Chapter 20

Ambient Intelligence for Eldercare – the Nuts and Bolts: Sensor Data Acquisition, Processing and Activity Recognition Under Resource Constraints

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ABSTRACT

This chapter provides examples of sensor data acquisition, processing and activity recognition systems that are necessary for ambient intelligence specifically applied to home care for the elderly. We envision a future where software and algorithms will be tailored and personalized towards the recognition and assistance of Activities of Daily Living (ADLs) of the elderly. In order to meet the needs of the elderly living alone, researchers all around the world are looking to the field of Ambient Intelligence or AmI (see http://www.ambientintelligence.org).

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I. INTRODUCTION

With environmental sensors and wearable sensors gathering data continuously (Figure 1), and with software algorithms working behind the scene, making sense (intelligence) of the data, continuously processing the data, the awareness of the context and situation of elderly can be achieved. In this manner the elderly can be assisted at points of need and thereby helped to live independently at home.

Distributed sensors have long been used to sense the status of environmental parameters such as humidity, temperature and light intensity and aggregate / record these parameters from a distance. Sensors have also long been used for surveillance and military applications, for example in the identification and tracking of targets such as aircrafts and battle tanks. Environmental changes, or aircraft / objects in motion may be thought of as causal agents for phenomena changes in a so-called phenomena aware system. The activities and behavioral patterns of the elderly may also be regarded as phenomena in an ambient space which is aware of various phenomena unfolding in the space.

Section II discusses sensor data acquisition and the notion of micro-context as a paradigm for building systems that support diverse applications which build upon knowledge captured from ambient spaces. The notion of activities as phenomena is presented in section III. In section IV is presented one of the most important aspects of any sensor data acquisition system, namely, feature extraction. It is important to note that feature extraction and further operational processes that follow, such as classification and reasoning are essentially independent of sensing modality. We illustrate this with a variety of examples in this chapter, ranging from video camera based agitation detection to pressure sensor based sleeping posture detection (both in section IV), and other modalities such as ultrasound sensors and accelerometers in subsequent sections. Algorithmic techniques are based on micro-context and are essentially agnostic of sensing modality. With the help of an example, section V introduces one of the key challenges of ambient intelligence – the

Figure 1. Activities of elderly as ambient phenomena