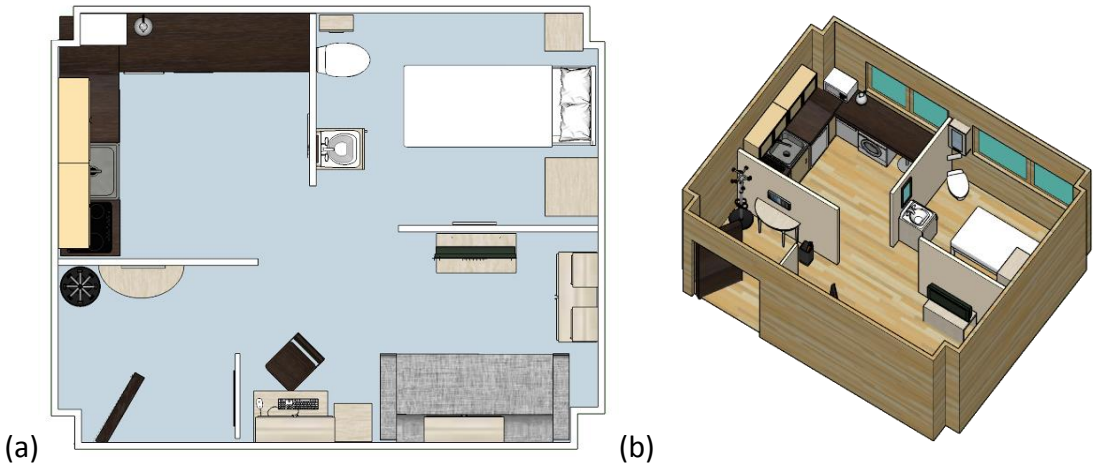
UCAmI Cup. Analysing the UJAEN Human Activity Recognition Dataset

1. UJAmI: University of Jaén's SmartLab

The University of Jaén's Ambient Intelligence (UJAmI) SmartLab represents an innovative space that plays a key role in the implementation of new ground-breaking research within the realms of AmI.

The UJAmI[1] environment several tools and resources related with AmI amongst them: a SmartLab, software tools, a repository of datasets and, finally, a media section with illustrative videos of SmartLab based demos.

The UJAmI SmartLab measures approximately 25 square meters, its measurements are 5.8 meters long and 4.6 meters wide. It is divided into five regions: entrance, kitchen, workplace, living room and a bedroom with an integrated bathroom. The layout of the UJAmI SmartLab is presented in Figure 1.



(a) (b)

Fig. 1. Layout of the UJAmI SmartLab (a) plan view (b) isometric view.

A set of multiple and heterogeneous sensors have been deployed in different areas of the environment in order to capture human-environment interactions in addition to inhabitant behaviour. Currently, middleware based on openHAB[2] is used to aggregate the data and store it in a standardised format.

[1] http://ceatic.ujaen.es/ujami/en/
[2] https://www.openhab.org/

2. UJAEN human activity recognition dataset

The dataset from the UJAmI SmartLab is composed of four data sources that have been obtained whilst an inhabitant performed 246 instances of activity classes over a period of 10 days. The dataset is divided into two sets:

- Part 1: Labelled training set with seven days of recordings that contains 169 instances.
- Part 2: Unlabelled test set with three days of recordings that contains 77 instances.

The four data sources are as follows:

1. Events stream generated by 30 binary sensors.
2. Proximity information between a smart watch worn by an inhabitant and a set of 15 Bluetooth Low Energy (BLE) beacons deployed in the UJAmI SmartLab.
3. Acceleration generated by the smart watch.
4. An intelligent floor with 40 modules that provides spatial information.

The inhabitant who performed the activities was a 24 year old male student from the University of Jaen. During data collection, the LG Urbane model[3] of the smart watch was worn on the participant's right hand. For reasons of energy saving, recording of acceleration data and proximity related information ceased when the inhabitant went to bed in addition to when he left the UJAmI SmartLab.

