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Using Crash Detection and Alert Beacons on an Electronic Device to Increase Survival of Snow Immersion Victims

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Abstract:

This publication describes systems and techniques for crash detection on an electronic device to trigger transmitting alert beacons with the electronic device. The alert beacons may be received by nearby electronic devices to alert the users of those electronic devices of a snow immersion victim. A crash is detected by monitoring one or more sensors on an electronic device for a tumbling or inversion of the electronic device that indicates a snow immersion accident. Additionally, location and weather may also be monitored to detect a snow immersion accident and support a crash detection. After a crash is detected, a user of the electronic device may be provided with a notification to dismiss triggering alert beacons. If the user does not dismiss the notification, the electronic device may trigger transmitting alert beacons to alert others via wireless signal that the user has been in a snow immersion accident. The alerts may be provided via a peer-to-peer system tagged with location information of the snow immersion accident. The alerts can assist others in locating the snow immersion accident victim more quickly.

Keywords:

Sensor, accelerometer, gyroscope, location, global positioning system, GPS, pressure sensor, gravity sensor, alert, beacon, alarm, peer-to-peer, Bluetooth, Bluetooth Low Energy, wireless local area network, Wi-Fi, tree well, avalanche, snow immersion, accident

Background:

A snow immersion accident (a “snow accident”) can occur when a skier or snowboarder falls into a tree well or deep snow and becomes immobilized. A tree well is a void or depression

that forms around the base of a tree and can be difficult to identify as dangerous. Tree wells are common within the bounds of a ski resort. If a skier or snowboarder falls into a tree well or deep snow and becomes immersed in the snow, they can suffocate if aid is not quickly provided. Skiers and snowboarders often have a partner with them that assists if an accident is witnessed. However, there are instances when an accident is unwitnessed, which significantly increases the time to extricate the victim. Many skiers and snowboarders have an electronic device (e.g., smart phone, smart watch, tablet, etc.) on their person but this technology is not leveraged if there is an accident.

Therefore, it is desirable to use sensors and connective technology on an electronic device to reduce the time for others to locate a victim of a snow accident.

Description:

This publication describes systems and techniques for crash detection of a snow accident on an electronic device to trigger transmission of an alert beacon with the electronic device. After a crash is detected, a user may be provided with a notification enabling the user to dismiss the transmission of the alert beacon. If a user does not dismiss the notification, the electronic device will trigger transmission of the alert beacon, via a wireless signal, that indicates that the user has been in a snow accident. The alert beacon may be received by other electronic devices to alert the users of those electronic devices of a snow immersion victim. The alert may be provided via a peer-to-peer wireless network and may be tagged with geolocation information indicating the location of the snow accident. The alerts can assist others in locating the snow accident victim more quickly.

Figure 1 illustrates an example system in which an electronic device that supports a crash detection application performs crash detection and a beaconing application supports the transmission of alert beacons wirelessly.

