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(54) **SYSTEM AND METHOD FOR DETERMINING A SPECIFIC USER LOCATION AND A PATH TO AN EXIT**

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(57) **ABSTRACT**

A system and method for determining a specific user location and path to an exit during an emergency condition. In response to an emergency alarm activated for a structure, a notification system may receive the alarm signal. The notification system may send a notification of the alert to a user mobile device when the user has subscribed to receive alerts regarding the structure. The notification may determine that the subscribed mobile device is located in the vicinity of the structure and activate an alarm on the device. A distressed user's mobile device may also be configured to transmit a supersonic audio SOS signal to a responder's mobile device. The two devices may establish supersonic communications between the responder and the distressed user devices to provide instructions or guidance to locate the distressed user device.

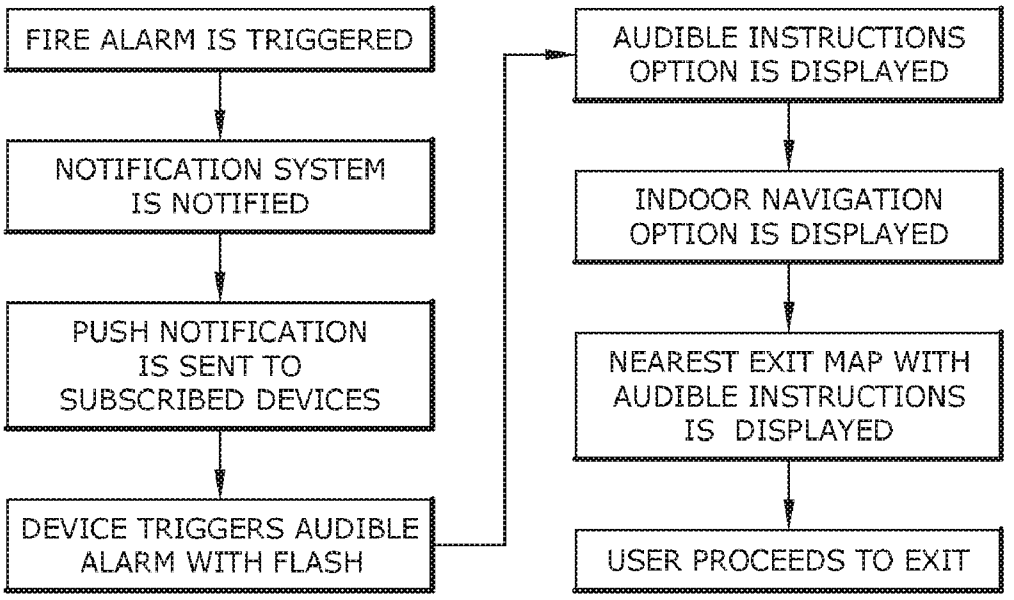


FIG.1

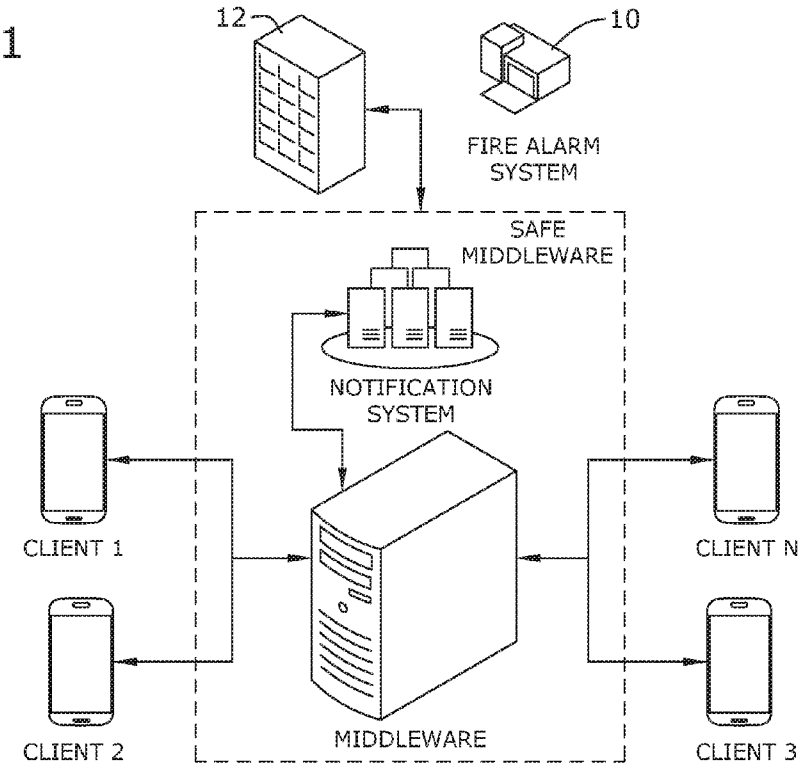

12
10
FIRE ALARM SYSTEM
SAFE MIDDLEWARE
NOTIFICATION SYSTEM
CLIENT 1
CLIENT N
CLIENT 2
CLIENT 3
MIDDLEWARE

FIG.2

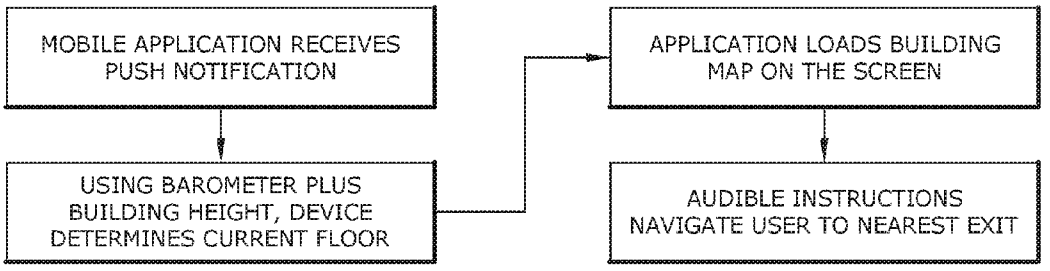

MOBILE APPLICATION RECEIVES PUSH NOTIFICATION
USING BAROMETER PLUS BUILDING HEIGHT, DEVICE DETERMINES CURRENT FLOOR
APPLICATION LOADS BUILDING MAP ON THE SCREEN
AUDIBLE INSTRUCTIONS NAVIGATE USER TO NEAREST EXIT

FIG.3

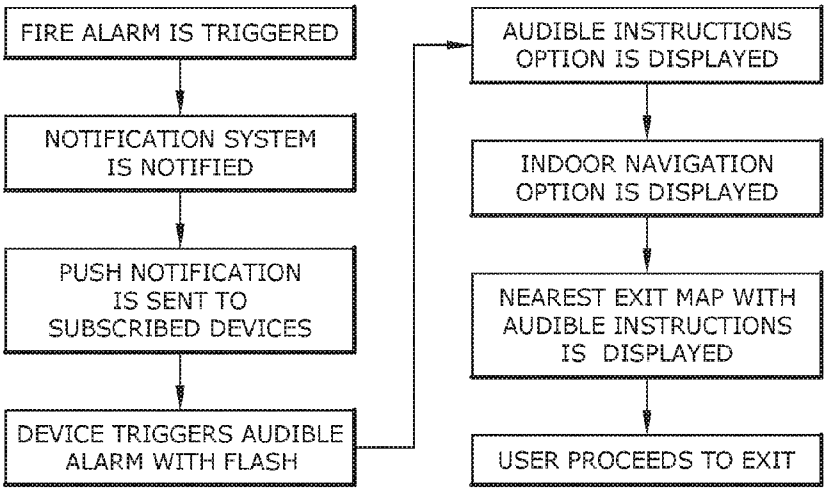

FIRE ALARM IS TRIGGERED
NOTIFICATION SYSTEM IS NOTIFIED
PUSH NOTIFICATION IS SENT TO SUBSCRIBED DEVICES
DEVICE TRIGGERS AUDIBLE ALARM WITH FLASH
AUDIBLE INSTRUCTIONS OPTION IS DISPLAYED
INDOOR NAVIGATION OPTION IS DISPLAYED
NEAREST EXIT MAP WITH AUDIBLE INSTRUCTIONS IS DISPLAYED
USER PROCEEDS TO EXIT