The dataset includes 24 different types of activities as presented in Table 1 with the frequency of each activity only in the training set.

Table. 1. Activities recorded in the UJAEN dataset.

ID Activity	Name activity	Freq.	Description
Act01	Take medication	7	This activity involved the inhabitant going to the kitchen, taking some water, removing medication from a box and swallowing the pills.
Act02	Prepare breakfast	7	This activity involved the inhabitant going to the kitchen, taking some products for lunch. This activity can involve i) making a tea with kettle or ii) making a hot chocolate with milk in the microwave. This activity involves placing things to eat in the dining room, but not sitting down to eat.
Act03	Prepare lunch	6	This activity involved the inhabitant going to the kitchen, and taking some products from the refrigerator and pantry.

[3] Http://www.lg.com/es/wearables/lg-LGW150-g-watch-urbane

			This activity can involve i) preparing a plate of hot food on the fire, for example pasta or ii) heating a precooked dish in the microwave. This activity also involves placing things to eat in the dining room, but not sitting down to eat.
Act04	Prepare dinner	7	This activity involved the inhabitant going to the kitchen, and taking some products from the refrigerator and pantry. This activity can involve i) preparing a plate of hot food on the fire, for example pasta or ii) heating a precooked dish in the microwave. This activity also involves placing things to eat in the dining room, but not sitting down to eat.
Act05	Breakfast	7	This activity involved the inhabitant going to the dining room in the kitchen in the morning and sitting down to eat. When the inhabitant finishes eating, he places the utensils in the sink or in the dishwasher.
Act06	Lunch	6	This activity involved the inhabitant going to the dining room in the kitchen in the afternoon and sitting down to eat. When the inhabitant finishes eating, he places the utensils in the sink or in the dishwasher.
Act07	Dinner	7	This activity involved the inhabitant going to the dining room in the kitchen in the evening and sitting down to eat. When the inhabitant finishes eating, he places the utensils in the sink or in the dishwasher.
Act08	Eat a snack	5	This activity involved the inhabitant going to the kitchen to take fruit or a snack, and to eat it in the kitchen or in the living room. This activity can imply that the utensils are placed in the sink or in the dishwasher.
Act09	Watch TV	6	This activity involved the inhabitant going to the living room, taking the remote control, sitting down on the sofa and when he was finished, the remote control was left close to the TV.
Act10	Enter the SmartLab	12	This activity involved the inhabitant entering the SmartLab through the entrance at the main door and putting the keys into a small basket.
Act11	Play a videogame	1	This activity involved the inhabitant going to the living room, taking the remote controls of the TV and XBOX, and sitting on the sofa. When the inhabitant finishes playing, he gets up from the sofa and places the controls near the TV.
Act12	Relax on the sofa	1	This activity involved the inhabitant going to the living room, sitting on the sofa and after several minutes, getting up off the sofa.

