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Aggregating Sensor Data from User Devices at a Fire Scene to Support Rescue Operations

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ABSTRACT

In structural firefighting and rescue operations, firefighters need to locate individuals to evacuate from the fire zone while protecting themselves from fire-related dangers. Currently, there is no mechanism to use data from user devices within a fire zone that include sensors that can provide fire-related information to support rescue operations. This disclosure describes techniques that enable the use of sensor data from user devices present at or near a fire scene for rescue operations. With appropriate user permissions, data from relevant sensors in user devices present at or near an active fire can be made available for rescue operations. The sensor data can help firefighters estimate the status of the fire and locate individuals present in the fire zone that may need to be rescued. Such data can include, e.g., temperature/ pressure distribution, visibility, location and/or motion of victims, alarm sounds, etc.

KEYWORDS

- Structural firefighting
- Fire & rescue
- Fire-related emergency
- Fire scene
- Sensor data
- Wearable sensor
- Fire alarm
- Fire alert
- Smoke detector

BACKGROUND

Mobile and/or wearable user devices, such as smartphones, fitness bands, smartwatches, etc., include a variety of sensors, such as accelerometers, gyroscopes, magnetometers, microphones, cameras, light sensors, thermometers, barometers, Global Positioning System (GPS) sensors, ultra-wideband (UWB) sensors, Bluetooth receivers, WiFi receivers, heart rate monitors, Saturation of Peripheral Oxygen (SpO2) sensors, etc. The types and number of sensors present in a device depend on the device function and vary from device to device. For example, cameras and microphones are typically present in smartphones while sensors to measure heart rate and SpO2 are common in fitness bands. With user permission, data obtained from the device sensors can be used to provide various functionalities within applications and services. For example, location and movement information derived from the sensor data can be used for providing directions in a mapping application; heart rate readings can be used to provide feedback about the intensity of an ongoing workout; etc.

In addition, sensor data aggregated across permitting devices can be used to obtain and provide information on collective activities within a given region. For example, aggregated information about movement can be used to estimate traffic patterns on the roads at any given time. Such aggregated data can also be used to detect potentially dangerous situations and support emergency operations. For instance, motion sensor data aggregated across devices in a given region can be used to estimate whether an earthquake is occurring and the corresponding intensity.

In structural firefighting and rescue operations (known as “fire & rescue”), firefighters need to locate individuals within the fire zone who need to be evacuated, while protecting themselves from fire-related dangers such as backdraft and flashover. Since many user devices

include sensors that can provide fire-related information, sensor data from devices located within a fire zone, such as a building, can be useful to support rescue operations. However, currently, there is no technique for devices within a fire zone (or the location of other hazardous conditions) to contribute sensor data to support rescue activities during a fire-related or other emergency in the vicinity of the device.

DESCRIPTION

This disclosure describes techniques that enable the use of sensor data from user devices present at or near a fire scene for rescue operations. With appropriate user permissions, data from relevant sensors in user devices, such as smartphones, smartwatches, fitness bands, etc., present at or near an active fire can be made available for rescue operations. The sensor data can be used to derive information that can help firefighters estimate the status of the fire and locate individuals present in the fire zone that may need to be rescued.

The data from different device sensors can be used to support rescue operations in different ways, such as:

- thermometer data can provide a measure of temperature distribution across the fire zone;
- barometer data can detect fire-related decreases in atmospheric pressure;
- data from microphones and accelerometers can capture acoustic signals generated by nearby burning objects, smoke detectors, fire alarms, potential victims, etc.;
- cameras and light sensors can be used to detect visual signals, such as smoke, flames, etc.;
- data from accelerometers, gyroscopes, and/or magnetometers can be combined to estimate a potential victim’s motion while that from heart rate and SpO2 sensors can indicate the presence of a victim even if the person is unconscious and/or immobile;

- location information from relevant sensors, such as GPS, Bluetooth, UWB, WiFi, etc., can help determine the position of the device within the fire zone; etc.

