# D6.4 CommonSense data integration

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SWELL Partners:

Noldus, Novay, Philips, TNO, Radboud Universiteit Nijmegen, Roessingh Research and Development, Almende, Sense Observation Systems, Universiteit Twente.

# Summary

This deliverable gives a status overview of the integration of sensor data sources and users into the CommonSense sensor platform. This platform is the central data hub for the SWELL project and also the place where the privacy and security policies as developed in WP4 will be implemented for all data and applications. As such, it will also be at the centre of the SWELL Golden Demo.

# Contents

# 1 Context of this deliverable

CommonSense is a platform that enables individuals to keep track of all their sensor data, store it in a central location, and play with it. CommonSense also processes raw sensor data into meaningful things like sleep, exercise, or your top locations.

The data from smartphone sensors can be combined with data from external sensors, such as a Fitbit, uLog and Facereader. Sense integrates any sensors on the market it deems interesting. Additionally, external users and developers can add their own sensors via an API. The API enables developers and 3rd party individuals and companies to develop their own applications using CommonSense.

Within the SWELL project CommonSense is positioned as the central sensor data storage and processing platform. This means that CommonSense serves as the link between the sensor technology provided by the industry partners (input) and de analyses and algorithms as developed by the SWELL PhD candidates (output).

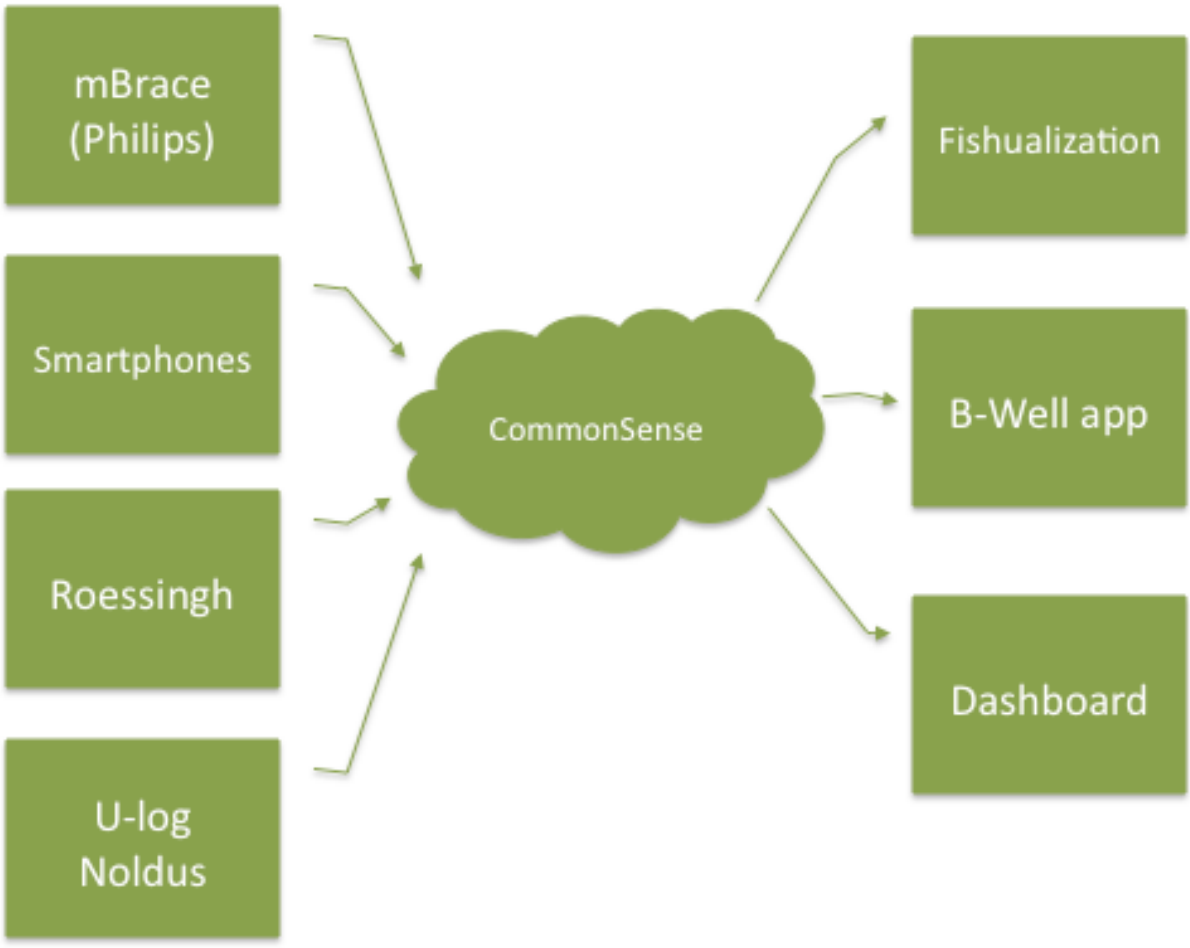


*Figure 1*. CommonSense serves as the central Hub for data exchange and processing in SWELL. Applications as selected preliminary for the Golden Demo need to be connected to this platform.