FIG.4

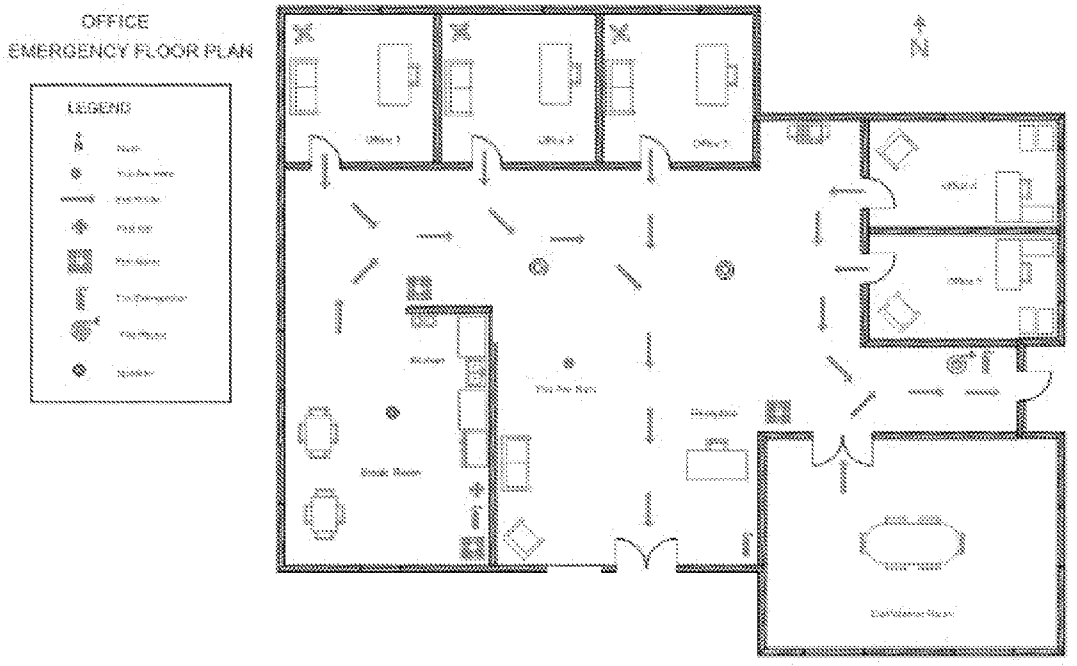

OFFICE
EMERGENCY FLOOR PLAN
LEGEND
N

FIG.5

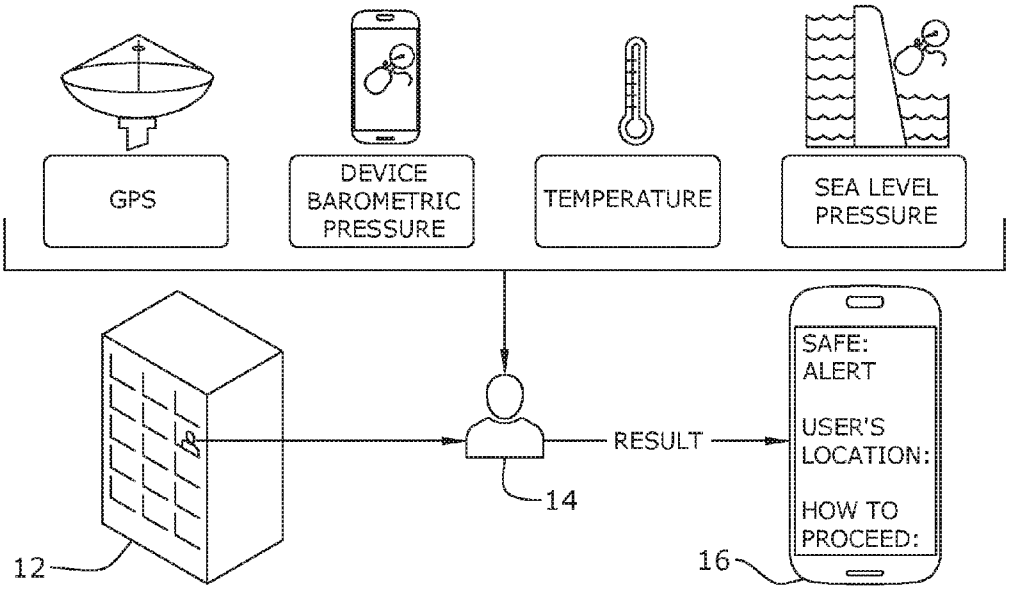


FIG.6

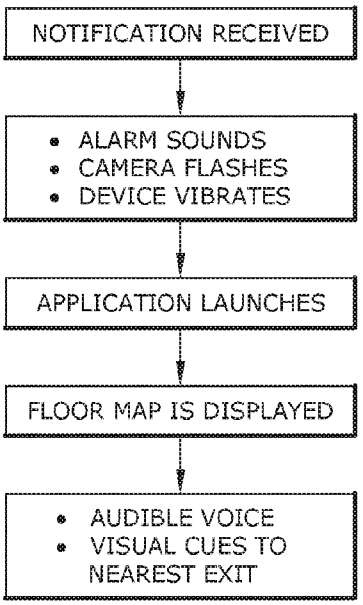
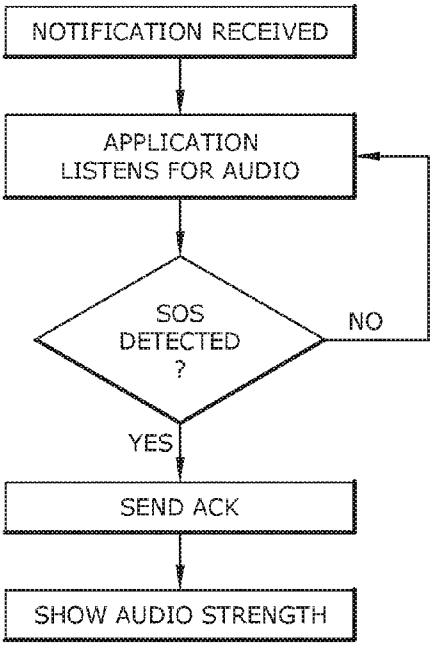


FIG.7



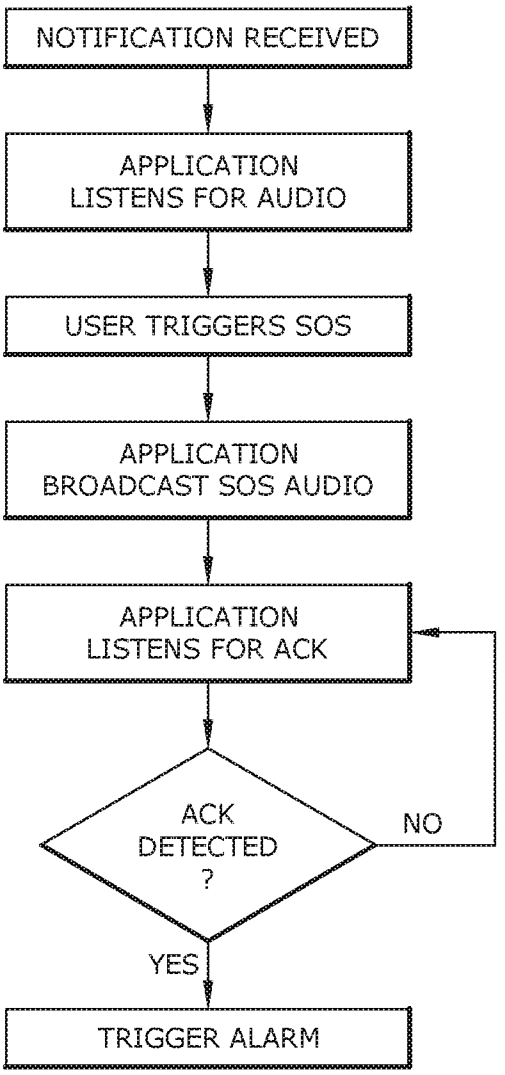

NOTIFICATION RECEIVED
APPLICATION LISTENS FOR AUDIO
USER TRIGGERS SOS
APPLICATION BROADCAST SOS AUDIO
APPLICATION LISTENS FOR ACK
ACK DETECTED ?
NO
YES
TRIGGER ALARM

FIG.8

SYSTEM AND METHOD FOR DETERMINING A SPECIFIC USER LOCATION AND A PATH TO AN EXIT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority of U.S. provisional application No. 62/095,132, filed Dec. 22, 2014, the contents of which are herein incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to emergency notification and response systems and, more particularly, to providing alerts to an emergency condition and guidance instructions to evacuate the area.

[0003] When a fire emergency occurs in a high rise building, it can be very hard to figure out where is the closest path to an exit. Similarly, for a building occupant that may be trapped from exiting the structure, it can be difficult to relay the trapped occupant's location to emergency response personnel.

[0004] Both of these circumstances can be especially true if a person may only be a visitor to the building.

[0005] As can be seen, there is a need for a method for determining a specific user location during an emergency situation so that the user may receive instructions for evacuating the area in the safest, most expeditious manner. There is also a need for providing location.

[0006] As can be seen, there is a need for a system and method for determining a user location within a structure during an emergency situation and providing guidance to the user to be able to safely exit the building.

SUMMARY OF THE INVENTION

[0007] In one aspect of the present invention, a method for determining a location and path is disclosed. The method comprises: notifying an automated notification system that an emergency alarm has been triggered at a specified location, the notification system hosted on a server; transmitting a notification from the notification system to a mobile application operating in a non-transitory memory of a mobile device, the notification indicating that the emergency alarm at the specified location has been triggered; triggering the mobile application to activate a device alarm on the mobile device; determining a position of the mobile device within the specified location; providing a map on a display screen on the mobile device, the map corresponding to the determined position of the mobile device; and providing instructions on a path towards an exit within the specified location.

