

## Chapter 98

# Early Detection of Dementia: Advances, Challenges, and Future Prospects

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### ABSTRACT

*Early detection and prediction of dementia through unobtrusive techniques or obtrusive tests is still in exploratory status and despite the increase of interest in recent years, many challenges remain open in designing methodologies that can accurately predict its onset. This chapter addresses the problem of the early detection of dementia from two points of view: Detection based on unobtrusive paradigms both in lab and home environments (behavioral monitoring, serious games, home based assisted living applications in telemedicine) and detection based on neuroimaging approaches. The chapter also provides information on setting up ecologically valid home labs for dementia related experiments. Consequently, the aim of this chapter is to provide an overview of a complete methodology of how researchers can possibly detect or predict the onset of dementia through the current state-of-the-art, underline open challenges and illustrate future work in the field.*

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## INTRODUCTION

Chronic illnesses impose a great burden on the lives of citizens worldwide. In modern health-care, decentralisation, de-hospitalization and self-management of diseases at home are crucial factors for improving the every-day life of the patients and the people close to them. People in general tend to dislike obtrusive monitoring on their daily activities, so the challenge for home care solutions is to implement systems that provide clinicians with adequate and concise information on their patients' health status while at the same time be unobtrusive and easy to use (Golle & Partridge, 2009; Röcker, Hinske, & Magerkurth, 2007). Based on sets of multimodal monitoring parameters and measuring scales feeding reconfigurable event detection mechanisms used for risk assessment and analysis, AAL systems aim to early detect symptoms that predict decline, avoid emergencies and secondary effects and, ultimately, prolong the period that patients can remain safely cared at home. In this chapter the authors aim at providing a description of current trends in context-aware ambient monitoring for the early detection of dementia and prediction of deterioration, as well as provide a background for minimally obtrusive neuroimaging approaches on prediction of dementia.

## BACKGROUND

The current applied paradigm for dementia, revolves around patients in the later stages of the disease, where the patient is beyond the stage of the application of delaying/preventive measures. This follows as a result of the delay in seeking care from the majority of patients and caregivers, until the disease has progressed (Boise, Morgan, Kaye, & Camicioli, 1999). There is a gap in the clinical paradigm which does not include the need for the application of methodologies for early detection of dementia, at the onset of the very first symptoms. This is further exacerbated by the fact that most physicians delay providing a diagnosis as they perceive dementia as a “terminal” disease without adequate remedial ways of treatment. These factors put together, severely compromise healthcare quality for such patients and also deprive them of the chance to face their disease at its early stages where much can be done, directly impacting overall patient care.

Our current understanding of dementia and the underlying mechanisms is that the disorder may well begin one or two decades before symptoms appear (Reiman et al., 2012). Dementia itself is identified as a late stage in the pathological development of neurodegenerative disorders. In the recent years, there has been a clear shift towards addressing the disease at its earlier pathological stages, but still the main focus of clinical practice falls on the later stages, with most diagnoses after the moderate or even severe stage. On the other hand, there is a rising trend to turn our focus on earlier detection of dementia, seeking prodromal, MCI or even completely healthy subjects to volunteer at experimental protocols for the early detection of dementia. Here we discern a huge impediment: Although we are in need of patient populations at the very early stages of dementia, to begin constructively developing better and more efficient detection paradigms and thus enabling clinical research in the race for better treatments, most patients are diagnosed very late. These facts may contribute to delayed or undetected cognitive decline or even false diagnosis among primary care providers (Borson et al., 2013; McCormick et al., 1994).

In the race for early detection of dementia, much can be said and more can be assumed or predicted. Following the rising trend of multidisciplinary practices in many scientific fields, thus early detection of dementia is now moving away from pure clinical practice and clinical instruments and moving to-

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