Act13	Leave the SmarLab	9	This activity involved the inhabitant going to the entrance, opening the main door and leaving the SmartLab, then closing the main door.
Act14	Visit in the SmartLab	1	This activity involved the inhabitant going to the entrance, opening the main door, chatting with someone at the main door, and then closing the door.
Act15	Put waste in the bin	11	This activity involved the inhabitant going to the kitchen, picking up the waste, then taking the keys from a small basket in the entrance and exiting the SmartLab. Usually, the inhabitant comes back after around 2 minutes, leaving the keys back in the small basket.
Act16	Wash hands	6	This activity involved the inhabitant going to the bathroom, opening/closing the tap, lathering soap, rinsing his hands and then drying them.
Act17	Brush teeth	21	This activity involved the inhabitant going to the bathroom and brushing his teeth, opening/closing the tap, lathering soap, rinsing his hands and then drying them.
Act18	Use the toilet	10	This activity involved the inhabitant going to the bathroom and using the toilet, opening/closing the toilet lid and pulling the cistern.
Act19	Wash dishes	2	This activity involved the inhabitant going to the kitchen and placing the dirty dishes in the dishwasher, and then placing the dishes back in the right place.
Act20	Put washing into the washing machine	6	This activity involved the inhabitant going to the bedroom, picking up the laundry basket, going to the kitchen, putting clothes in the washing machine, waiting around 20 minutes and then taking the clothes out of the washing machine and placing them in the bedroom closet.
Act21	Work at the table	2	This activity involved the inhabitant going to the workplace, sitting down, doing work, and finally, getting up.
Act22	Dressing	15	This activity involved the inhabitant going to the bedroom, putting dirty clothes in the laundry basket, opening the closet, putting on clean clothes and then closing the closet.
Act23	Go to the bed	7	This activity involved the inhabitant going to the bedroom, lying in bed and sleeping. This activity is terminated once the inhabitant stays 1 minute in bed.
Act24	Wake up	7	This activity involved the inhabitant getting up and out of the bed.

The activities being undertaken during data collection were annotated by using NFC tags and a smartphone. This process was used to label the beginning and end of each activity

3. Format of the dataset.

The root folder of the dataset contains the folders and files as illustrated in Figure 2.

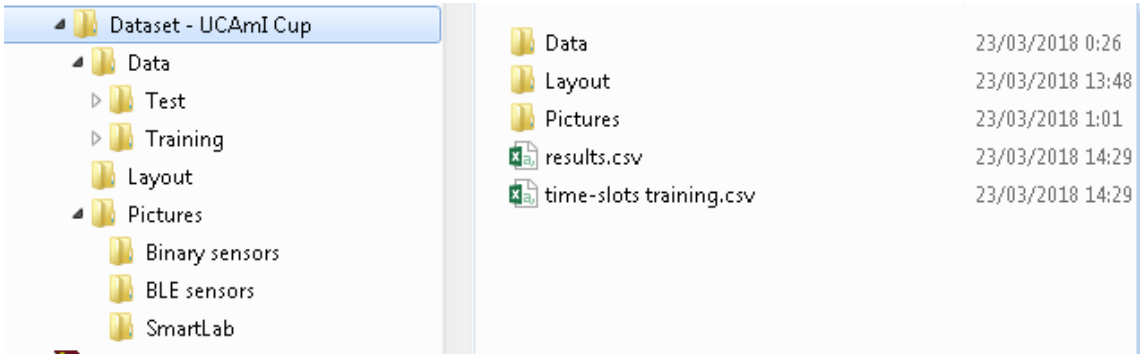


Fig. 2. Folders and files in the root folder of the UJAEN dataset.

- **The Folder named "Pictures" (UCAmI Cup\Pictures\) contains:**
  - A folder named "Binary Sensors" with pictures of each binary sensor used for data collection in the UJAmI SmartLab.
  - A folder named "BLE sensor" with pictures of each BLE sensor used in the UJAmI SmartLab during data collection.
  - A folder named "Smart Lab" which contains pictures of each area in the UJAmI SmartLab.
- **The Folder named "Layout" (UCAmI Cup\Layout\) contains:**
  - A file named "sensors.png" which shows the layout of the UJAmI SmartLab and where each of the binary sensors are located.
  - A file named "proximity.png" which shows the layout of the UJAmI SmartLab and where each of the BLE sensors are located.
  - A file named "Coordinates.docx" which contains a table with the coordinates X and Y of each binary sensor and each BLE sensor in the UJAmI SmartLab.
  - A file named "floor.png" which shows the layout of the smart floor in the UJAmI SmartLab.
  - A file named "floor-modules.png" which shows the layout of the smart floor in the UJAmI SmartLab with the ID of each module in the layout.
- **The Folder named "Data" (UCAmI Cup\Data\) contains** 10 days of recordings divided into the following two folders (refer to Figure 4):
  - The Folder named Test contains the data for 3 days and is unlabelled.
  - The Folder named Training contains data for 7 days and is fully labelled.

