# KeepWell: A Generic Platform for the Self-Management of Chronic Conditions

# Introduction
## Chronic Conditions

- It is estimated that the number of persons with chronic conditions such as dementia (PwD) will continually increase (Figure 1)

- This increase will ultimately lead to astringent socio-economic conditions such as:
  - Increased health care expenditure
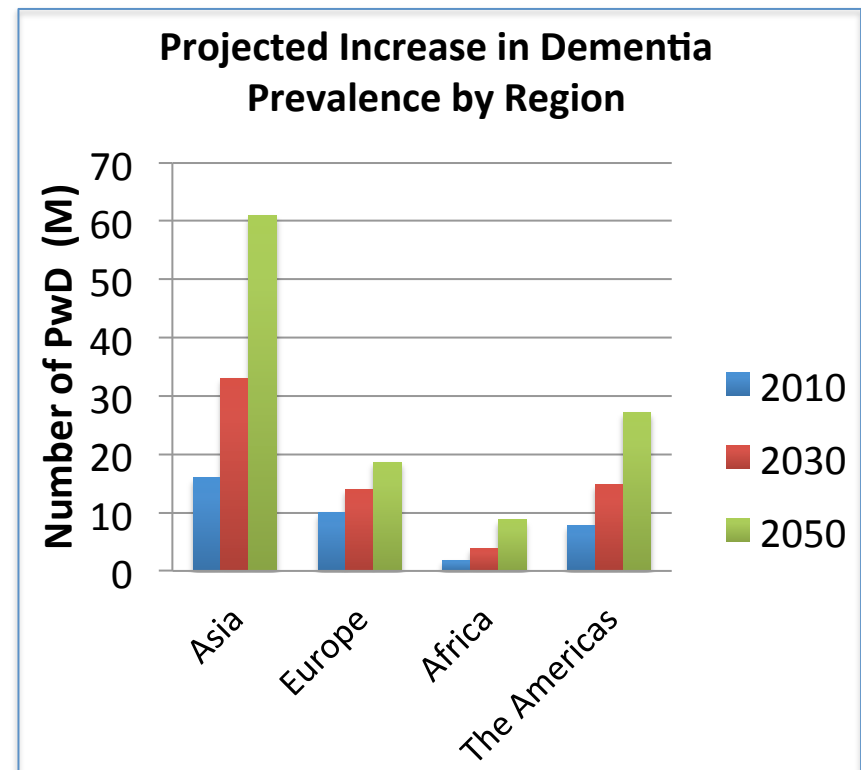  - Social disconnectedness amongst sufferers and their carers

**Projected Increase in Dementia Prevalence by Region**



*Figure 1: Projected increase in dementia prevalence from 2010-2015 by region (Data from [1])*

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# Introduction
## Self-Management

- Self management of chronic conditions aims to empower individuals to manage their own conditions and thus has the potential to alleviate, to some extent these socio-economic burdens. Advantages include:

  - Increased motivation for the patient to engage with healthcare process, e.g. collaborative goal setting

  - Use of collected data (personal, e.g. health measurements and environmental, e.g. weather) to predict events, e.g. Chronic Obstructive Pulmonary Disease (COPD) exacerbations