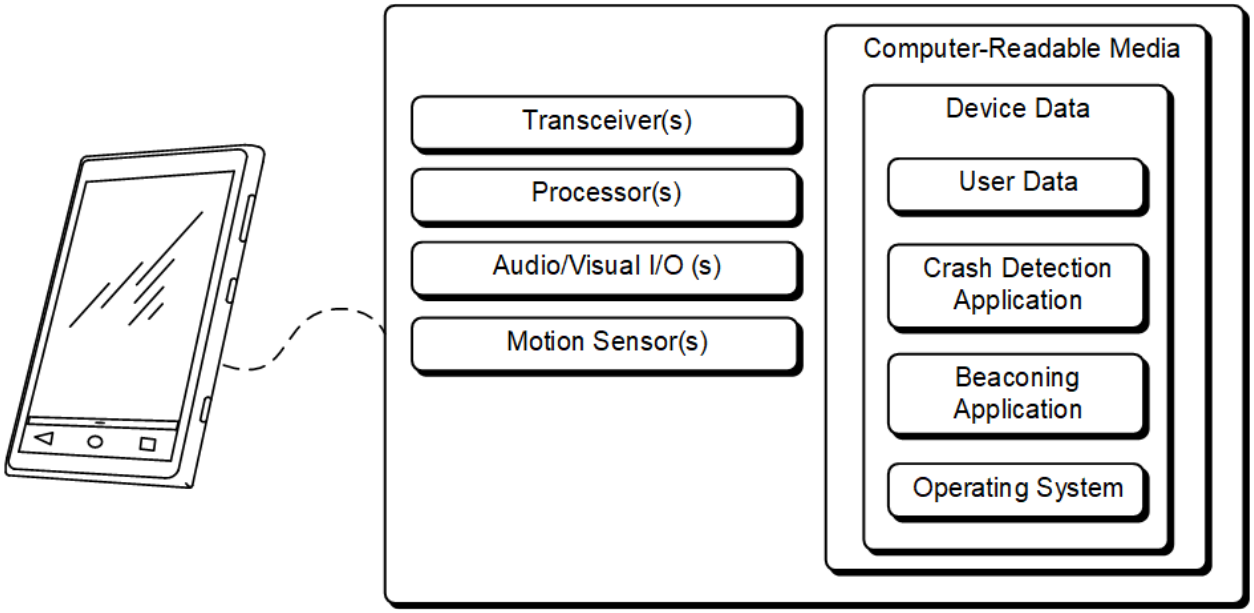

Figure 1

As illustrated in Figure 1, the electronic device is a smartphone. However, other electronic devices (e.g., a tablet, smartwatch, a wearable device, or the like) can also support the crash detection application and beaconing application described in this publication. The electronic device includes a processor(s), transceivers (e.g., 4G LTE, 5G NR, Bluetooth, Bluetooth Low Energy, Ultra-Wide Band (UWB)) for transmitting data to and receiving data from a wireless network, one or more audio/visual inputs and outputs (e.g., LEDs, speakers, camera, display), and one or more motion sensors (e.g., gravity sensor, accelerometer, gyroscope). The electronic device also includes a computer-readable medium (CRM) with device data. The device data includes user data, applications (e.g., a crash detection application, a beaconing application), and/or an operating system of the electronic device, which are executable by the processor(s) to enable crash detection. While the crash detection application and beaconing application could be

stored within the CRM, other implementations can include any combination of firmware, hardware, and/or software.

The device data includes executable instructions of a crash detection application that can be executed by the processor(s). The crash detection application represents functionality that monitors location data of an electronic device from a user, monitors weather data associated with the location data, monitors sensor data (e.g., velocity, direction, acceleration, etc.) from one or more motion sensors on the electronic device, analyzes sensor data to detect a change in velocity, tumbling, and/or inversion to determine a significant event, provides a notification to the user to dismiss the significant event, and triggers a beaconing application.

Figure 2, below, illustrates a diagram of a crash detection application logic that may be performed by an electronic device.

