A New Generation of Wireless Personal Alarm Facilitating Context-aware Location Based Emergency Response Outside the Home.

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Abstract: A recently patented innovation describes a discrete button-sized wireless device with a long-life battery which, when activated, uses a Bluetooth® signal to initiate the sending of emergency messages from the users' mobile phone, which could be 10 metres away. In an emergency, the device also seeks to locate itself using GPS and/or GSM network-based positioning technology. Moreover, the device permits faster location of the user after the alarm has been raised through the transmission of a strobing signal to allow first responders to home in on the user. The potential to interface wearable sensors with the alarm device raises the prospect of providing context-specific information that could be used for decision-support on the part of carers, first responders or emergency monitoring centre personnel. This paper illustrates the application of the device to decision support and triage systems, indicating its potential for worldwide deployment within medical, social and family contexts.

Keywords: emergency response, wireless alarm, health telematics, context aware, location based service

1. Introduction

Wearable wireless technology has, for several years, provided a means of raising the alarm for elderly people living alone, as well as others whose state of health may necessitate the intervention of a carer or medical professional at short notice. Today, such wireless technology is generally based on proprietary cordless telephony or analogue short range radio, with the attendant disadvantages that it typically functions only within the immediate vicinity of the user's home, it is bulky and hence uncomfortable to wear and it requires frequent recharging of its batteries. A recent patent application [1] describes a wireless device which, when activated, uses a Bluetooth® or similar signal to initiate the sending of emergency messages from the users' mobile phone.

Two design assumptions have been made, which characterize the novelty of the invention: it is assumed that the user will always be (i) within a short distance of a mobile phone, and (ii) either within a short distance of a wireless-enabled GPS receiver or has subscribed to a GSM network-based positioning service. These assumptions have enabled significant improvements on the state-of-the-art in terms of size, cost, battery autonomy, performance and usability.

2. Wireless Personal Alarm Device

Currently available as a pre-production prototype, the WPA device measures just 32 mm in diameter and weighs less that 18 g. It can thus be worn discretely, as a neck-pendant, on the wrist, or concealed in clothing, perhaps with the appearance of a button. As can be seen in Figure 1, its user interface consists of a microphone, a single LED and two large switches, mounted on opposing sides of the device. The action of depressing both switches with a squeezing motion for a prolonged period activates the emergency alarm. The seriousness of the emergency, as perceived by the wearer, can be communicated by the length of time that the switches are depressed.

On initiation of an alarm, a Bluetooth® signal is sent from the WPA to a GSM mobile phone, which must be within range of the radio frequency signal (approximately 10m for Bluetooth® Class 2). The mobile phone then transmits an SMS text message to one or more addressees, the telephone numbers of whom are held in the WPA device's memory. The choice of addressees and their prioritization is a function of the length of time for which the switches were depressed. Simultaneously, the GSM mobile phone is commanded to open a voice channel so that a further, or one of the same addressees can hear audio signals captured from the WPA's microphone. Whilst this audio channel is open, the WPA device simultaneously initiates a series of actions to ascertain its location co-ordinates. Firstly, it interrogates the GSM handset in case its hardware incorporates GPS or other position-fixing technology. If unsuccessful, the WPA's next action will be a search for Bluetooth-enabled GPS devices anywhere within radio frequency range. If it still fails to find such a device, it will then proceed to interrogate the GSM network using a location-based service (LBS), using triangulation or cell-id methods.

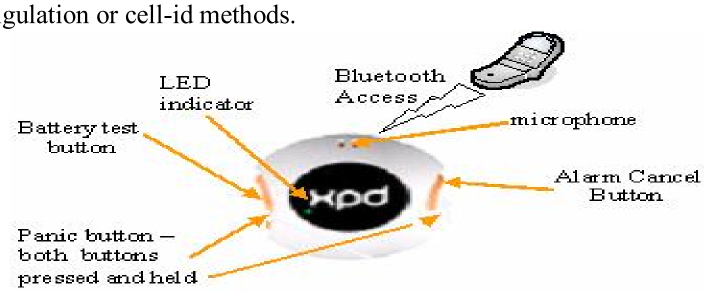

Figure 1.Wireless Personal Alarm (WPA) Device

The emergency messages are periodically retransmitted, and include whatever location co-ordinates have been obtained. In an enhancement of the current prototype, the messages may also contain telemetry corresponding to the health of the user (e.g heart rate), context (e.g. verticality) or environment (e.g. ambient temperature).

The usability of the WPA device is not compromised by the complexity of this sequence of actions, as this functionality is transparent to the wearer, who only needs to be aware that both switches must be squeezed in the event of a perceived emergency for a certain duration and that a longer duration will signify a greater emergency.

