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Automatically Generating Notifications of Emergency Medical Events

ABSTRACT

This disclosure describes techniques that enable rapid response to medical events or emergencies by automatically notifying, with user and recipient permission, those nearby with medical knowledge (e.g., family members, neighbors, etc.) of a medical emergency. Nearby medical professionals can immediately initiate assistance procedures, or otherwise alleviate the medical condition, until emergency personnel can arrive. With user permission, the techniques can also leverage nearby devices, e.g., neighboring devices, devices not on the user’s person, etc., to detect medical events (e.g., a fall), via passive detection. The techniques make advantageous and coordinated use of the array of sensors available via wearable devices, IoT devices, smart-home devices, etc., to detect and confirm via multiple modalities, e.g., audio heatmaps, motion-sensing radar, WiFi reflectivity patterns, etc., a medical emergency.

KEYWORDS

- Medical emergency
- Emergency alert
- Medical assistance
- Crowdsourced medical response
- Wearable sensor
- Smart home
- Audio heatmap
- Motion-sensing radar
- WiFi reflectivity pattern
BACKGROUND

Various technologies, e.g., wearables equipped with sensors such as accelerometer, gyroscope, pulse rate monitors, etc., can be used to detect a medical event, such as a fall or a change in heartbeat pattern. These devices can also be programmed to automatically alert emergency medical services via a central notification service in case of a medical event. However, such devices do not notify or make use of medical professionals who might be nearby, e.g., those licensed in cardiopulmonary resuscitation (CPR), those with emergency medical technician (EMT) experience, or with otherwise useful medical training (e.g., nurses, doctors, etc.). For notifications to be generated, it is also necessary that the wearer/owner have these devices on them or nearby.

DESCRIPTION

This disclosure describes techniques that enable rapid response to medical events or emergencies by automatically notifying, with user and recipient permission, those nearby with medical knowledge (e.g., family members, neighbors, etc.) of a medical emergency. Nearby medical professionals can immediately initiate assistance procedures, or otherwise alleviate the medical condition, until emergency personnel can arrive. The techniques enable a peer-to-peer medical response.

With user permission, the techniques can also leverage nearby devices, e.g., neighboring devices, devices not on the user’s person, etc., to detect medical events (e.g., a fall), via passive detection. This can be useful in helping neighbors, particularly elderly neighbors, who, for instance, may have fallen, suffered a cardiac arrest or other detectable medical event.

The techniques make advantageous and coordinated use of the array of sensors available on wearable devices, e.g., motion-sensing radar, which can help detect whether the person has
fallen or merely dropped their device; IoT devices such as smart speakers, where audio-based
fall and cry-for-help detection can be added and responded to with audio confirmations; etc.

As illustrated in Fig. 1(a), per the techniques, a user is asked if a medical emergency can
trigger an alert to nearby people, medical professionals, friends/family, etc. (102). Upon user
consent (106), a list of individuals to be alerted in case of medical emergency (108) is developed.
With user permission, the list can include neighbors, medical professionals in the vicinity, etc.

In a similar manner, if a user is a medical professional (110), she is asked if she can
volunteer in a medical emergency in their vicinity (112). If the medical professional user agrees
(114), she is registered as a potential volunteer in an emergency medical situation (116).

Fig. 1: (a) Confirming that alerts can be sent to nearby medical professionals and friends or family
in case of a medical event; (b) Confirming a medical professional as a volunteer

As illustrated in Fig. 1(a), per the techniques, a user is asked if a medical emergency can
Per the techniques, upon the detection of a medical emergency, nearby people and medical professionals are alerted over one or more channels of communications, e.g., 4G, 5G, LTE, WiFi, near-field communications (NFC), Bluetooth, etc. A dedicated medical alert (SoS) protocol can be created such that devices equipped with the protocol software and any of the aforementioned communications channels can exchange information relating to the medical emergency.

The medical emergency communications channels can be duplex, such that people can not only be notified of an emergency event, but they can also communicate with the person at the other end of the call (similar to a VoIP call). With prior user authorization, smart-home equipped devices such as smart door locks can be configured to automatically unlock in the event of a detected medical emergency. The lock can also be programmed to automatically open if the user does not respond to communications after a certain period of time, e.g., one minute. Additionally, the user can configure the smart locks to let in previously authorized and known neighbors in the event that a medical alert goes off. The user can also configure a check-in procedure such that if they don't check in periodically, a medical alert goes off that automatically unlocks smart locks.

In addition to nearby people and medical professionals, the user can also configure and permit IoT, smart-home, wearable and other devices to alert, upon the detection of a medical emergency, the user’s doctors, certain contacts or family, known neighbors, caretakers, emergency services, welfare officers, social service providers, etc., and to automatically permit their entry.