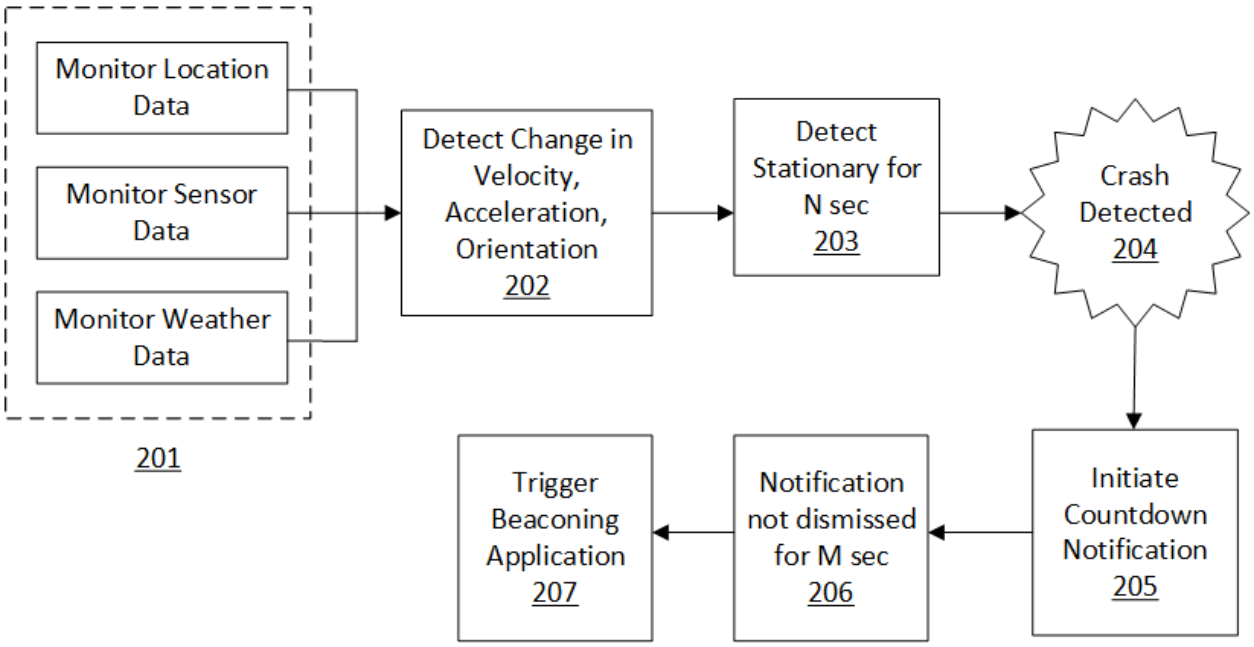

Figure 2

The crash detection application may leverage data from multiple sources to accurately identify the occurrence of a snow accident. The crash detection application may monitor several

types of data as indicated at 201 in Figure 2. The crash detection application may monitor location data of an electronic device by using global navigation satellite system (GNSS) data (e.g., global positioning system (GPS) data), by using cellular towers, or any other means to monitor the location of the electronic device to confirm that the electronic device is at a ski resort. The crash detection application may monitor weather data associated with the location, for example, fresh snow received (e.g., how many inches), current weather, and/or snow conditions of the ski resort to inform a risk for a snow immersion. Typically, a snow accident occurs when there is significant recent snow and/or significant cumulative snowfall for the season.

The crash detection application may monitor sensors (e.g., gravity sensor, accelerometer, orientation sensor) to detect a change in velocity, acceleration, and/or orientation. The data may be indicative of a tumbling or inversion of the electronic device, for example, a change in g-force or a stationary inversion. A significant change in g-force is not required during a snow accident that results in a snow immersion. On the contrary, the snow accident may not be violent but leave a user with an inverted body position. Thus, other criteria for example, inverting/tumbling detections may be useful.

At 202, the electronic device detects a significant change to one or more sensors. At 203, the device determines if the electronic device remains stationary for N seconds using sensor and/or GPS data. A snow accident is more likely to be an immersion if the electronic device is stationary indicating that a user of the electronic device is not able to move. The number of seconds (N) may be provided to the crash detection application. At 204, the electronic device determines that a crash is detected. At 205, a countdown of M seconds is initiated with an audio and/or visual cue to allow the user to dismiss a crash. The number of seconds (M) may be provided to the crash

detection application. At 206, the user has M seconds to dismiss the crash until the crash detection application triggers the beaconing application at 207.

The crash detection application may use a peer-to-peer networking application programming interface (API) to retrieve sensor information and device state information, and fuse signals (e.g., air pressure change, travel speed, flight mode toggle, indoor/outdoor schedule, real-time location and directions, signals from other users in ski resorts) to detect the occurrence of a crash and inverting/tumbling.

The beaconing application on a snow immersion victim's electronic device may transmit alerts via the peer-to-peer networking API to increase the survival rate of the victim. Figure 3, below, illustrates a snow immersion victim whose beaconing application on their electronic device is communicating an alert wirelessly to a passerby's electronic device.

