

Chapter 4

Localization and Monitoring of People with a Near- Field Imaging System: Boosting the Elderly Care

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ABSTRACT

The chapter describes the state of the art and potentialities of near-field imaging (NFI) technology, applications, and nursing tools in health care. First, principles of NFI are discussed. Various uses of NFI sensor data are presented. The data can be used for indoor tracking, automatic fall detection, activity monitoring, bed exit detection, passage control, vital functions monitoring, household automation and other applications. Special attention is given to the techniques and problems in localization, posture recognition, vital functions recording and additional functions for people identification. Examples of statistical analysis of person behavior are given. Three cases of realized applications of NFI technique are discussed.

INTRODUCTION

Both in developing and industrialized countries, the proportion of aged people is predicted to grow remarkably (Pollack 2005). This will create a major need for resources for the elderly care. Given the prospective age proportions, the human resources for manual care will be exhausted in a decade. We

have to use the appropriate technologies, even if there are questions about their humanity.

To provide efficient services in pervasive applications in health care, a proactive approach is necessary. This means that the service is made available on the basis of context, not by manual command. New sensor and analysis technologies can be effectively utilized by matching infrastructure capabilities to health care needs. Emerging technologies include, e.g. (Varshney, 2006):

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- The use of location tracking, intelligent devices, user interfaces, body sensors, and short-range wireless communications for patient monitoring.
- The use of instant, flexible, and universal wireless access to increase the accessibility of health care providers.
- The use of unobstructed communication among medical devices, patients, health-care providers, and vehicles for effective emergency management.

The main requirements of a pervasive application in elderly care are effectiveness, unobtrusiveness, and reliability. Effectiveness means that the service provides both the elderly and the care personnel with some real added value, not only a new gadget or extra work. Unobtrusiveness means that the system should not interfere in any way with the elderly or the caregiver. Reliability means that there is a possibility of the use of the system really improving living or work habits.

Many pervasive applications, especially technologies to support ambient assisted living, rely on tracking people. The applications include e.g. activity monitoring, straying detection, and a simple detection of presence (Lin, Chiu, Hsiao, Lee & Tsai Y 2006). Falling is one of the greatest health risks and also a source of insecurity for the elderly. Pervasive tracking of movement and falls in a home environment could open the way to independent living for many ageing people, and thus improve their quality of life (Perry, Dowdall, Lines, & Hone 2004).

The tracking function can be realized in various ways, depending on the application, required area, and resolution. The environment also presents different limitations and benefits to the systems intended for application. For example, the widely used GPS location system can be used to locate objects to within an accuracy of 1 to 10 m. The system, however, does not function inside build-

ings and even if it did, its accuracy is not sufficient to track people in a room-scale environment (Bahl & Padmanabhan 2000).

A contemporary home monitoring system consists of various sensors which communicate with a local base station. The sensors can be infrared motion sensors, magnetic door sensors or pressure sensors in bed or on floor. If abnormal or a lack of activity is detected, the base station generates an alert to a family member, care facility or emergency unit, whichever is suitable for the case. The resident may also wear an emergency call device for immediate help when needed. The communication is internet or subscriber line based. Often there is also a teleconferencing possibility for telemedicine applications or simply for communicating with family or friends.

On the other hand, the system in an elderly care facility consists mainly of wandering or bed exit sensors, mostly pressure sensors. Also here the resident may wear a personal emergency call. The main difference from home environment is that the assisting person is always quite near.

In addition to the mainstream sensor techniques, an emerging technique of near field imaging (NFI) can be used to replace most separate sensors. To elicit the state of the art and potentialities of NFI technology, applications, requirements, boundaries and nursing tools related to the floor based sensors are discussed in this chapter. Some case examples are also presented of systems which have been realized and relate to human tracking and tracking analysis.

BACKGROUND

Tracking Methods in Elderly Care

Person tracking services in elderly care should meet some major requirements (Kleinberger, Becker, Ras, Holzinger & Muller 2007):

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