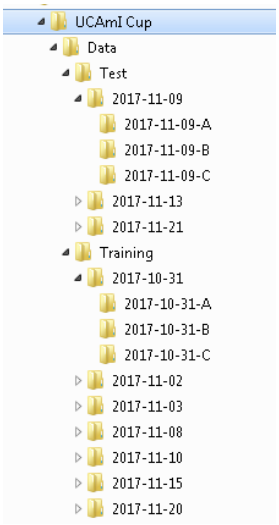


Fig. 3. File structure of the data folder.

Each of the 10 sub-folders contains data for each recording day.

The name of each folder in each recording day has the following format: YYYY-MM-DD, with YYYY representing the year, MM the month and DD the day. Each of the folders contain three sub-folders, one for each time routine of the day. The time routines are represented by T, which can take the following values: A for the morning, B for the afternoon and C for the evening.
In a similar manner, each of the 3 sub-folders are named according to the day of the recording and the time of the routine (YYYY-MM-DD-T). Each routine-folder has the following files according to the four data sources: Binary Sensors, Proximity (BLE sensors), Acceleration and Floor.

Furthermore, **each routine-folder in the training set** contains the file YYYY-MM-DD-T-activity.csv with the sequence of activities that are carried out together and the timestamps of the beginning and the end of each activity. More details about this are provided in the section “Activity files”.

As an example, folders and files included in the day-folder named "2017-11-08-A" are listed in Figure 4. This folder is contained in the training set.

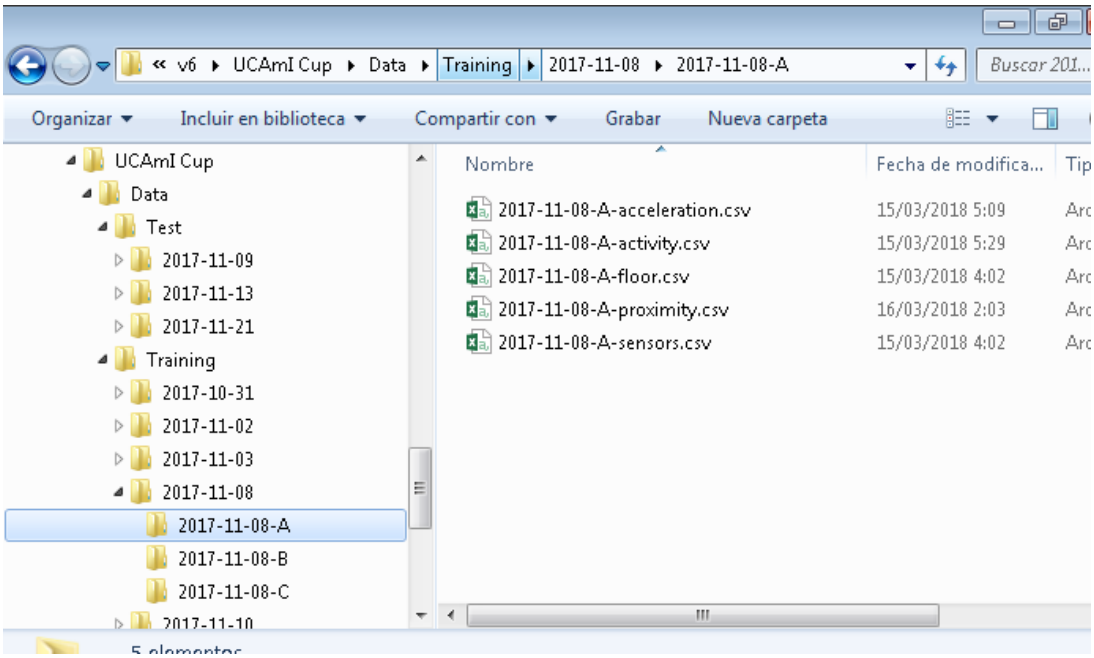


Fig. 4. Examples of the files included in the data folder called "2017-11-08-A" in the training set.