  - Facilitate home-based care, e.g. for dementia

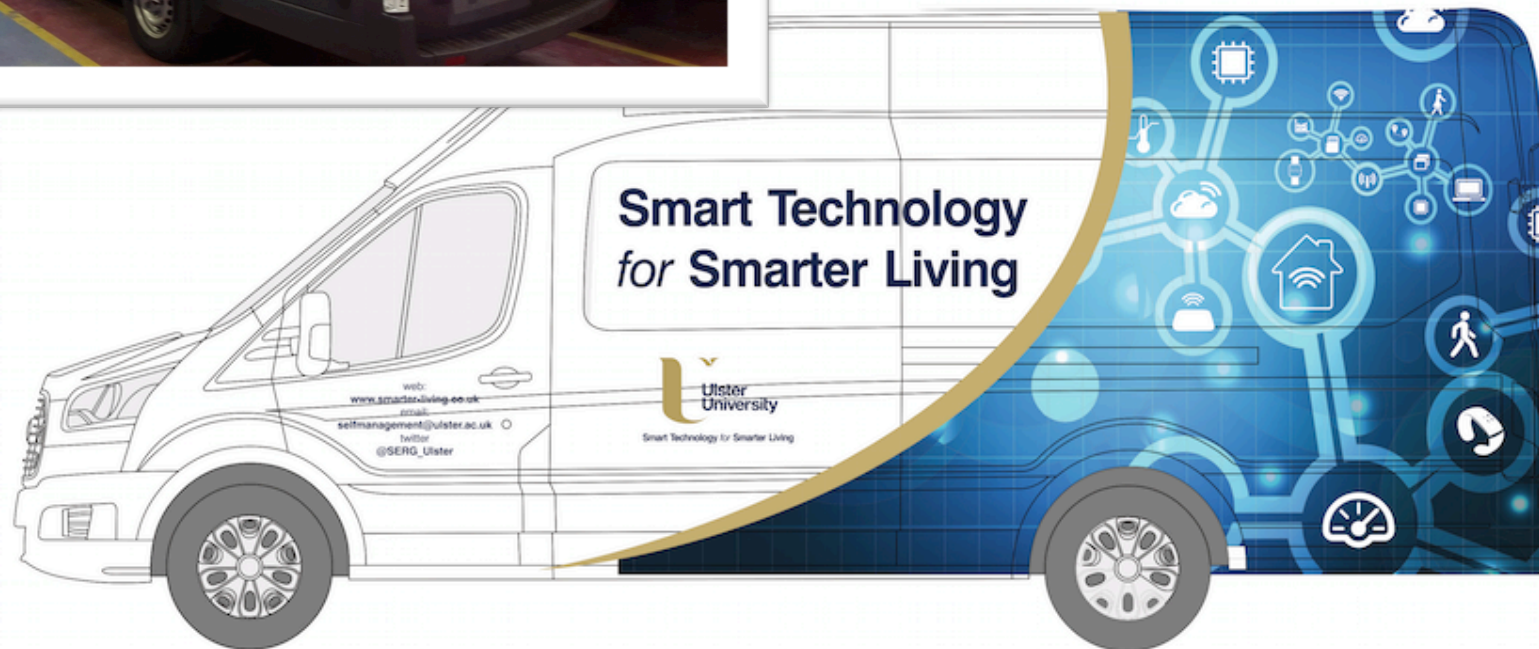    - Higher quality of life [2]

    - Lower cost [3]



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# Aim

1. Define contemporary views of self-management for each intervention model.

2. Identify functional requirements for each condition.

3. Identify common functionality for a generic self-management platform.

