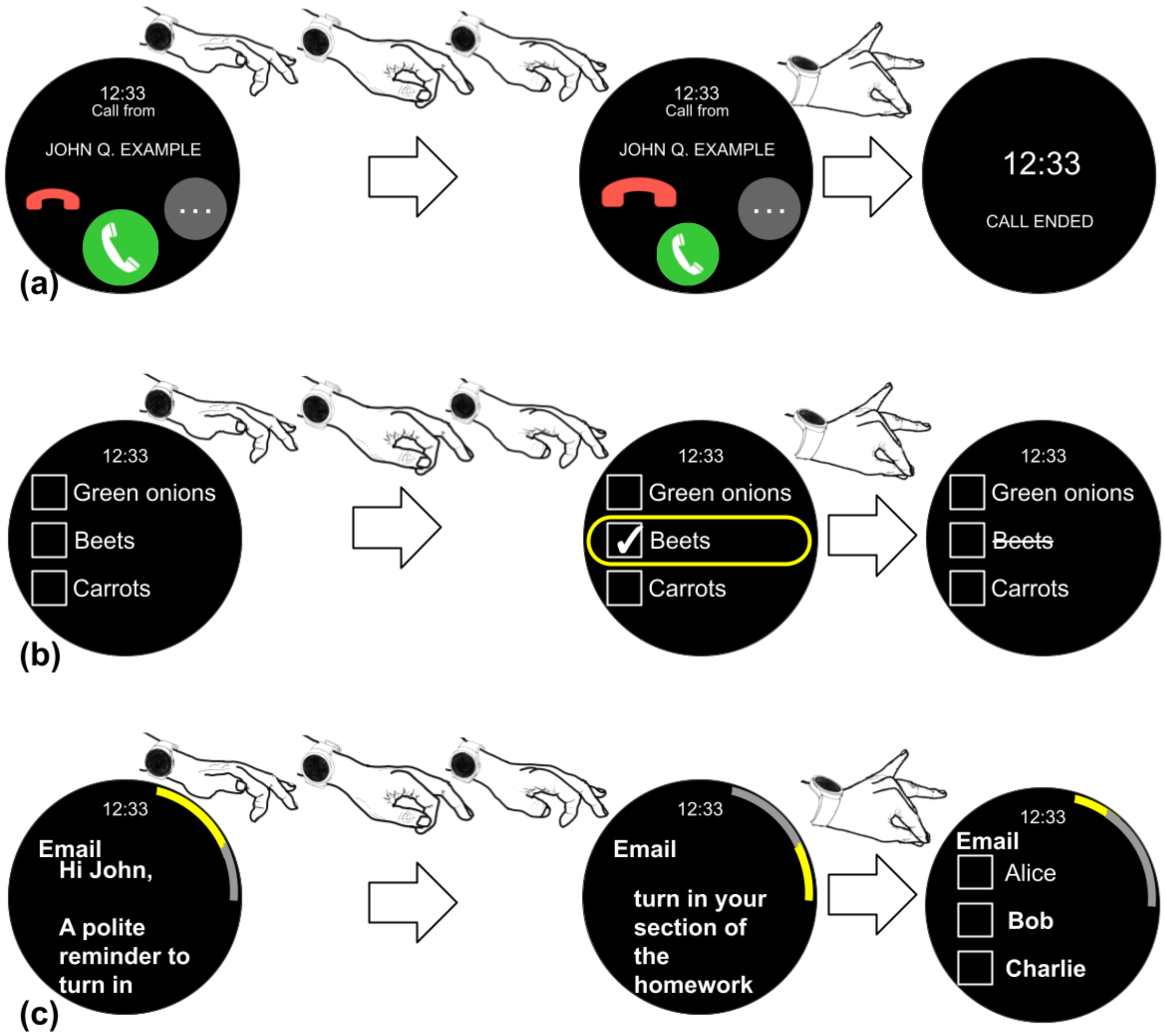

Fig. 4: Single-hand gestures for various applications

Fig. 4 illustrates examples of single-hand gestures for user interaction with various applications. In Fig. 4(a), the user uses the navigation gesture to scroll through accept/reject call options in a dialer/messaging app before selecting call-reject using the confirmation gesture. In Fig. 4(b), the user uses the navigation gesture to scroll through a shopping list in a notes app and checks off purchased items using the confirmation gesture. In Fig. 4(c), the user uses the navigation gesture to scroll through an email in an email app and uses the confirmation gesture to go back to the inbox.

False gesture recognition is avoided by having an activation action that precedes the gesture. An example activation action is glancing at the watch face. The single-hand gesture must occur within a listening window of the activation action for it to be considered valid.

The single-hand gestures herein described can be detected using various sensing technologies such as built-in accelerometers, inertial measurement units, miniature radar, etc. Such sensors can be embedded in on-wrist devices and used unobtrusively. Fine-motor recognition can be enabled using miniature radar on the on-wrist device itself or via a wristband accessory. Combined with ultra-wideband communications, the described gestures can enable user control of or directional input to other devices.

In this manner, the techniques of this disclosure enable single-hand control of AR glasses, smartwatches, smartphones, smart home devices, on-wrist, in-ear, and other wearable devices using gestures that are performed with the user's fine motor skills, e.g., finger movements, of the same hand on which a wrist-mounted device is worn. The techniques do not require wrist extension, flexion, arm-sweeping, or other unergonomic movements. The techniques do not require the user to execute non-discrete gestures or movements that are unergonomic under repetition. The techniques can be used in conjunction with other techniques of UI control, e.g., voice-based navigation, etc. The single-hand control described herein supports situational and permanent accessibility use cases.

CONCLUSION

This disclosure describes discrete, finger-based, single-hand gestures for controlling wrist-based devices. The described gestures are performed using the hand on which the device is worn, with no involvement from the other hand. The gestures include movements for core inputs, e.g., navigation, scrolling, confirmation, selection, etc., within a menu. The described finger gestures are ergonomic and work well for repetitive actions. The gestures advantageously use a single hand and rely on the user's fine motor skills.

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