In addition to supporting rescue operations, data from device sensors can additionally be used to detect and broadcast fire-related emergencies. For example, if the sensor readings from a device indicate a fire with high confidence, a fire-related emergency alert can be broadcast to devices that happen to be nearby. Detection of nearby devices can be based on any relevant location information, such as GPS sensors within devices. Relay of the emergency alert can be achieved via any suitable standard techniques, such as device-to-device connection (e.g., Bluetooth), communication over local WiFi, broadcast using cellular towers, relay over the Internet, etc.

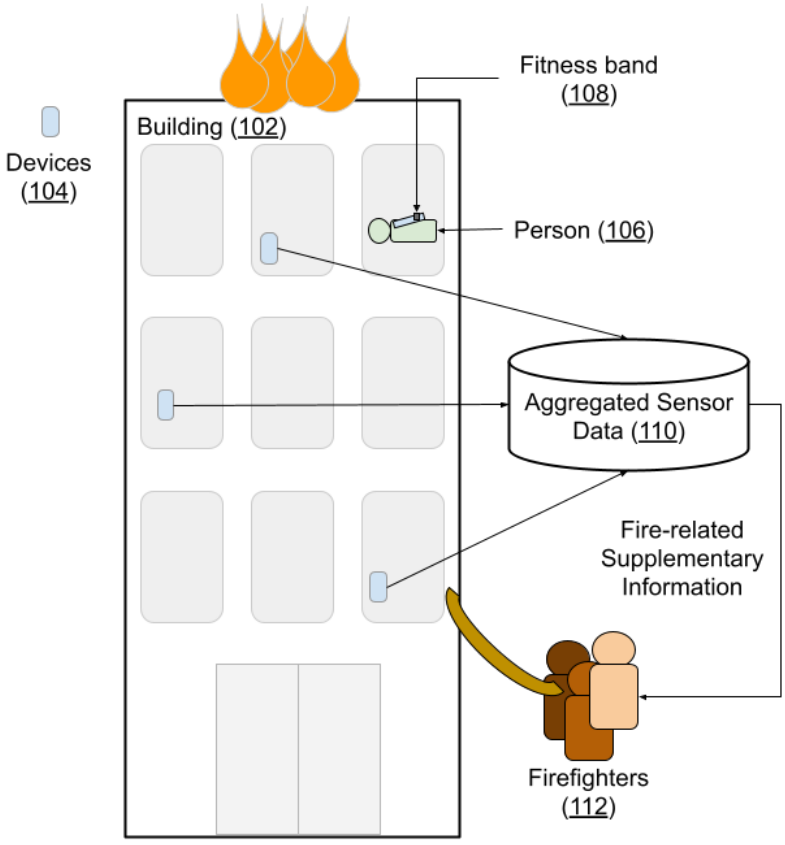

Fig. 1: Obtaining fire-related information from sensors within devices in a fire zone

Fig. 1 shows an example operational implementation of the techniques described in this disclosure. Firefighters (112) are dealing with a fire in a building (102). Various user devices (104) are distributed throughout the building. Data from the various sensors within these devices is aggregated (110) to generate relevant fire-related information that is relayed to the firefighters for use during rescue operations. Such information from the fitness band (108) of a person (106) can help firefighters locate the person more quickly.

The techniques described herein can be implemented on any device that includes a sensor that can capture and relay data relevant for obtaining fire-related information. Raw data from one or more sensors from one or more devices can be combined to determine higher-level information, such as location, motion, etc. Such aggregation can be performed on-device, on another device within a local area network for a facility, on a server, etc.

The information obtained from the device sensors can be made available to firefighters and other supporting personnel involved in rescue operations as supplementary information within applications and platforms that include information from existing networks of dedicated fire sensors. The addition of the supplementary information can enable a more accurate and complete estimate of the fire conditions within the fire zone, thus reducing risks to firefighters and enhancing the efficiency and effectiveness of rescue operations.

Further to the descriptions above, a user may be 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 about a user's devices, sensor data from a user's devices, 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 may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

This disclosure describes techniques that enable the use of sensor data from user devices present at or near a fire scene for rescue operations. With appropriate user permissions, data from relevant sensors in user devices present at or near an active fire can be made available for rescue operations. The sensor data can help firefighters estimate the status of the fire and locate individuals present in the fire zone that may need to be rescued. Such data can include, e.g., temperature/ pressure distribution, visibility, location and/or motion of victims, alarm sounds, etc.

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