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Support dementia: using wearable assistive technology and analysing real-time data

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## Abstract

Support provided to sufferers of Dementia by the National Health Service (NHS) is mainly in the form of personal attendants such as nurses and social workers. The main focus of this research is to present how the **use of assistive technologies can help early sufferers of Dementia patients** to overcome barriers in achieving their daily activities and to illustrate how **data analytics**, such as **Complex Event Processing (CEP) in real-time** can allow better monitoring of these patients.

**This activity will contribute to research work which is to provide a suitable framework to accurately analyse real-time data from assistive technology and wearable devices for remote healthcare, particularly monitoring early sufferers of dementia in order to promote good quality independent living.**

## Introduction

**> 40,000 (UK)  
Dementia  
under the age  
of 65!  
1 M by 2025!**

*“Dementia is a journey that begins with memory loss and cognitive problems. Without effective support in place, the journey may quickly end with the sufferer being profoundly disabled and requiring care with all activities of their day to day living.”  
Alzheimers.org.uk (2016)*

CEP encompasses methods, techniques, and tools for processing events from a variety of sources in real time; while they occur in a continuous and timely manner. It derives valuable higher-level knowledge from lower-level events. This is referred as complex events; combination of several events.

For developing a suitable framework to accurately analyse data from assistive technologies, our approach to modelling is based on the assumption that dynamic changes in the patients situational conditions such as room occupancy and movement within the living environment has to be analysed against the semantic knowledge about the condition’ symptoms and the patient’s related profile (medical history, age, etc.). Therefore, we can define our proposed framework as context-aware and knowledge-based.

## Aims and Objectives

### Research Question:

**? How can the application of Complex Event Processing be used for real-time analytics on data from wearable devices within Healthcare?**

Determine how data from wearable devices can help to identify patterns and causes that may lead to an imminent fall or injury, and in turn assist carers to better monitor such at-risk patients.

## Method: Proposed Framework

- ★ The infrastructure of a real time data processing system will incorporate a two-way data binding for live data transportation. The existing device and sensor data processors require a real time middleware system for wearable and embedded devices.
- ★ The research project proposes the use of extended middleware for the health care and dementia with real-time data processing unit using Complex Event Processors, with connectivity to wearable and mobile devices as clients.
- ★ The current standards for middleware require real time processing of data from wearable devices with built-in real time pattern recognition and analysis. The Wearable-Middleware equipped with the two-way data binding will bring the power of the middleware into the devices.
- ★ Information from patients, using wearable sensors will be collected in terms of location and behaviour. Patterns and the variation in the speed of the changes in these patterns will be analysed in real-time.
- ★ Data streams will be processed in real-time to detect variations in the behaviour of patients using sensor data from wearables.
- ★ Data buffering will be achieved by storing the data as message queues in the form of message-oriented-middleware feeding to the CEP engine.
- ★ The Data Processor Unit will provide the implementation for the algorithms in the context of dementia patients and take into account the background knowledge base and context-aware semantics.