Programming the device is equally simple and can be done from a Bluetooth®-enabled mobile phone or from a computer. It is anticipated that this would typically be done by a carer, health care professional or service provider and safeguards are in place to ensure that it could not be easily un-programmed by an over-inquisitive wearer or third party. With regard to battery autonomy, typical usage would give a life of one year. Two versions of the device are currently being considered: a water-proof (IP67) version with a permanent non-rechargeable battery and a rechargeable-version.

3. Test Results

Laboratory tests and a limited set of user trials were conducted within the framework of a European Space Agency (ESA) sponsored project [2] during the summer of 2005. These trials were conducted with lone worker users, rather than in a medicare context.

The issues that have been highlighted during the user trials related to the ease of interpretation of the LED sequences. All other tests were passed and the overall feedback from participants was positive. Subsequent further development has been conducted and improvements made to the visual indicator.

Whilst these user trials focussed on lone workers, information was also collected about the requirements of elderly users, many of whom participated in focus groups and user surveys.

4. Device application to decision-support and triage systems

Despite the fact that the service provided through the mobile WPA represents a great value for its user, it may lead to some issues that the care service provider needs to address when integrating the WPA into an emergency response system. The two most important issues are:

- being able to discriminate true alarm calls from false alarm calls ;
- assigning a priority of intervention to an alarm (triage).

Concerning false alarms, the right-hand button of the WPA is of great importance as a user can cancel an alarm shortly after unintentionally triggering it. However, if the alarm has been started for a while, the button can not revoke it. In fact, in such a case, false alarms are almost impossible to discern unless the sender of the alarm is able to communicate with the service provider or vice-versa. The WPA gives the possibility to contact the alarm monitoring personnel in two ways in order to confirm the validity of the alarm: either synchronously by opening a voice communication with the other party or asynchronously by sending SMS text message. The care service provider can rely on both means of communication for filtering true and false alarms.

Regarding the alarm prioritisation issue, the WPA system gives a first level of decision making. This is done by choosing the appropriate phone number to contact based on the length of time for which the WPA switches were depressed. For instance, the care service provider can program the WPA so that relatives or neighbours are called for low risk alarms and the monitoring centre is contacted in case of medium to high risk alarms.

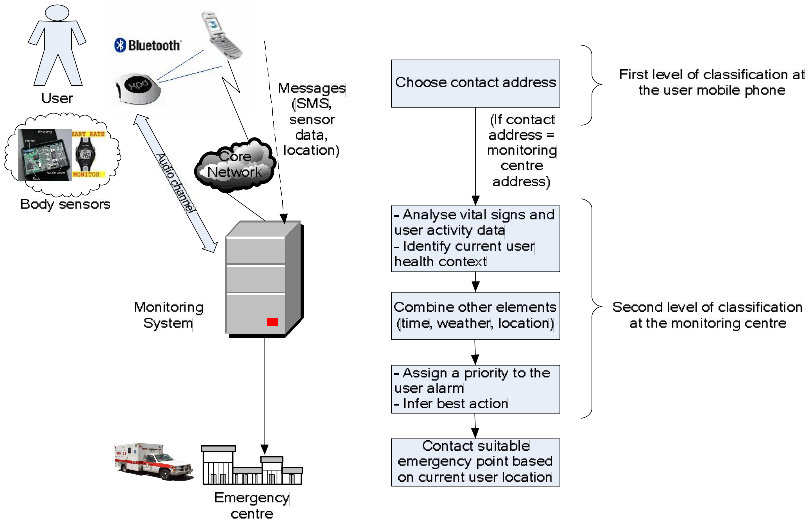

Figure 2. Priority assignment to user alarms

The monitoring centre can provide a second decision making level for assigning a priority of intervention to an alarm relying on the use of complementary context aware intelligence. Context identification is based on the computation of complementary data gathered from body area network and sensors network. As an improvement of the current WPA features, the WPA messages can include data collected from body and environment sensors [3] such as heart beats, pulse, temperature and an accelerometer to identify the user type of activity. This extends the use of WPA for monitoring and possibly assisting patients, for example elderly people, who can be remotely monitored. Figure 2 shows the steps for classifying the user alarm.

5. Summary and future plan

In this paper, we described the WPA device and its capabilities and action sequence as well as its application to decision-support and triage systems. The future plan for further deploying the WPA system includes trials involving users with physiological and cognitive impairment. We intend to, first, identify plausible scenarios for such pathological cases, and, second, test with real users.

References

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