As an example, the files included in the day-folder named "2017-11-09-A" are presented in Figure 5. This day is contained in the test set and therefore does not include any labelling of the data.

Fig. 5. Files in the data folder called "2017-11-09-A" in the test set.

- **“time-slots training.csv” (UCAmI Cup\ time-slots training.csv)** contains a csv file which stores the annotations of the activities. This file has 30 second timeslots of the dataset where only the activities that are carried out in this time period are labelled. An excerpt from this file is presented in Figure 6.

```
2017-10-31-A-activity.csv;;;;;;;;;;
Time;Act24;Act18;Act16;Act02;Act05;Act17;Act22;Act13;;
2017/10/31 11:11:30;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:12:00;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:12:30;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:13:00;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:13:30;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:14:00;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:14:30;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:15:00;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:15:30;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:16:00;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:16:30;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:17:00;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:17:30;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:18:00;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:18:30;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:19:00;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:19:30;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:20:00;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:20:30;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:21:00;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:21:30;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:22:00;FALSE;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;;
2017/10/31 11:22:30;FALSE;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;;
2017/10/31 11:23:00;FALSE;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;;
2017/10/31 11:23:30;FALSE;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;;
2017/10/31 11:24:00;FALSE;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;;
2017/10/31 11:24:30;FALSE;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;FALSE;;
2017/10/31 11:25:00;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;FALSE;;
2017/10/31 11:25:30;FALSE;FALSE;FALSE;FALSE;FALSE;TRUE;FALSE;FALSE;;
```

Fig. 6. An excerpt from the file named time-slots-Training.xls.

- **“results.csv” (UCAmI Cup\results.csv)** contains a csv file with the timeslots for the test set, however, none of the activities have been labelled. This labelling exercise is to be completed by the participants in the UCAmI Cup. An excerpt from this file is presented in Figure 7.

```
2017-11-09-A-activity.csv;;;;;;;;;;
Timestampstamp;ActXX;ActXX;ActXX;ActXX;ActXX;ActXX;ActXX;ActXX;ActXX;
2017/11/09 12:02:30;;;;;;;;;;
2017/11/09 12:03:00;;;;;;;;;;
2017/11/09 12:03:30;;;;;;;;;;
2017/11/09 12:04:00;;;;;;;;;;
2017/11/09 12:04:30;;;;;;;;;;
2017/11/09 12:05:00;;;;;;;;;;
2017/11/09 12:05:30;;;;;;;;;;
2017/11/09 12:06:00;;;;;;;;;;
2017/11/09 12:06:30;;;;;;;;;;
2017/11/09 12:07:00;;;;;;;;;;
2017/11/09 12:07:30;;;;;;;;;;
2017/11/09 12:08:00;;;;;;;;;;
2017/11/09 12:08:30;;;;;;;;;;
2017/11/09 12:09:00;;;;;;;;;;
2017/11/09 12:09:30;;;;;;;;;;
2017/11/09 12:10:00;;;;;;;;;;
2017/11/09 12:10:30;;;;;;;;;;
2017/11/09 12:11:00;;;;;;;;;;
2017/11/09 12:11:30;;;;;;;;;;
2017/11/09 12:12:00;;;;;;;;;;
2017/11/09 12:12:30;;;;;;;;;;
2017/11/09 12:13:00;;;;;;;;;;
```

Fig. 7. An excerpt from the file named results.xls.

