

# ICT-Robotic Architecture for Cognitive Assessment

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## 1. Introduction

Cognitive computing, sensors and robotic technology for the cognitive assessment of people with cognitive impairment and Dementia's. This system has the potential to:

- Facilitate continuous assessment [3]
- Provide monitoring and guidance
- Lighten carers' burden [5]
- Reduce economic and personal costs.

## 3. Background

- Current pen and paper methods are often inaccurate and vary with culture, education and none can take into account variability with time.
- The use of activities of daily living (ADL) for assessment better reflect real world performance.[3]
- Cognitive therapy based on virtual reality (VR) allows to create situations which resemble real life, but with experimental control.
- However VR technologies have also been found to poorly reflect real world performance.

## 2. Annual Costs of Dementia Worldwide and in Britain

The breakdown of the total annual cost of dementia (£17 billion) in the United Kingdom [1]

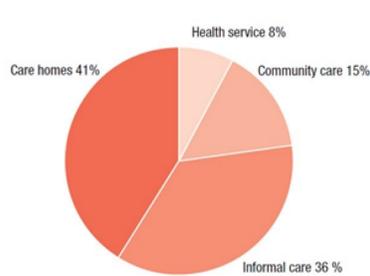
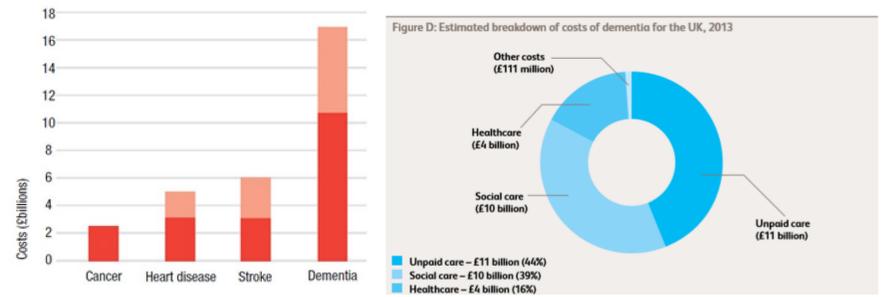
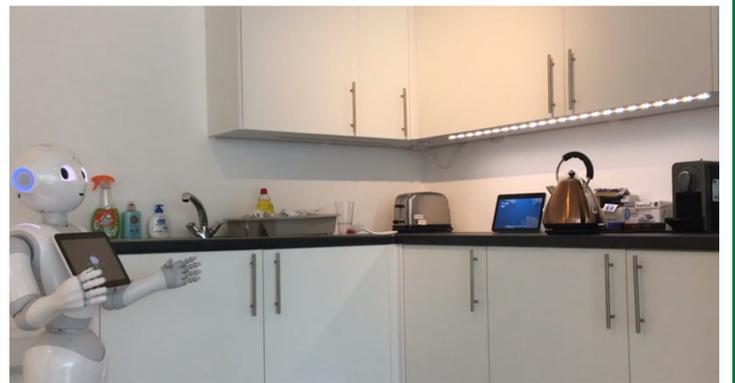


Figure D: Estimated breakdown of costs of dementia for the UK, 2013



figure(left): World [1] (right): UK [2]

## 4. VR kitchen and System Implementation



Implementation in VR (left) and the living lab implementation (right) [4]

## 5. System Architecture

The system links a variety of sensors using the openHAB smart home middle ware[6] bridging to a Robotic Operating System program. [8]

This program combines the data, using ontology's, into a scene representation which can be used in addition to user schema and a knowledge base to conduct activity recognition and cognitive assessment.

The system also tests intervention methods, currently using the Pepper platform from Softbank robotics [7], to give hints and guide the user towards the successful completion of the ADL.

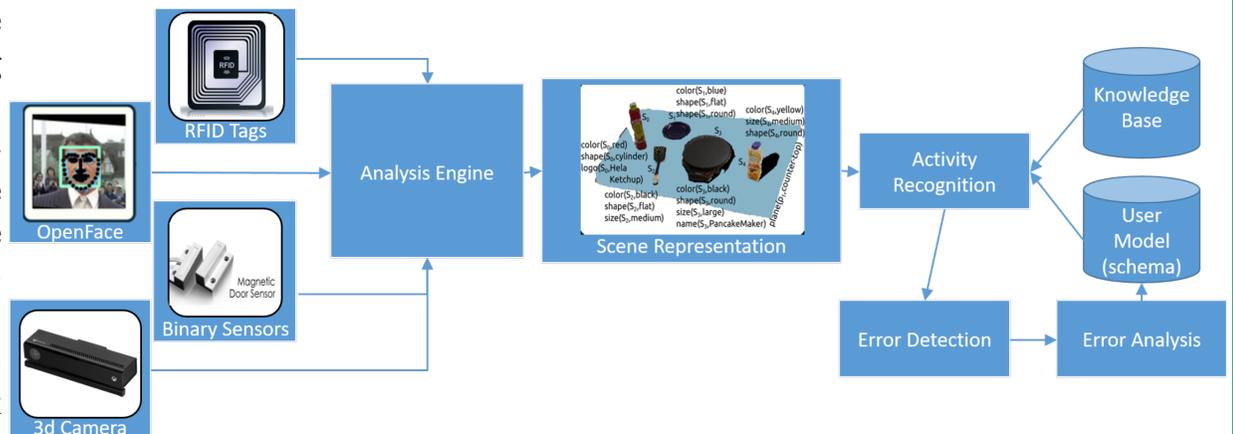


figure: System Architecture

## 6. System Implementation



Initial system mock up was implemented and received feedback and a Blackwood Design Award

## 7. Future Work

1. Integrate Multiple sensors into the system
2. Build the Knowledge Base that contains the multitudes of uses of the items in the kitchen and the scripts for the activities
3. Survey cognitively driven assistive technologies
4. User study idea with a user group testing the assistive assessing system
5. Encode more activities into the system from the ADL assessment

## 8. References

- [1] Alzheimer's Disease International. *World Alzheimer Report 2009*. 2009.
- [2] Alzheimer's Society. *2014 Dementia UK report*. registered Charity No. 296645. 2014.
- [3] Ruijiao Li, Bowen Lu, and Klaus D. McDonald-Maier. "Cognitive assisted living ambient system: a survey". In: (2015).
- [4] Neurophysiologylab Heriot-Watt University. *VR kitchen*. 2018.
- [5] Peter Novitzky et al. "A Review of Contemporary Work on the Ethics of Ambient Assisted Living Technologies for People with Dementia". In: (2015).
- [6] *openhab, empowering the smart home*. <https://www.openhab.org/>. (accessed May 5, 2019).
- [7] *Softbank Robotics Pepper*. <https://www.softbankrobotics.com/us/pepper>. (accessed May 5, 2019).
- [8] *The Robot Operating System (ROS)*. <http://www.ros.org/about-ros/>. (accessed May 5, 2019).