Safe-in-Place Awareness GPS System with Distance-Based and Duration-Based Notification Control

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Abstract. This paper describes the design of SIPGPS (Safe-in-Place GPS System) which is a GPS assistance environment helping track the elderly people outdoors. This environment is intended to facilitate the use of the GPS cell phones in assisting elderly people with walking safely in daily life. SIPGPS facilitates safe-in-place by assisting elderly people with emergency assistance via distance-based and duration-based notification control. The SIPGPS which provides the dedicated family easier way to locate their elderly family may expand the role of care in remote location.

Keywords: Safe-in-Place GPS System**,** Participatory Design.

1 Introduction

GPS cell phones are emerging as a new opportunity for the elderly people walking safe in place. The development of cell phones with embedded GPS engines has been a reality in many platforms of smart phones, such as iPhone, Google Android phone, and Windows phone. These phones, in part, are mandated requiring the position of a cell phone to be available to emergency call dispatchers, but the lack of self-conscious awareness for the elderly people means that many are missing out or positioning a critical condition with or without such critical service.

There are three basic types of technologies GPS, GSM and GIS incorporated with cars to provide tracking information. Thus the assistance server in security center is able to compute position solutions, leaving the GPS receiver with the sole job of collecting range measurements. As smart home technology emerges, it could be augment its usage to facilitate aging-in-place by assisting patients with emergency assistance, fall prevention/detection, reminder systems, medication administration and assistance for those with hearing, visual or cognitive impairments.

This paper intends to make aging-in-place a reality, continuous monitoring, and improved psychosocial effects. The concept of safe-in-place awareness expands the role of the caring in the future. It is important for all family to understand how their concerns will be transformed as remote-caring become a reality for the aging population.

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2 Safe-in-Place GPS System

Safe-in-Place GPS System (SIPGPS) describes a system where outside sources, such as a monitoring server (Fig. 1) and instant message network, and an inside GPS receiver agent (Fig. 2), help a GPS cell phone perform the tasks required to make range measurement and duration of stay at a place measurement for alert notification. The GPS receiver agent installed in GPS cell phone could connect to monitoring server every 60 seconds with collected cell phone numbers from the SIM chip and longitude and latitude from the GPS receiver of cell phone. The monitoring server communicates with GPS cell phone via a wireless link and measures those information to trace

Fig. 1. Homepage of Monitor Server

Fig. 2. GPS receiver agent installed in GPS cell phone

out the distance moved and time stayed in a Google map dynamically (Fig. 3). According to the dedicated family managed safe range and duration of activity in the monitoring server, they could log on to identify where the elderly people are in the safe range of area and if they stayed still at one position for some potential health reasons. As the alerts of violated distance or duration triggered, the dedicated family could receive email, instant message and text message through phone and computer. Therefore the resulting SIPGPS system could boost performance beyond that of the GPS cell phone in a stand-alone mode.

Fig. 3. Tracking measurements of safe range and duration of stay

3 Evaluation of Safe-in-Place GPS System

The focus of SIPGPS has been to design an online interaction and community that would increase family's motivation, commitment and satisfaction with the online care system. The Participatory Design methodology originating from Scandinavian software development traditions [3] encouraged the participation of effected workers in technology development processes [6]. Participatory Design advocates the user involvement is seen as critical both because users are the experts in the work practices supported by the technologies and because users ultimately will be the ones creating new practices in response to new technologies [1, 2, 4, 5]. Engaging participation of potential end-users and stakeholders in open but monitored environments allows for exploration of design responses to situations generated by daily lives. In Participatory Design, the prototype of SIPGPS is central to the notion of design-by-doing that is a necessary component for simulating situated environments as natural experiments [7]. In the case of design research, combined uses of prototype exist that are themselves outcomes and conditions for experimental research.

This experiment used the Participatory Design to evaluate the efficiency and effectiveness of supports by SIPGPS. SIPGPS consists of two main parts, monitoring server and instant message network used by dedicated family, and a GPS receiver agent used by subjects' cell phones. 6 subjects of elderly people with dedicated family were conducted in this study. Each subject's dedicated family members could use the SIPGPS. Digital video cameras held by researchers were used to capture each subject's movements. Subjects were all told their daily outside activities would be recorded without their notice to avoid interfering with their natural behaviors. During the experiment, researchers may engage in an active discussion of what the participants are doing, or have them think aloud along the way. Researchers may also consider waiting until participants are finished, and ask questions at that point about the functions they have chosen. This all depends on researchers' goals for the study.

The target event is comprised of monitored subjects who walk out of family-defined distance in potential dangerous area around subject's residence (such as busy transportation zone), monitored subjects who stay still somewhere over some setup time (such as heart attack), or monitored subjects who are more commonly in need of assistance (such as stray or health problem). These monitored subjects benefit from being able to be located somewhere immediately from a remote location by the dedicated family and requesting assistance by pressing a single button. These actions are made possible by exact location obtained by using the GPS receiver agent with SIPGPS.

3.1 Results and Discussion

Participatory Design in the study elicited ideas that the subjects needed awareness too while some event occurred (e.g. cell phone vibration), multi-response to dedicated family (e.g. text message and email), and more interaction interface other than visual clues (e.g. voice).

The evaluation results of SIPGPS are shown in Table 1. Dedicated family members received notification significantly fast enough in 2 minutes when the safe distance or period of staying still was measured. After issuing any emergency call, the subject could be calmed down in 7 minutes by getting a solution message from the family and waited for the actual rescue. These data meant that safe awareness has been adapted to family concerns in that elderly people could be taken care of in time with SIPGPS.

Table 1. Efficiency Evaluation of Safe-in-Place GPS System (minutes)

Event	Response Time*	Waiting Time**
Out of family-defined distance	1.6	2.2
Staying still	2.1	10.8
Requesting assistance	3.5	5.8

* Response time – amount of time it takes from when a event was submitted until the first response is produced

** Waiting time – amount of time a request has been waiting in the assurance of assistance solution, not assistance acquisition.

SIPGPS is most useful at a situation as the dedicated family is concerned about the subject's certain conditions if he/she walks alone in a safe state. The more concerns bring the more watching on SIPGPS. The event response time in the monitoring context reveals the efficiency of SIPGPS. While event "staying still" occurs, waiting time shows the complicated caring process in finding out what is going on for the elderly people with no movement, such as falling down, heart attack or chatting with some. The SIPGPS tends to elicit effective remote caring from the Internet.

4 Conclusions

Mobile services play an important role in assisting elderly people with lack of self-conscious awareness in daily life. SIPGPS facilitates safe-in-place by assisting elderly people with emergency assistance via distance-based and duration-based notification control. The SIPGPS which provides the dedicated family easier way to locate their elderly family may expand the role of care in the future. Benefits include making safe-in-place a reality, continuous monitoring, and improved the well being of aging society.

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