The general structure of the platform is such that all data collected by an individual will remain the property of said individual. Sense Observation Systems has no rights whatsoever to access the data and thus cannot resell this data. Only the individual owning the data can share and delete this data.

The security and privacy policies as developed in SWELL WP4 will be implemented in the CommonSense platform. Therefore, any application that is to be labelled “SWELL” outside the project, should adhere to these standards. This also applies to any application that is to be part of the Golden Demo.

# 2 Source integration and usage

Until the entry of Sense Observation Systems (summer 2013) in SWELL, all data gathering and storage was done locally by the SWELL PhD candidates. This made the sharing of data gathered within SWELL, the combination of multiple sensor data and the implementation of a uniform privacy and security policy virtually impossible. Therefore it was decided to use this platform as the central data hub in SWELL, and to put effort in making sure that the data of any sensor selected by the PhD candidates would upload in CommonSense, and that the candidates would be able to work with the system.

This document gives and overview of the work done and the status of this integration.

## 2.1 Smartphone/ Dashboard

Apps for both Android and iOS have been developed to integrate data measured through a smartphone into CommonSense. The apps collect sensor data from different smartphone sensors, if the sensors are available in the phone and on the version of the OS:

- Accelerometer (3 axes)
- Gyroscope (3 axes)
- Location coordinates (based on GPS, Wi-Fi access points, or GSM cell towers)
- Ambient light
- Magnetometer
- Noise
- Call states

Ten seconds of data is sampled every minute, aggregated over 5 minutes, and uploaded to the server every 30 minutes. After pilot testing, this showed to be the best trade-off between battery consumption and measurement resolution for the purposes within the project.

The iOS and Android apps are currently available in the App store and Play store. A CommonSense account can be created at www.commonsense-dashboard.com, which will be necessary to login to the apps.

Ongoing work is being done on the integration of the noise sensor on iOS. With the launch of iOS 7 it was no longer possible to measure noise in the background. Different workaround solutions are currently being explored and researched.

## 2.2 Fitbit

Fitbit is a commercially available wrist device that tracks steps, distance and sleep. A connection between a Fitbit account and CommonSense has been created using OAUTH authentication. This is a leading standard in application authentication and compatible with both Fitbit and CommonSense. A user can thereby link his/her CommonSense and Fitbit accounts.

Depending on the kind of Fitbit devices being used the following information will be gathered in CommonSense:

- Number of steps

- Number of active minutes
- Sleep duration
- Sleep onset
- Sleep offset
- Weight
- Fat percentage

## 2.3 Twitter

A connection between a Twitter account and CommonSense has been created using OAUTH authentication. This is a leading standard in application authentication and compatible with both Twitter and CommonSense. A user can thereby link his/her CommonSense and Twitter accounts.

Currently the number of a user's tweets and mentions are is being stored in his/her CommonSense account.

## 2.4 HappyWorker/ BeWell

A first step towards integration of the HappyWorker data has been made by providing the relevant persons working on the integration training on using the CommonSense API for storing and retrieving the HappyWorker measurements. This activity is therefore more on the output/ application side of things, mostly on how the PhD candidates could store and use for example uLog data with CommonSense. There is also locally gathered data (manual input) that can use the same method. Implementation of the integration is currently ongoing.

## 2.5 Physical activity mapping

Almost all of the work in this field is done at the University of Twente (UT). Initial exploring of the possibilities to integrate the data produced there with the CommonSense platform has resulted in the following insight:

- The research goal of this physical activity tracking asks for a very fine granularity in data gathering by sensors, in this case e.g. 50 data points per second. This cannot be provided by CommonSense, that has a minimum interval of 1 second.

Even if it were possible, using CommonSense would generate too much up and down traffic through a public network, with considerable costs. And apart from that, energy efficiency to save batteries is a research goal as well. Still, abstracts with a larger interval could be uploaded to the platform, after local processing.

This would be the way forward to ensure that the work of the UT PhD candidates could be incorporated into the Golden Demo. However, there is no time or budget presently available to make such an interface. Any results are therefore also not yet included in figure 1 (Chapter 1).