Some examples of techniques to detect a medical emergency or event are provided below:
Motion-sensing radar

With user permission, motion-sensing radar in wearable devices such as smartphones, smartglasses, etc., can detect the position of the user relative to the device. Specifically, such radar can determine if the device is lying flat on the floor or on an elevated surface such as a table; if the user is standing vertically or lying on the floor; etc. Such radar can therefore be used to determine if a user has merely dropped their device, or whether the user has actually fallen. For example, if both the user and the device are detected as being vertical, or the user is detected as being vertical and the device is detected as being on a surface such as a table, then it is likely that there is no medical event. If the device is detected as lying on the floor while the user is detected as being vertical, it is likely that the user has merely dropped the device. If both the user and the device are detected as lying on the floor, then it is likely that the user has fallen, not merely dropped the device.

Anomalies in device usage or user responsiveness to events

With user permission, the frequency with which the user unlocks or uses a device such as a smartphone can be used to detect an anomaly. For example, during waking or working hours, if the user checks the phone on average every ten minutes or within one minute of getting a notification, the phone can determine anomalous user behavior if the device is left unchecked for durations well in excess of the average duration, e.g., longer than ten minutes. With user permission, the device can undertake various actions, e.g., it can alert or ping the user to see if an emergency event has occurred. If the user does not respond, an emergency beacon, which can be a signal to emergency responders, can go off. In addition, with user permission, nearby medical professionals can be alerted of the user’s possibly unresponsive condition. Alternatively or
additionally, an audio beacon can be emitted, which, besides serving as an automatic emergency measure, can also serve as an automatic lost device finder.

**IoT devices in the smart home, audio heat maps, and WiFi reflectivity patterns**

With user permission, sensors on IoT, smart-home devices, smart speakers, etc. can also be used to detect medical events. Microphones on such devices detect and recognize the sounds of falls, cries for help, etc., using, e.g., audio, convolutional, or deep-learning networks or other machine learning models. Microphones can also be used to detect the anomalous absence of a sound.

With user permission, an in-home audio heat map can be constructed and used to infer usage. The smart-home or IoT devices, along with factors such as activity data from the user’s smartphone, the user’s position as detected via WiFi or geo-fence, can be used to detect that the user is still in the house. An anomalous drop in the audio heatmap of the volume and frequency for that time of day (compared to the historical audio heatmap) can be an indication of a medical event.

Microphone data and audio heatmaps can be fused with data from motion-sensing radar to differentiate between a medically-compromised user and a user who is merely resting. For example, a determination by the motion-sensing radar that the user is resting on the kitchen floor can be indicative of a medical event. Such a determination can be followed up with various actions with user permission. For example, the devices can alert or ping the user, and the further lack of user response can cause an automatic alert to emergency services or to nearby medical professionals.

In addition to IoT and smart-home sensors, if permitted by the user, WiFi signals can be used to detect medical events, as follows. WiFi signals being body reflective, the pattern of WiFi
reflectivity (multipath pattern) can be mapped to user position and action. For example, WiFi
reflectivity patterns can be obtained for a user resting in the middle of the day in a room, for user
movement between particular spaces or rooms, etc. Machine learning models can be trained on
WiFi reflectivity patterns. For example, the WiFi reflectivity pattern of a resting user can be
labeled as such using position-location data gathered by other sensors. A WiFi reflectivity
pattern indicative of the user laying down in an anomalous place, such as the living room, can
trigger certain actions. For example, the device(s) can alert or ping the user, and further lack of
user response can cause an automatic alert to emergency services or to nearby medical
professionals. The turning off, or the snoozing, of the health-check ping by the user indicates the
lack of a medical event.

With user permission, optical (RGB) in-home cameras can be used to detect falls or other
medical events within sight of the camera using deep-learned activity classification. RGB
cameras can also act as remote photoplethysmogram (PPG) sensors, which can be used to detect
the heart rate of a user using a few seconds of video frames. A sudden drop or rise in the heart
rate can be indicative of a medical event.

Further to the descriptions above, a user is provided with controls allowing the user to
make an election as to both if and when systems, programs or features described herein may
enable collection of user information (e.g., information from one or more the user’s devices,
devices in the user’s home, activity patterns of device usage, a user’s preferences, or a user’s
current location), and if the user is sent content or communications from a server. In addition,
certain data may be treated in one or more ways before it is stored 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, 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 has control over whether information is collected about the user, how the information is used, and what information is provided to the user.

CONCLUSION

This disclosure describes techniques that enable rapid response to medical events or emergencies by automatically notifying, with user and recipient permission, those nearby with medical knowledge (e.g., family members, neighbors, etc.) of a medical emergency. Nearby medical professionals can immediately initiate assistance procedures, or otherwise alleviate the medical condition, until emergency personnel can arrive. With user permission, the techniques can also leverage nearby devices, e.g., neighboring devices, devices not on the user’s person, etc., to detect medical events (e.g., a fall), via passive detection. The techniques make advantageous and coordinated use of the array of sensors available via wearable devices, IoT devices, smart-home devices, etc., to detect and confirm via multiple modalities, e.g., audio heatmaps, motion-sensing radar, WiFi reflectivity patterns, etc., a medical emergency.

REFERENCES