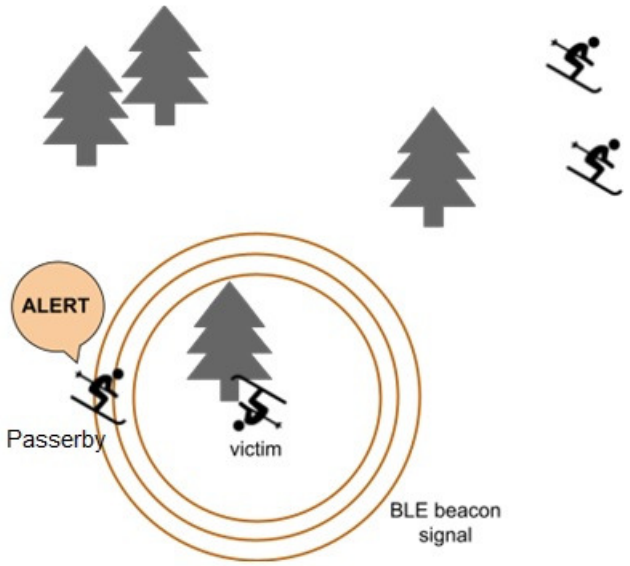

Figure 3

In the above illustration, the electronic device is sending an alert via BLE advertisement. However, the alert may be communicated via Bluetooth, BLE, a Wi-Fi connection, and/or other wireless connections. The alert may use a combination of communication platforms to provide

high-bandwidth, low-latency, and fully encrypted data transfers. The passerby may use an electronic device with an operating system that scans for beacons from other electronic devices. Accordingly, the passerby does not need to know the snow immersion victim in order to receive the alert beacon. The alert beacon may cause an alert to display on the user interface (UI) of the passerby's electronic device.

The peer-to-peer networking API enables the wireless connections (e.g., Bluetooth, Wi-Fi, etc.) in the passerby's and victim's electronic devices, as and when required, and restores the devices to their prior state once the beaconing application is done. Accordingly, the passerby and victim do not need to be prompted to turn on a wireless transceiver to make a connection. The alert beacon sent from the snow immersion victim may include a geolocation of the snow immersion victim (e.g., GPS, or last detected GPS) to enable a timely rescue. Additionally, the beaconing application may trigger a ringtone on the snow immersion victim's phone at a maximum value and/or provide a rangefinder UI (e.g., compass) on the passerby's electronic device that is equipped with ultra-wideband (UWB) radio for ranging and angle of arrival (AoA) capability.

In addition to alerting passerby devices, the beaconing application may send an alert to search-and-rescue, ski patrol, family, and/or friends to expedite the identification of the snow immersion victim's location as illustrated in Figure 4.

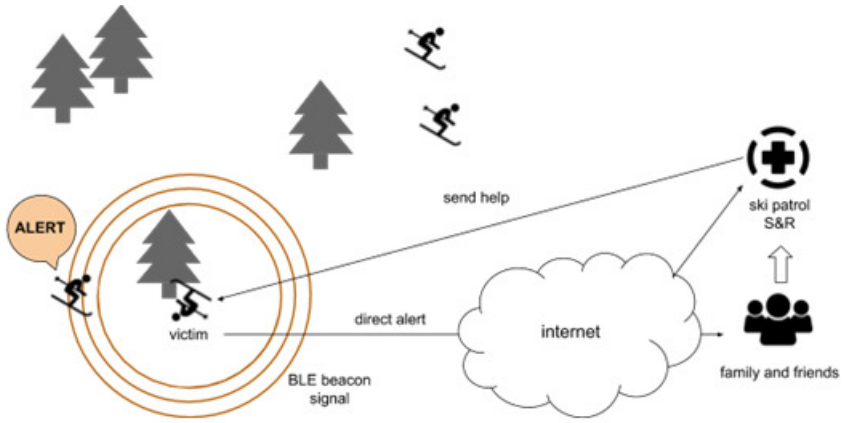

Figure 4

Using the methods and systems described herein, electronic devices are able to distinguish time-sensitive events, for example, a snow immersion, and communicate location information to improve the survival rate of a snow immersion victim.

Throughout this disclosure, examples are described where an electronic device may analyze information (e.g., velocity, acceleration, and positional sensor data, locational data, weather data) associated with a user, for example, the crash detection mentioned with respect to Figure 2. Further to the above descriptions, a user may be provided with controls allowing the user to make an election as to both if and when systems, applications, and/or features described herein may enable collection of user information (e.g., recreational activities, information about a user's social network, social actions, social activities, profession, a user's preferences, a user's current location), and if the user is sent content and/or communications from a server. In addition, certain data may be treated in one or more ways before it is stored and/or used, 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 for the user. In another example, a user's geographic location may be generalized where location information is obtained (for example, 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 what information is collected about the user, how that information is used, and what information is provided to the user.

References:

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