## 2.6 uLog

uLog3 is a key- and mouse logger tool for the Windows platform developed by Noldus. It can detect the following items based on user actions (those marked with an asterisk are used for the SWELL WP3 Fishualization tool).

Noldus has built a test interface between uLog and CommonSense using the CommonSense API. This test has shown that the data from uLog can be stored and processed for use by the PhD candidates.

- *Mouse Click (Left, middle, right)
- *Mouse Double Click (Left, middle, right)
- *Mouse Wheel
- Mouse Drag
- Mouse Hover

Keyboard String

- *Keyboard Special key (Tab, Esc, Enter, etc.).
- *Keyboard Key combination (Control+, Alt+)
- *Keyboard Single character

- *Window activated
- *Application started
- *Application exited
- Control focus changes

For each of these items extra information can be added like name of active application, active control, etc. Next to these low level events, uLog can deduce some simple statistics:

- Average mouse events per minute
- Average mouse clicks per minute
- Average left mouse clicks per minute
- Average right mouse clicks per minute
- Average middle mouse clicks per minute
- Average double mouse clicks per minute
- Average mouse scroll events per minute
- Average mouse scroll distance per minute

- Average key presses per minute
- Average normal character per minute
- Average numeric character per minute
- Average remainder character per minute
- Average words per minute
- Average shortcut key presses per minute
- Average direction key presses per minute
- Average error key presses per minute
- Character/Key ratio
- Error/Key ratio

- Application Switches per minute
- Application percentage usage

## 2.7 FaceReader

FaceReader is a program for facial analysis developed by Noldus. It can detect emotional expressions in the face. It can identify six basic emotions: happy, sad, angry, surprised, scared,

disgusted and a neutral state. Additionally, it can detect facial states(left and right eye open or closed, mouth open or closed and eyebrows raised, neutral or lowered), the test participant's global gaze direction and track the head orientation. FaceReader can also indicate the person's gender, age, ethnicity, the amount of facial hair (beard and/or moustache) and whether the person is wearing glasses or not. The software can also identify the subject.

FaceReader detects the following 19 elements from FACS (Facial Analysis Coding Scheme).

1 Inner Brow Raiser
2 Outer Brow Raiser
4 Brow Lowerer
5 Upper Lid Raiser
6 Cheek Raiser
7 Lid Tightener
9 Nose Wrinkler
10 Upper Lid Raiser
12 Lip Corner Puller
14 Dimpler
15 Lip Corner Depressor
17 Chin Raiser
20 Lip Stretcher
23 Lip Tightener
24 Lip Pressor
25 Lips Part
26 Jaw Drop
27 Mouth Stretch
43 Eyes Closed

Each element is scored with an intensity. Intensities are annotated by appending letters, A (trace); B (slight); C (pronounced); D (severe) or E (max).

Given the format of the output there are no significant issues foreseen with uploading Facereader data into CommonSense. However, the actual application of this link depends on the actual functional usage by one of the PhD candidates.

## 2.8 Roessingh R&D accelerometer

Discussions with Roessingh have brought us to the conclusion that the added value of their autonomous accelerometer device would be limited in this project as the smartphone sensors provide similar information. Hence, the choice was made not to further integrate it into CommonSense for now.

## 2.9 mBrace

There has been some debate about the level on which the Philips mBrace would integrate into the SWELL architecture, as Philips is working on its own IPR and aims at developing and protecting its algorithms. However, this interpretation would be made available on the level of 'heart rate' or 'blood pressure" and the like, which is more than adequate for use in the SWELL project, and can

easily be assigned a state of value in the CommonSense platform. Philips also has the API for this product ready.

As Philips works in a more formalized way than the SME industry partners, at present neither the physical mBrace nor the API are available to SWELL as yet. Philips will decide on the formal release of these products in prototype or ‘beta’ status shortly.

# 3 Conclusion

At present we are at the point where the PhD candidates at TNO and Radboud University Nijmegen are able to work with the CommonSense platform both on the input side (sensor technology) and on the output side (analyses and algorithms).

For the PhD candidates at the University of Twente there is still the challenge to find a meaningful modus operandi, which is really necessary if we want to include their work in the Golden Demo.

On the Industry side, only the Philips mBrace is still not available to SWELL, but pending a release decision by Philips there is still time to incorporate this device and its results into the Golden Demo.

For the moment we will not proceed to integrate the Roessingh accelerometer, which is a nice device in its own right, but on a technical level does not generate any additional data as compared to the low-cost accelerometers as integrated in smartphones and wristband devices.

The Noldus sensors can be used by SWELL and the data generated can be stored in CommonSense