4. Create a system architecture which can facilitate this functionality.

5. Identify and procure existing technologies where possible.

6. Develop and implement the generic platform.

7. Tailor this for each condition, Stroke, dementia and COPD.

8. Evaluate the solution with a target cohort, HSC trusts, non-profit.

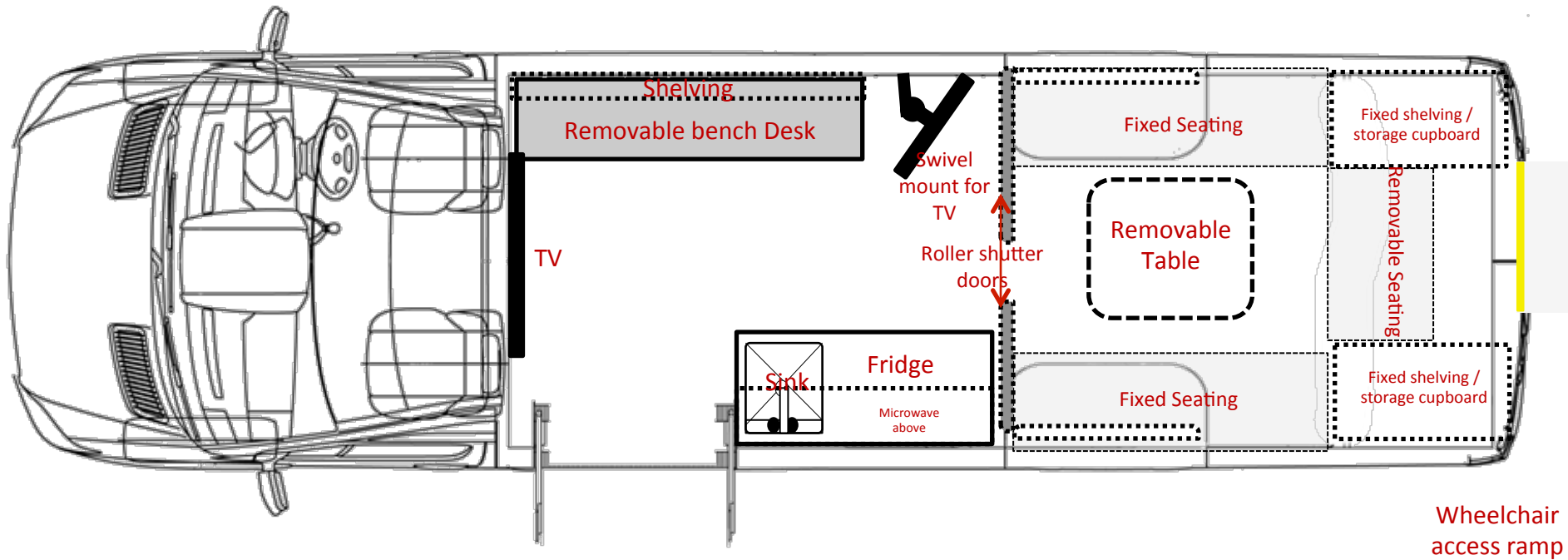9. Assess the extensibility and scalability of the solution.