[0008] In other aspects of the invention, the step of determining the position of the mobile device within the specified location may further comprise: receiving geographic coordinates of the mobile device; and determining an elevation of the mobile device. The step of determining the elevation of the mobile device may further comprise: receiving a barometric pressure measurement from the mobile device; receiving an atmospheric pressure and a temperature for an area in the vicinity of the specified location; and calculating an estimated elevation of the device at the specified location.

[0009] The step of determining the elevation of the mobile device may further comprise: comparing the estimated elevation of the device to a building plan corresponding to the specified location to determine a current floor of the specified location where the device is located. Determining the elevation of the mobile device may also include receiving a GPS altitude signal from the mobile device.

[0010] In other aspects of the invention the step of providing the map on the display screen further comprises: providing a map corresponding to the current floor of the specified location. The step of providing instructions on the path towards the exit within the specified location may also include providing instructions on the path from the current floor to the exit.

[0011] In certain embodiments of the invention, the step of triggering the mobile application to activate the device alarm occurs after the notification system receives information indicating the mobile device is located in a near proximity of the specified location.

[0012] In yet another aspect of the invention, a method of locating a distressed mobile device user is disclosed. The method comprises: receiving a notification of an emergency condition at a specified location on a mobile device located at the specified location; and monitoring for a supersonic audio signal on the mobile device. The method may also include activating a supersonic audio SOS signal on a user interface of the mobile device of the distressed mobile device user; and broadcasting the supersonic audio SOS signal through a device speaker of the distressed mobile device user.

[0013] Other aspects of the method may include: receiving an acknowledgement of the supersonic audio SOS signal through a device microphone of the distressed mobile device user; and triggering a human perceptible alarm signal after receiving the acknowledgement. The human perceptible alarm may be an audible alarm or a a visual alarm.

[0014] The method of locating a distressed mobile device user may further comprise the steps of detecting a supersonic audio SOS signal on a second mobile device; and broadcasting a supersonic audio acknowledgement of the SOS signal. Other aspects of the method may comprise presenting an audio strength meter on a display screen of the second mobile device. The method may also comprise presenting directional guidance on the display screen of the second mobile device to the source of the supersonic audio SOS signal.

[0015] These and other features, aspects and advantages of the present invention will become better understood with reference to the following drawings, description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. **1** is a schematic diagram of aspects of the invention.

[0017] FIG. **2** is a flow chart for providing indoor navigation instructions.

[0018] FIG. **3** is a flow chart of an emergency response flow.

[0019] FIG. **4** is the key features.

[0020] FIG. **5** is a schematic of a floor detection approach.

[0021] FIG. **6** is a flow chart of the notification and navigation approach.

[0022] FIG. **7** is a flow chart of the safe audio system module **1**.

[0023] FIG. **8** is a flow chart of the safe audio system module **2**.

DETAILED DESCRIPTION OF THE INVENTION

[0024] The following detailed description is of the best currently contemplated modes of carrying out exemplary

embodiments of the invention. The description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention, since the scope of the invention is best defined by the appended claims.

[0025] Broadly, an embodiment of the present invention provides a method for determining a specific location and path comprising: notifying a notification system that a fire alarm has been triggered; pushing a notification to a mobile application on a mobile device; triggering an alarm on the mobile application; providing a map on a screen on the mobile device; and providing instructions on a path towards an exit within a building. As used herein, the system contemplated by the present invention may be referred to as the Smart Application Fire Exit (SAFE).

[0026] The present invention may include at least one computer with a user interface. The computer may include any computer including, but not limited to, a desktop, laptop, and smart mobile computing device, such as, a tablet and smart phone. The computer includes a program product including a machine-readable program code for causing, when executed, the computer to perform steps. The program product may include software which may either be loaded onto the computer or accessed by the computer. The loaded software may also include an application on a smart device. The software may be accessed by the computer using a web browser.

[0027] The computer may access the software via the web browser using the internet, extranet, intranet, host server, internet cloud and the like. As is illustrated in FIG. **1**, a representative system architecture is depicted. An embodiment of a method for determining a specific location and path may include accessing a mobile application. A user with a mobile device may download the application. The user may subscribe to receive notifications for the application and for at least one specific building. The mobile application may be connected to at least one fire detection system. The at least one fire detection system may include a fire alarm that may be triggered in the case of a fire emergency. At least one building map may be included with the application.

