June 2022

PROXIMITY-BASED SETTINGS AND FUNCTIONALITY

Chinmay Dhodapkar

PROXIMITY-BASED SETTINGS AND FUNCTIONALITY

ABSTRACT

A first computing device (e.g., a smart speaker, a smart television, etc.) may employ ultrawide band (UWB) technology (e.g., signals with a bandwidth higher than 20% of its center frequency, or signals with a bandwidth higher than 0.5 gigahertz (GHz)) to locate a second computing device (e.g., a smartphone, mobile phone, a tablet computer, a laptop computer, a wearable device, etc.) in order to automatically perform various actions based on the distance (and, optionally, relative position) between the first computing device and the second computing device. In some examples, the first computing device may use time-of-flight to determine distance between the first computing device and the second computing device. In some examples, the first computing device may select one or more actions to perform based on attributes (e.g., interests, preferences, settings, child or adult, etc.) of the user of the second computing device and the distance between the first computing device and the second computing device. For example, the first computing device may start audio playback of the user's favorite songs when the second computing device is close to the first computing device (e.g., within 10 meters (m)) and stop audio playback when the second computing device is far from the first computing device (e.g., further than 10 m).

DESCRIPTION

FIG. 1 below is a conceptual diagram illustrating a system 10 including a number of computing devices 100A-100N (collectively, "computing devices 100") in accordance with techniques of this disclosure. As shown in FIG. 1, computing devices 100 may be disposed within an environment 102 (e.g., an outdoor location, an interior of a building, etc.).

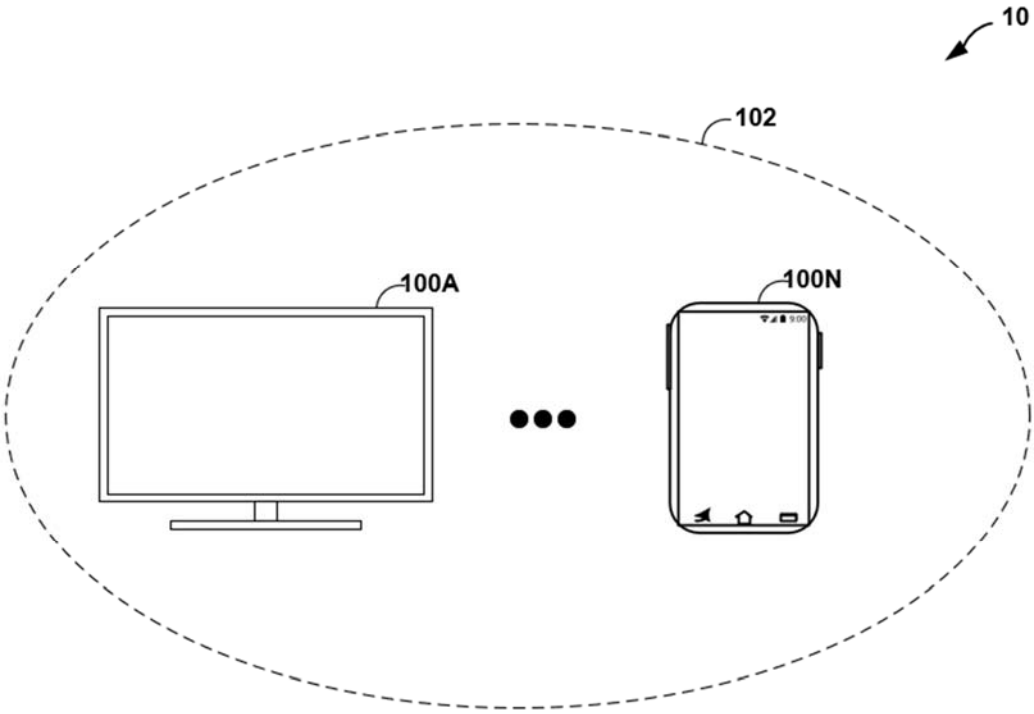

FIG. 1

In the example of FIG. 1, each of computing devices 100 may be a mobile or non-mobile computing device. Examples of computing devices 100 include, but are not limited to, a mobile phone, a smartphone, a desktop computer, a laptop computer, a tablet computer, a portable gaming device, a portable media player, an e-book reader, a watch (including a so-called "smartwatch"), an add-on device (such as a casting device), smart glasses, a gaming controller, a mixed-reality (XR) headset (which includes virtual reality (VR) headsets, augmented reality (AR) headsets, and the like), smart speakers, smart televisions, a camera device, a television platform, an infotainment system, an automobile navigation system, and a wearable computing device (e.g., a computerized watch, computerized eyewear, computerized ring, computerized clothing, etc.).