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# Mobile Demonstrator
## The Self-Management Project

# Mobile Demonstrator
## The Self-Management Project



Shelving

Removable bench Desk

TV

Swivel mount for TV

Roller shutter doors

Sink

Fridge

Microwave above

Fixed Seating

Removable Table

Removable Seating

Fixed shelving / storage cupboard

Fixed Seating

Fixed shelving / storage cupboard

Wheelchair access ramp

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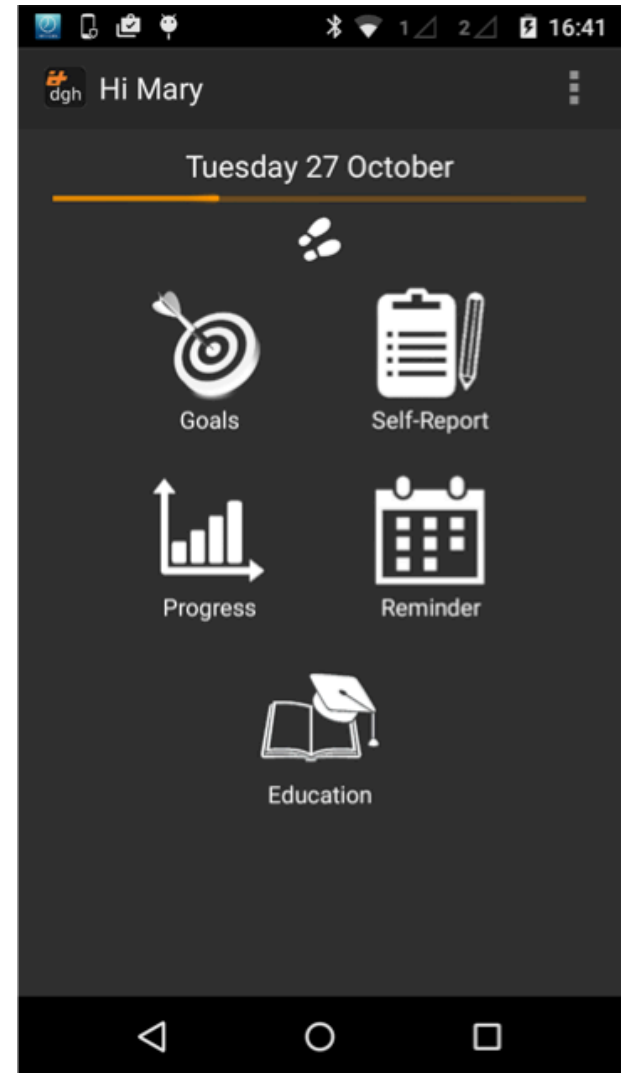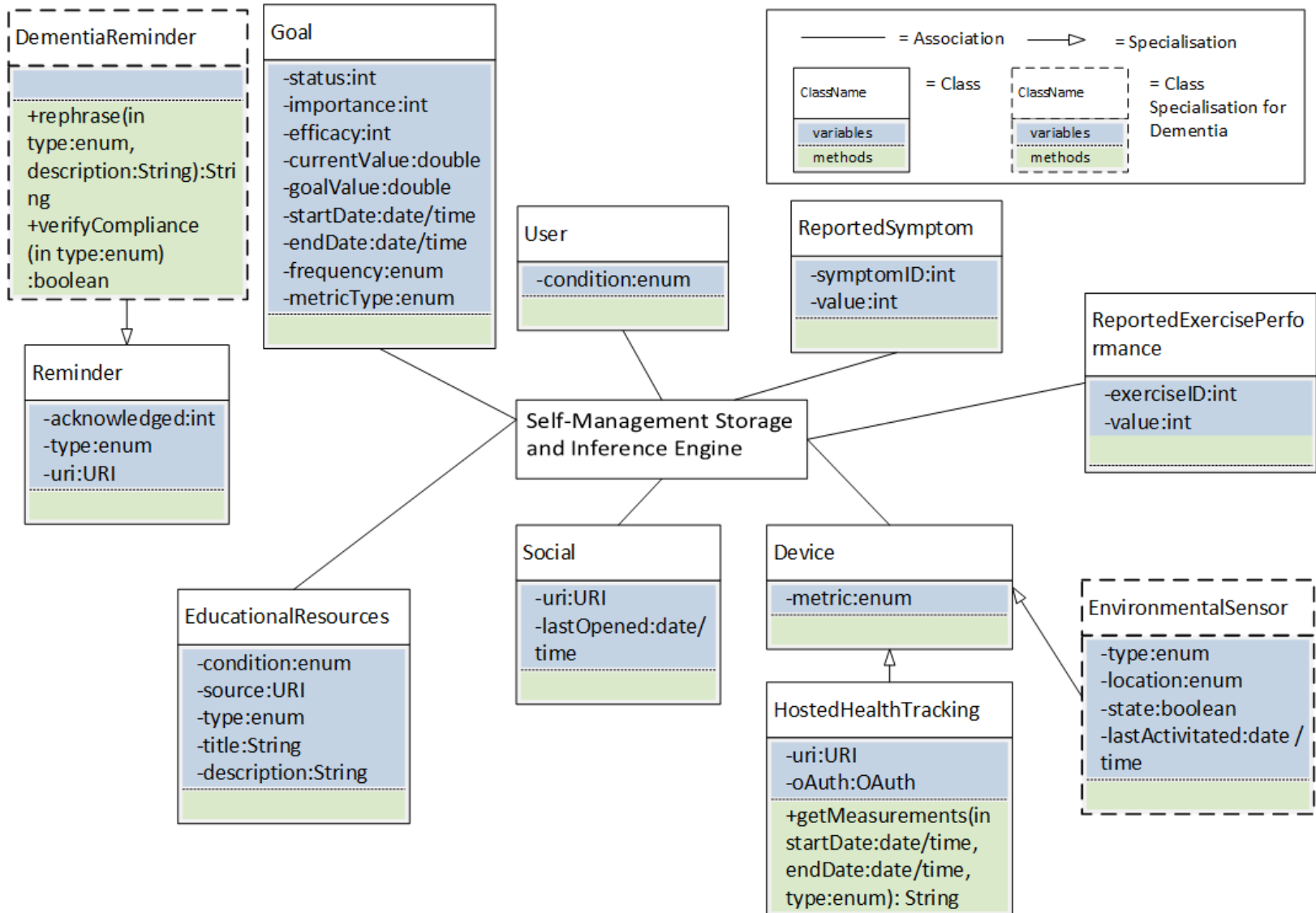
# The KeepWell Platform
## Overview

- Requirements based on:

  - Engagement with clinicians

  - Academic Literature

  - Previous experience

- Developed Android app has five core areas of functionality
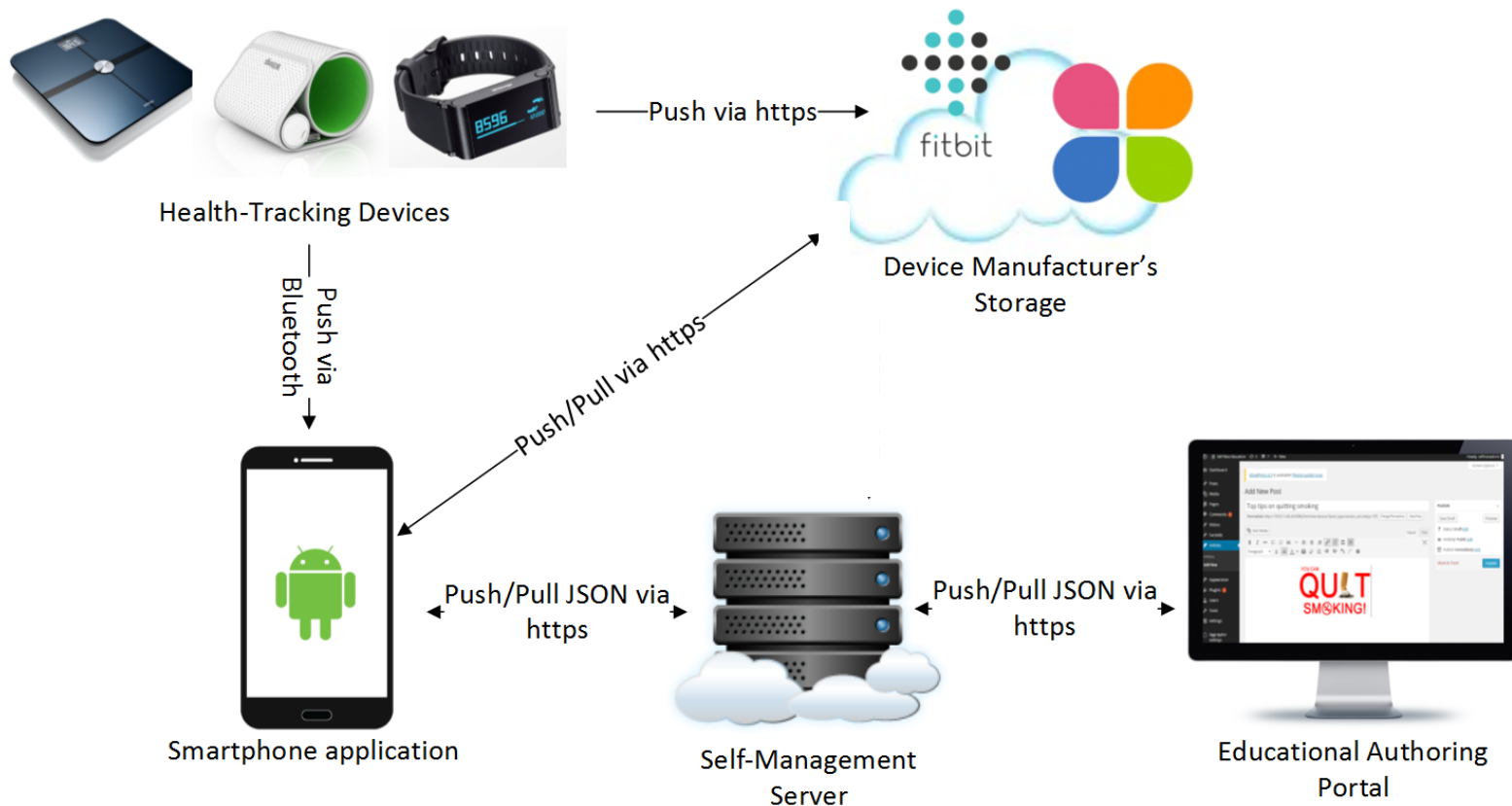
- Purchased the generic version



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# The KeepWell Platform
## Class Diagram of Key Attributes



**DementiaReminder**

+rephrase(in type:enum, description:String):String

+verifyCompliance (in type:enum) :boolean

**Goal**

-status:int
-importance:int
-efficacy:int
-currentValue:double
-goalValue:double
-startDate:date/time
-endDate:date/time
-frequency:enum
-metricType:enum

**User**

-condition:enum

**ReportedSymptom**

-symptomID:int
-value:int

**ReportedExercisePerformance**

-exerciseID:int
-value:int

Legend:
——— = Association
———▷ = Specialisation
ClassName (variables, methods) = Class
ClassName (variables, methods) [dashed] = Class Specialisation for Dementia

**Reminder**

-acknowledged:int
-type:enum
-uri:URI

**Self-Management Storage and Inference Engine**

**EducationalResources**

-condition:enum
-source:URI
-type:enum
-title:String
-description:String

**Social**

-uri:URI
-lastOpened:date/time

**Device**

-metric:enum

**HostedHealthTracking**

-uri:URI
-oAuth:OAuth

+getMeasurements(in startDate:date/time, endDate:date/time, type:enum): String

**EnvironmentalSensor**

-type:enum
-location:enum
-state:boolean
-lastActivitated:date/time

# The KeepWell Platform
## System Components

- Utilises Commercial Off-The-Shelf Technology



Health-Tracking Devices

Push via https

fitbit

Device Manufacturer's Storage

Push via Bluetooth

Push/Pull via https

Smartphone application

Push/Pull JSON via https

Self-Management Server

Push/Pull JSON via https

QUIT SM😊KING!