Hosting Options

[0028] The SAFE system will require integration with the building's emergency alarm system. This integration may be done through the use of a middleware component which will relay notifications from the emergency system to the end user devices **16**. The SAFE solution may be provided to potential clients with various options, such as to install & host the middleware on premises; or to use middleware hosted in a cloud hosting service, such as Amazon, Google, etc.

[0029] The middleware component of the system may also be configured to interact with a messaging system, for example the Apple Push Notification System (APNS), the Google Cloud Messaging (GCM), or like messaging systems. It may also act as a gateway for all notifications coming from the building's alarm system to the user's mobile devices **16**.

Login & Registration Module

[0030] The first time the application is launched, users **14** will have an option to register. The registration process requires users **14** to enter an ID sent to their email address. Once they have logged into the application, the device will store this information and may keep them logged in going forward. Once the credential are validated, the user **14** lands on the application main screen where they can see which locations or buildings **12** they're currently subscribed to. A subscription to a building **12** means the user **14** will be notified and alerted of any emergencies relating to that building **12** that may be communicated via a fire alarm system **10**.

Push Notification Module

[0031] Once the user **14** has registered in the system, they will have the ability to subscribe to a building **12** to receive alert notifications. In the background, the SAFE system leverages the Apple Push Notification System to send and receive push notifications on the mobile devices (Client **1**-Client N). When a push notification is received, the application retrieves the current floor details and proceeds to take the user directly to the navigation/guidance screen of the floor they are currently on.

Geofencing Module

[0032] The SAFE application allows users **14** to subscribe to more than one building **12**. For enterprises, this is particularly useful when a company has more than one building **12**. It can also be used by users **14** to subscribe to multiple buildings **12** for which they user may want to receive alerts from. The geofencing module makes use of the Apple device GPS and Location Based notification alerts to determine if a user **14** is nearby or close to a specific location **12**. The application may monitor when they are in the building **12** or close by. This monitoring allows the system to determine if the user **14** is in any danger at the time of an emergency.

[0033] A flow chart of the system process is illustrated in reference to FIG. **3**. When an emergency alarm **10**, such as a fire alarm, is activated, the notification system is notified of the emergency. Responsive to the notification a push notification is sent to all subscribed devices **16**. The subscribed devices **16** may be configured to receive an audible alarm, a visual flashing alarm, a vibration, or combination thereof. The alarm will be triggered on devices **16** that have subscribed to the building **12** and may also be limited to devices **16** that are within a geographic vicinity of the subscribed building **12**, based on a reported global positioning system (GPS) information reported by the user's device **16**. Each of the devices **16** that are subscribed to a building **12** may be polled for their current GPS location, before activating the application alarm on the device.

[0034] The subscribed device **16** may display an option for the user **14** to receive audible instructions to accompany a visual indoor navigation display. The instructions may direct the user **14** to the nearest exit via a map or audible instructions. and the user **14** may proceed to the nearest exit.

Floor Plan Integration

[0035] The floor plans for each business location **12** may be acquired at the time that the service is agreed with a business building. The information may include: an indoor map for each of the building floors; a highlighted location of FIRE exists; and highlighted emergency routes to nearest exists. For security purposes, the building floor plans may be retained on the system server and may only be communicated to the client devices **16** in the event of an actual emergency condition.

Notification & Navigation System

[0036] A notification and navigation system is depicted in reference to FIGS. **2** and **3**. When an emergency notification

is received by the mobile application, the next step is to show the user **14** an interface that will easily allow them to navigate to the nearest exit. The application can provide guidance and navigation in the form of audio in conjunction with a display of visual cues from the user's device **16**.

[0037] Once the user **14** opens the application, the application may determine the user's current floor location and display the current floor's map. This map may include cues to the let user know the route to the nearest exit(s). The application may also provide audio feedback which can include phrases such as:

[0038] "Please remain calm"

[0039] "Follow the signs or use the floor map to the nearest exit"

[0040] "Please proceed straight ahead"

[0041] "Please turn right/left"

Floor Detection Approach

[0042] Floor detection is one of the main features of the mobile application. When an emergency notification is received, the user **14** is presented with an option to open up the application. Once the application is opened, it will attempt to use various device components in order to determine the floor the user is currently located on within the building **12**.

[0043] As seen in reference to FIG. **5**, the application may use a barometer and the building height to determine a current floor for the user **14**. Once a current floor may be determined, the application may load a building map onto the screen of the mobile device **16**. In certain embodiments, a set of audible instructions may be broadcasted from the mobile device **16**. The building map may identify the closest exit on the current floor. A visual instruction may also be displayed. An audible instruction may be produced. The user may then follow the instructions to an exit and to safety.