Computing devices 100 may include communication components ("COMM components"). COMM components may receive and transmit various types of information over

a network, such as an ultrawide band (UWB) radio, a cellular radio, a third-generation (3G) radio, a fourth-generation (4G) radio, a fifth-generation (5G) radio, a Bluetooth® radio (or any other personal area network (PAN) radio), a near-field communication (NFC) radio, a WiFi® radio (or any other wireless local area network (WLAN) radio), and/or the like.

Throughout the disclosure, examples are described where computing devices 100 analyze information associated with a computing device (e.g., computing device 100A) and a user of the computing device only if the computing device receives permission from the user of the computing device to analyze the information. For example, in situations discussed below, before computing devices 100 can collect or make use of information associated with a user, the user may be provided with an opportunity to provide input to control whether programs or features of computing devices 100 can collect and make use of user information (e.g., information about a user's current location, current speed, etc.).

In addition, certain data may be treated in one or more ways before it is stored or used by computing devices 100 so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined about the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over how information is collected about the user and used by computing devices 100.

In general, it may be desirable for computing devices 100 to automatically perform various actions based on the people who are proximate to computing devices 100. For example, if parents are using computing device 100A, which is shown as a smart television in FIG. 1, in environment 102 (e.g., a living room) to watch a movie with an R-rating and their child happens

to walk within view or earshot of computing device 100A, the parents may wish to stop the movie or otherwise prevent their child from being exposed to the movie. However, manually stopping the movie (e.g., by using a remote control) may take several seconds, at which point irreparable harm may occur.

In accordance with techniques of this disclosure, computing devices 100 may employ UWB technology to locate computing devices 100, and in turn users of computing devices 100, in order to automatically perform various actions based on the users who are proximate to computing devices 100. In some examples, computing devices 100 may select one or more actions to perform based on attributes (e.g., child or adult, interests, preferences, settings, etc.) of the users. In this way, computing devices 100 may automatically perform actions that are personalized to the users who actually experience those actions (e.g., because they are close to computing devices 100).

COMM components of computing device 100 may send and receive UWB signals (which may include one or more packets of information). A UWB signal may be defined as a signal with a bandwidth higher than 20% of its center frequency, or a signal with a bandwidth higher than 0.5 gigahertz (GHz). In some examples, UWB technology may operate over a frequency range from 3.1 to 10.6 GHz. Because UWB technology operates over a relatively wide bandwidth (e.g., compared to Bluetooth®), UWB technology may transmit data at high data rates. The high data rates may enable computing devices 100 to perform distance-based measurement via time-of-flight (e.g., a method for calculating location based on how long it takes for pulses of a signal to travel from one device to another) with high accuracy and low latency. In contrast, other standards like BLE and Wi-Fi® may be incapable of transmitting data at the rate necessary for time-of-flight. As a result, if computing devices 100 use those other standards, computing

devices 100 may need to rely on less reliable and/or precise parameters than time-of-flight (e.g., Received Signal Strength Indicator (RSSI) values) to determine distance.

As noted above, computing devices 100 may employ UWB technology to determine the distance of nearby objects (e.g., other computing devices) from computing devices 100 via time-of-flight. Time-of-flight may refer to the period of time spanning from when a first computing device (e.g., computing device 100A) sends UWB signals that a second computing device (e.g., computing device 100N) receives to when the first computing device receives UWB signals from the second computing device that the second computing device sent in response. Because time-of-flight is correlated to distance, computing devices 100 may process the time-of-flight to determine the distance between computing devices 100.

As an example, a first computing device (e.g., computing device 100B, which may be a smart speaker) may periodically broadcast (e.g., send) a first UWB signal to search for one or more nearby computing devices. Responsive to a second computing device (e.g., computing device 100N, which may be a smart phone) receiving the first UWB signal (which may indicate that the first and second computing devices are within range of each other), the second computing device may send a second UWB signal to the first computing device. The second UWB signal may include one or more packets that include the time that the second computing device received the first UWB signal and the time that the second computing device sent the second UWB signal. The first computing device may determine, based on the send time and receive time of the first UWB signal and the send time and receive time of the second UWB signal to determine the distance between the first and second computing devices. The second computing device (as well as any other computing device of computing devices 100) may similarly determine distance.

Computing devices 100 may automatically perform various actions based on the distance of other computing devices proximate to computing devices 100 and the user accounts associated with the other computing devices. Computing devices 100 may identify the user accounts associated with particular computing devices and obtain information related to the user accounts (e.g., preferences, settings, etc.).