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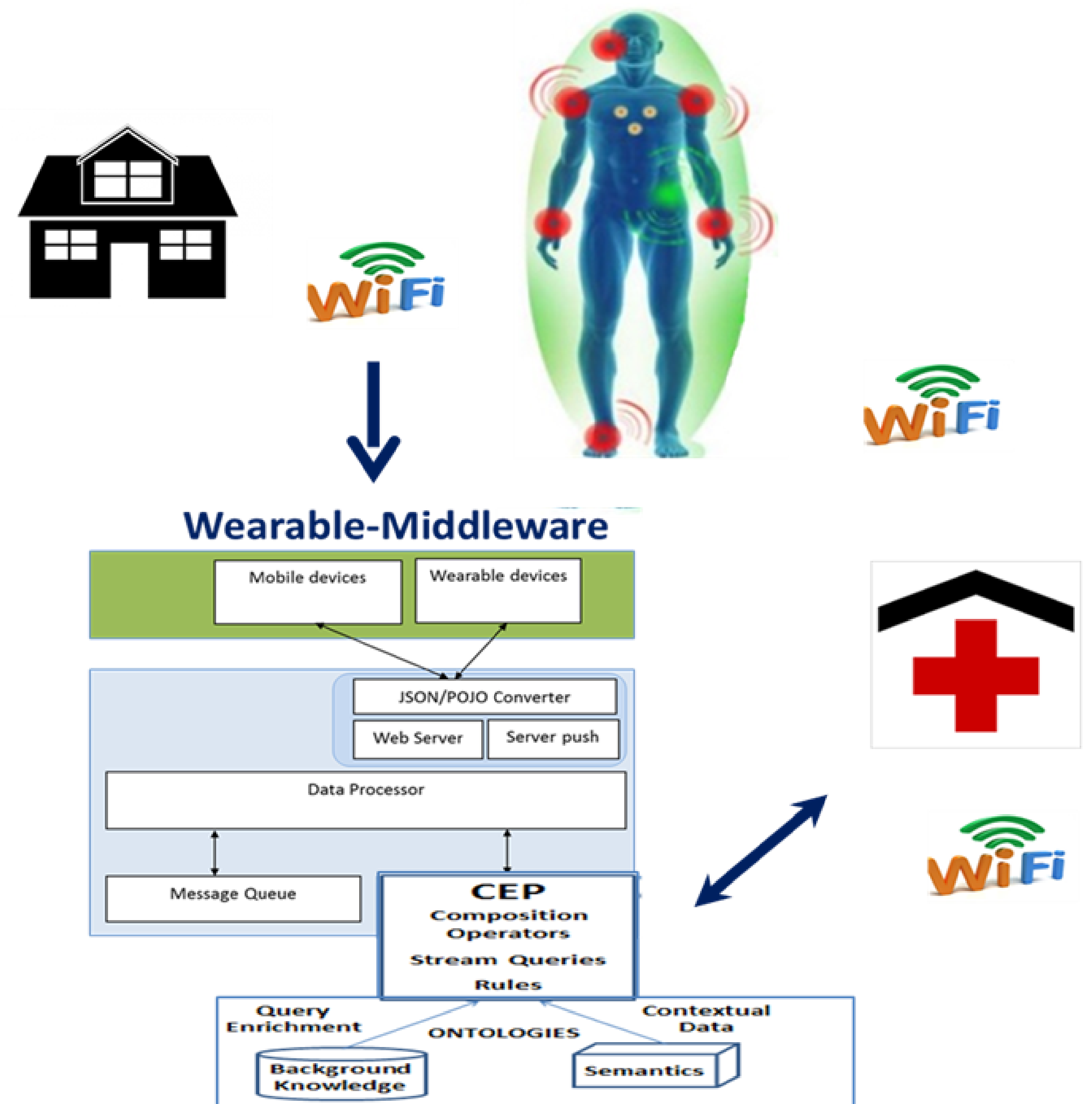
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## Results

### Overview of proposed framework



## Conclusions

The application of CEP techniques via the proposed wearable middleware framework will help to identify patterns and causes that may lead to an imminent fall or injury, and in turn assist carers to better monitor such at-risk patients.

Therefore, home monitoring and effective use of assistive technologies will help to identify changes in health and behaviour in home settings, and to facilitate successful adaptation to those changes.

## Future Work

Further research into wearable assistive technology and development of our wearable-middleware framework will aim to achieve the following outcomes:

- ✓ The use of sensors should provide robust, high-precision perception of context and components related to assistive living.
- ✓ Identify mobile and wearable devices that are comfortable to wear and less obtrusive. Assistive devices can be designed to enhance not only physical but also cognitive skills of human users through mobility experiences.
- ✓ Allow carers to better monitor and adapt to the patient’s gradual physical and cognitive decline, as well as to any sudden changes such as a hip fracture.
- ✓ Allow researchers and developers to pay attention to the combination of biological, physiological and medical aspects in order to develop intelligent cognitive devices for assistive services.
- ✓ A framework to allow for system coordination, components integration, service allocation, and knowledge sharing in order to support the use of assistive technology.