[0044] iBeacon Guidance System

[0045] As seen in reference to FIG. **4**, the system may also be configured to utilize an iBeacon Guidance system, by Apple Inc., of Cupertino, Calif. The iBeacon Guidance system includes a plurality of Bluetooth low energy devices (BLE) that provide location information of devices along the fire exit path and may define the exit path on a virtual floor map. The user can see the fire exit paths lit up on each floor, and can also receive step-by-step navigation along the fire exit based on the proximity to a particular BLE device.

[0046] The diagram below illustrates how the iBeacon devices placed in different locations in the floor will allow the device to determine where the user needs to go. For example, if the user is close to iBeacon A, the device may tell the user to walk straight ahead. Whereas when the user is close to iBeacon B, the device would the user to proceed to the right. All via audible and user interface instructions.

[0047] iOS Platform Devices

[0048] Implementation of the SAFE system on iOS platform devices **16** utilizes Apple iBeacon technology to determine when a user **14** is close to a specific location. When the SAFE solution is deployed in a building **12**, part of the installation may involve setting up iBeacon devices in strategically determined locations. These locations may then be picked up by the mobile application and will allow it to determine the exact location of the user.

[0049] Android Platform Devices

[0050] Implementation of the SAFE system on Android operating system devices and applications have the ability to determine the user's floor location using two different methods: 1. utilizing the iBeacon technology and re-using the same approach utilized by the iOS application; and 2. using the device's barometric pressure sensor and the GPS to determine the height. The second approach may utilize the following technique:

a. Acquire the device pressure using the barometric pressure sensor http://developer.android.com/reference/android/hardware/Sensor.html#TYPE PRESSURE incorporated herein by reference.

b. Acquire the device latitude and longitude using the GPS.

c. Using a third party API, such as Forecast iOS, to acquire the current location's temperature and atmospheric pressure.

d. Use the following equation to determine the device height:

$$h = h_s + \frac{T_b}{L_s} \cdot \left[\left(\frac{P}{P_s} \right)^{\frac{-R \cdot L_s}{S_s \cdot M}} - 1 \right]$$

Reference: http://www.mide.com/products/slamstick/air-pressure-altitude-calculator.php, incorporated herein by reference.

e. Using the building's estimated floor height to determine the floor the user is currently on.

SAFE High Frequency Audio SOS Module

[0051] In another aspect of the present invention, the mobile client application may also be configured to use the internal speakers and microphones of participating client devices **16** in order to provide a localized SOS communications with other mobile devices **16** in close proximity to the device of a distressed user **14**. In this embodiment, the devices **16** will utilize high frequency audio (inaudible to the users) signals to transmit information between devices **16** in surrounding areas.

[0052] As seen in reference to FIG. **8**, when an emergency notification is received by the mobile application, the next step is to present the user **14** an interface that will easily allow them to navigate to the nearest exit. At the same time, the mobile application may also be configured activate an audio SOS module, which activates an SOS listening mode on the user's device **16**. The user interface may also provide the user **14** the option to call for help via an SOS button. When a distressed user **14** activates the SOS button, the SOS system module may perform two functions.

[0053] First the SOS module may send a distress notification of the user's distress to the notification system. This will alert first responders to the presence of the distressed individual in the structure **12**. If the application has been able to ascertain the distressed user's location within the structure **12**, the distress notification may include an identification of the distressed user's **14** location within the structure **12**.

[0054] Second, the SOS module may also broadcast a high frequency audio alert which will be audible to other nearby devices **16**. The distressed user's device will then monitor for an acknowledgement from a nearby user's device. If no acknowledgement is received, the distressed user's device will continue to monitor for an acknowledgement. If the distressed user's device receives an acknowledgement from another user's device, the distressed user's device may then trigger an alarm to assist the other user in locating the distressed user. The alarm may be a human detectable audible

alarm. On devices equipped with a camera flash capability, the alarm may also include a visual alarm via a repeated flashing of the camera flash.

[0055] As seen in reference to FIG. **7**, devices **16** that are in an SOS listening mode and close to the distressed user, which activated the SOS stress call feature, will be able to locate and assist or provide assistance to those in need. When in the listening mode, the devices monitor for a high frequency SOS audio signal. If no SOS audio signal is detected, the application continues to monitor for the signal. If the device detects the high frequency SOS audio, it will transmit an acknowledgement to the distressed user's device. The user interface on the recipient's device may then present an audio signal strength display to provide directional guidance to the location of distressed user. For example, if a Fire Emergency team is in the building, they will be able to locate the distressed user's location by looking at the system and also by using the SAFE application which will help them narrow down the location of the user by showing the strength of the audio signal as they get closer to the distressed user.