For example, computing device 100A, which is shown as a smart television in FIG. 1, may determine that computing device 100N, which is shown as a smart phone in FIG.1, is within a threshold distance (e.g., 10 m) of computing device 100A. Computing device 100A may interrogate computing device 100N to determine the user account associated with computing device 100N, information related to the associated user account, etc. In this example, the user account associated with computing device 100N may have a child-safety setting activated. Accordingly, if computing device 100A is playing a video inappropriate for a child (e.g., a movie with an R-rating), computing device 100A may automatically stop playing the video (and even turn off the display of the video) in response to computing device 100N being within the threshold distance of computing device 100A. In some examples, computing device 100A may automatically resume playing the video in response to computing device 100N no longer being within the threshold distance of computing device 100A.

In another example, computing device 100B, which may be a smart speaker, may determine that computing device 100C, which may be a smart phone, is within a threshold distance of computing device 100B. Computing device 100B may interrogate computing device 100C and determine that the user account associated with computing device 100C has a playlist of frequently played songs. Accordingly, computing device 100B may automatically start playing the playlist of frequently played songs in response to computing device 100N being

within the threshold distance of computing device 100B. In some examples, computing device 100B may automatically stop playing the playlist in response to computing device 100C no longer being within the threshold distance of computing device 100B.

In yet another example, computing device 100B, which may be a smart speaker, may determine that computing device 100N, which may be a smart phone, is within a threshold distance of computing device 100B. Computing device 100B may interrogate computing device 100N and determine that the user account associated with computing device 100N has a child safety setting activated. Accordingly, if computing device 100B is playing a song inappropriate for a child (e.g., a song containing explicit language), computing device 100B may automatically censor or stop playing the song in response to computing device 100N being within the threshold distance of computing device 100B. In some examples, computing device 100B may automatically resume playing the song in response to computing device 100N no longer being within the threshold distance of computing device 100B.

In yet another example, computing device 100D, which may be a smart lock, may determine that computing device 100E, which may be a smart phone, is within a threshold distance of computing device 100D. Computing device 100D may interrogate computing device 100E and determine that the user account associated with computing device 100D has access privileges (e.g., the user is the owner of the residence to which the smart lock is affixed). Accordingly, computing device 100D may automatically unlock in response to computing device 100E being within the threshold distance of computing device 100D. In some examples, computing device 100D may automatically lock in response to computing device 100E no longer being within the threshold distance of computing device 10D.

In some examples, computing devices 100 may automatically perform various actions based on the relative position of other computing devices (e.g., the distance of the other computing devices from computing devices 100 and the angle between the other computing devices and computing devices 100) proximate to computing devices 100 and the user accounts associated with the other computing devices. For example, computing device 100A, which is shown as a smart television in FIG. 1, may determine that computing device 100N, which is shown as a smart phone in FIG.1, is within a threshold distance (e.g., 10 m) of computing device 100A, but that the relative position of computing device 100N is behind computing device 100A (e.g., because computing device 100N is in another room). In this case, computing device 100A may not perform any actions even though computing device 100N is within the threshold distance of computing device 100A because of the relative position of computing device 100N.

On the other hand, if computing device 100A determines that computing device 100N is within a threshold distance (e.g., 10 m) of computing device 100A, and that the relative position of computing device 100N is in front of computing device 100A, computing device 100A may interrogate computing device 100N to determine the user account associated with computing device 100N, information related to the associated user account, etc. In this example, the user account associated with computing device 100N may have a child-safety setting activated. Thus, in this and other ways, computing devices 100 may perform actions based on the distance and relative position of other computing devices.

Although described here with respect to a smart television, a smart speaker, and a smart lock, it should be understood that the techniques of this disclosure may be applied to other computing devices as well. Moreover, although described here as performing actions such as playing and stopping video playback, playing and stopping music playback, and unlocking and

locking a lock, it should be understood that the techniques may be applied to other actions. Thus, the examples described here are for purposes of explanation and are not intended to limit the scope of this disclosure.

It is noted that the techniques of this disclosure may be combined with any other suitable technique or combination of techniques. As one example, the techniques of this disclosure may be combined with the techniques described in U.S. Patent Application Publication No. 2020/0178027A1. In another example, the techniques of this disclosure may be combined with the techniques described in U.S. Patent Application Publication No. 2018/0018827A1. In yet another example, the techniques of this disclosure may be combined with the techniques described in U.S. Patent Application Publication No. 2020/0349966A1. In yet another example, the techniques of this disclosure may be combined with the techniques described in U.S. Patent Application Publication No. 2012/0124456A1. In yet another example, the techniques of this disclosure may be combined with the techniques described in U.S. Patent Application Publication No. 2019/0124394A1. In yet another example, the techniques of this disclosure may be combined with the techniques described in Andrew Zignani, "How UWB Expands Into the IoT - Where We Stand Today," NXP Semiconductors, June 24, 2021.