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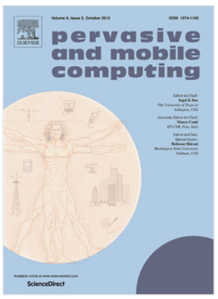

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iKnow: Ontology-Driven Situational Awareness for the Recognition of Activities of Daily Living

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Abstract

We present iKnow, an ontology-driven framework for semantic situation understanding in pervasive multi-sensor environments for human activity recognition. iKnow capitalises on the use of OWL ontological knowledge to capture domain relationships between low-level observations and high-level activities, while context aggregation and activity interpretation are supported through context-aware fusion. Rather than using ontologies as highly-structured, strict contextual models, our aim is to capture abstract dependencies among low- and high-level concepts, such as locations and objects involved in activities, towards addressing practical real-world challenges in the domain. The framework has been applied in the eminent field of healthcare, providing the models for the semantic enrichment and fusion of heterogeneous multisensory descriptors for monitoring the behaviour of people with Alzherimer's disease.

Keywords: situational awareness, activity recognition, context, fusion, ontologies

1. Introduction

Recent advances in pervasive computing and sensor technologies have enabled the contextualized enrichment of business processes capitalizing on the ability to sense, process, combine and interpret data of different modalities. Out of the numerous domains of interest, the recognition of activities of daily living (ADLs) is a notable case where pervasive frameworks provide unique solutions for the contextualized monitoring and assessment of human behaviour, such as in the healthcare sector. A key challenge in such domains is the ability to effectively fuse multiple sources of heterogeneous, noisy and potentially inconsistent information in a way that provides accurate and useful outputs.

Ontologies have attracted growing interest as means for modelling and reasoning over contextual information [1] and human activities, in particular [2, 3]. Under this paradigm, the Web Ontology Language (OWL [4]), which is the W3C recommendation for creating and sharing ontologies, has been used in a substantial body of approaches for describing the elements of interest (e.g. events, objects, location), their logical associations, and the background knowledge required to infer additional information. In many cases, activity recognition is further augmented with rules [5] for capturing richer relationships not supported by the standard ontology semantics, like e.g. temporal reasoning and structured activities [6].

A common characteristic of ontology-based solutions is the use of highly structured activity patterns. TBox axioms and/or rules are used for designating the start and end of activities or strict temporal correlations are considered among events. As such, the dynamic and ambiguous nature of multisensor environments are not always taken into account, failing to adequately describe and capture contextual information and, thus, address practical real-world challenges. For instance, activity duration usually varies in practice and many activities do not have a predefined order they are carried out.

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