[0056] The computer-based data processing system and method described above is for purposes of example only, and may be implemented in any type of computer system or programming or processing environment, or in a computer program, alone or in conjunction with hardware. The present invention may also be implemented in software stored on a computer-readable medium and executed as a computer program on a general purpose or special purpose computer. For clarity, only those aspects of the system germane to the invention are described, and product details well known in the art are omitted. For the same reason, the computer hardware is not described in further detail. It should thus be understood that the invention is not limited to any specific computer language, program, or computer. It is further contemplated that the present invention may be run on a stand-alone computer system, or may be run from a server computer system that can be accessed by a plurality of client computer systems interconnected over an intranet network, or that is accessible to clients over the Internet. In addition, many embodiments of the present invention have application to a wide range of industries. To the extent the present application discloses a system, the method implemented by that system, as well as software stored on a computer-readable medium and executed as a computer program to perform the method on a general purpose or special purpose computer, are within the scope of the present invention. Further, to the extent the present application discloses a method, a system of apparatuses configured to implement the method are within the scope of the present invention.

[0057] It should be understood, of course, that the foregoing relates to exemplary embodiments of the invention and that modifications may be made without departing from the spirit and scope of the invention as set forth in the following claims.

What is claimed is:

1. A method for determining a location and path comprising:

notifying an automated notification system that an emergency alarm has been triggered at a specified location, the notification system hosted on a server;

transmitting a notification from the notification system to a mobile application operating in a non-transitory memory of a mobile device, the notification indicating that the emergency alarm at the specified location has been triggered;

triggering the mobile application to activate a device alarm on the mobile device;

determining a position of the mobile device within the specified location;

providing a map on a display screen on the mobile device, the map corresponding to the determined position of the mobile device; and

providing instructions on a path towards an exit within the specified location.

2. The method of claim **1**, wherein the step of determining the position of the mobile device within the specified location comprises:

receiving geographic coordinates of the mobile device; and

determining an elevation of the mobile device.

3. The method of claim **2**, wherein the step of determining the elevation of the mobile device comprises:

receiving a barometric pressure measurement from the mobile device;

receiving an atmospheric pressure and a temperature for an area in the vicinity of the specified location; and

calculating an estimated elevation of the device at the specified location.

4. The method of claim **3**, wherein the step of determining the elevation of the mobile device further comprises:

comparing the estimated elevation of the device to a building plan corresponding to the specified location to determine a current floor of the specified location where the device is located.

5. The method of claim **4**, wherein the step of providing the map on the display screen further comprises:

providing a map corresponding to the current floor of the specified location.

6. The method of claim **5**, wherein the step of providing instructions on the path towards the exit within the specified location further comprises:

providing instructions on the path from the current floor to the exit.

7. The method of claim **2**, wherein the step of determining the position of the mobile device within the specified location comprises:

receiving a GPS altitude signal from the mobile device.

8. The method of claim **1**, wherein triggering the mobile application to activate the device alarm occurs after the notification system receives information indicating the mobile device is located in a near proximity of the specified location.

9. A method of locating a distressed mobile device user, comprising:

receiving a notification of an emergency condition at a specified location on a mobile device located at the specified location; and

monitoring for a supersonic audio signal on the mobile device.

10. The method of claim **9**, further comprising:

activating a supersonic audio SOS signal on a user interface of the mobile device of the distressed mobile device user; and

broadcasting the supersonic audio SOS signal through a device speaker of the distressed mobile device user.

11. The method of claim **10**, further comprising:

receiving an acknowledgement of the supersonic audio SOS signal through a device microphone of the distressed mobile device user; and

triggering a human perceptible alarm signal after receiving the acknowledgement.

12. The method of claim **11**, wherein the human perceptible alarm is an audible alarm.

13. The method of claim **11**, wherein the human perceptible alarm is a visual alarm.

14. The method of claim **10**, further comprising:

detecting a supersonic audio SOS signal on a second mobile device; and

broadcasting a supersonic audio acknowledgement of the SOS signal.

15. The method of claim **14**, further comprising:

presenting an audio strength meter on a display screen of the second mobile device.

16. The method of claim **15**, further comprising:

presenting a directional guidance on the display screen of the second mobile device to the source of the supersonic audio SOS signal.

* * * * *