Educational Authoring Portal

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# The KeepWell Platform
## Devices

Currently using a suite of Withings devices
API rate limit of 60 per minute per developer key – can be increased

1) Blood pressure monitor (≈£90)
   - Systolic/Diastolic Blood pressure
   - Heart rate

2) Pulse Ox (≈£70)
   - Steps, distance, elevation, calories burned, light, moderate, intense activity
   - Light sleep, deep sleep, number of times awake
   - SPO2, heart rate

3) Smart Body Analyser (≈£110)
   - Weight, body fat
   - Heart rate
   - $CO_2$

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# The KeepWell Platform

**Data storage**

To ensure extensibility of the platform to heterogeneous data sources all measurements are represented as *'events'*

Events model – key attributes

Start time          of event
End time            of event
Label               denotes metric captured e.g. distance
Type                denotes source type e.g. withings.activity
Descriptor          denotes units of measurement e.g. metres
Value               the measurement value

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# The KeepWell Platform
## Data storage

### Withings event

```
-1209: {
    startTime: "2015-05-29T00:00:00.000+0100"
    endTime: "2015-05-29T00:00:00.000+0100"
    label: "distance"
    type: "WITHINGS.ACTIVITY"
    -attributes: {
        embedded_id: 401343
        -entry: [1]
            -0: {
                key: "distance"
                -value: {
                    value: "3385.37"
                    descriptor: "m"
                }
            }
    }
}
```

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# The KeepWell Platform
## Data storage

### Self-reported workout event

```
-1444:  {
    startTime: "2015-07-20T16:13:41.753+0100"
    endTime: "2015-07-20T16:13:41.753+0100"
    label: "Seated exercise - bicycling"
    type: "workout"
    -attributes: {
        embedded_id: 402338
        -entry: [1]
            -0:  {
                key: "Seated exercise - bicycling"
                -value: {
                    value: "5.0"
                    descriptor: ""
                }
            }
        }
```

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# The KeepWell Platform
## Data storage

**Reminder acknowledgement event**

```
−1508: {
    startTime: "2015-07-28T11:42:09.761+0100"
    endTime: "2015-07-28T11:42:09.762+0100"
    label: "Reminder"
    type: "REMINDER_ACKNOWLEDGEMENT"
    −attributes: {
        embedded_id: 402684
        −entry: [1]
            −0: {
                key: "Reminder"
                −value: {
                    value: "MISSED"
                    descriptor: "ACK"
                }
            }
    }
}
```

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**Retrieving data**

Data can be retrieved 'by example' e.g.
'Steps measured using Withings.Activity in July 2015'



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# The KeepWell Platform
**Web Portal**

- **Enables authorised users to:**
  - Create/modify educational content (articles, videos, factoids)
  - Create new conditions e.g. Diabetes
  - Create/modify condition-specific symptoms and workouts that a user can use as the basis for goal setting and subsequently self-report measurements
  - Create/modify condition-specific goals and reminders
    - Can choose upon registration to help avoid a 'cold-start'

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# The KeepWell Platform
## Web Portal

# The KeepWell Platform

## Demo of App

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# The KeepWell Platform

[1] Prince, M., Bryce, R., Albanese, E., Wimo, A., Ribeiro, W., & Ferri, C. P. (2013). The global prevalence of dementia: a systematic review and metaanalysis. Alzheimer's & Dementia : The Journal of the Alzheimer's Association, 9(1), 63–75.e2. doi:10.1016/j.jalz.2012.11.007

[2] Nikmat, A. W., Hawthorne, G., & Al-Mashoor, S. H. (2013). The comparison of quality of life among people with mild dementia in nursing home and home care-a preliminary report. *Dementia*, 1–12. doi:10.1177/1471301213494509

[3] Crisp, H. (2011). *Spotlight on Dementia Care*. London, UK: The Health Foundation.

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