4. Activity files

The files in the training set with the annotated activities are named YYYY-MM-DD-T-activity.csv and contain the fields as presented in Figure 8:

```
DATE BEGIN;DATE END;ACTIVITY;HABITANT
2017/10/31 11:12:38.0;2017/10/31 11:15:25.0;Act24;Mario
2017/10/31 11:15:51.0;2017/10/31 11:16:37.0;Act18;Mario
2017/10/31 11:17:04.0;2017/10/31 11:18:06.0;Act16;Mario
2017/10/31 11:18:36.0;2017/10/31 11:21:54.0;Act02;Mario
2017/10/31 11:22:12.0;2017/10/31 11:24:59.0;Act05;Mario
2017/10/31 11:25:55.0;2017/10/31 11:27:06.0;Act17;Mario
2017/10/31 11:27:25.0;2017/10/31 11:29:01.0;Act22;Mario
2017/10/31 11:29:24.0;2017/10/31 11:30:09.0;Act13;Mario
```

Fig. 8. Excerpt from the file activity.csv

The file named YYYY-MM-DD-T-activity.csv contains the following fields:

- DATE BEGIN: Timestamp when the inhabitant starts the activity.
- DATE END: Timestamp when the inhabitant finishes the activity.
- ACTIVITY: Name of the activity carried out by the inhabitant.
- HABITANT: Person that carries out the activity

Please note that the name of the inhabitant has been included to support the future extension of the AR evaluation for multiple occupancy scenarios. The 1st UCAmI Cup is, however, only concerned with a single inhabitant scenario.

5. Binary sensor file

In the UJAmI SmartLab a set of 30 binary sensors were deployed. All of them send a binary value together with the timestamp. The set of binary sensors are categorised into the following three sensor types where the meaning/semantic of the values are described:

- Magnetic contact. This is a wireless magnetic sensor[4] that works with the Z-Wave protocol. When the sensor detects that the two pieces of the sensor have been separated, the sensor sends an event with a value that represents "open". When the pieces of the sensor are put back together, the sensor sends an event with a value that represents "close". In our dataset, this kind of sensor is used for the purposes of tracking the position of doors in addition to placing them in objects that have a fixed place when they are not being used. For example, a TV remote control, medicine box, or bottle of water. In these instances when the value is “close”, it means that the object is not being used, otherwise, when the value is “open”, it means that the object is being used.

[4] http://www.everspring.com/portfolio-item/sm810-doorwindow-contact-sensor/

- Motion. This is a wireless PIR sensor[5] that works with the ZigBee protocol that is used to detect whether an inhabitant has moved in or out of the sensor's range. It has a maximum IR detection range of 7 metres with a sample rate of 5 seconds. When motion is detected the sensor sends a value that represents movement. When the movement ceases, the sensor sends a value that represents no movement.
- Pressure. This is a wireless sensor that works with the Z-Wave protocol that is connected to a textile layer. When pressure is detected in the textile layer the sensor sends a value that represents press. When the pressure ceases, the sensor sends a value that represents no press. Usually, this kind of sensor is used in sofas, chairs or beds.

The details of the objects/sensors and their locations are presented in the Table 2.

ID	OBJECT	X	Y	Type	STATE 1	STATE 2
M01	Door	450	460	Contact	Open	Close
TV0	TV	119	252	Contact	Open	Close
SM1	Sensor Kitchen movement	580	260	Motion	Movement	No movement
SM3	Motion sensor bathroom	270	128	Motion	Movement	No movement
SM4	Motion sensor bedroom	146	0	Motion	Movement	No movement
SM5	Motion sensor sofa	164	249	Motion	Movement	No movement
D01	Refrigerator	510	144	Contact	Open	Close
D02	Microwave	480	37	Contact	Open	Close
D03	Wardrobe clothes	59	169	Contact	Open	Close
D04	Cupboard cups	546	104	Contact	Open	Close
D05	Dishwasher	487	63	Contact	Open	Close
D07	Top WC	254	56	Contact	Open	Close
D08	Closet	546	194	Contact	Open	Close
D09	Washing machine	408	63	Contact	Open	Close
D10	Pantry	546	149	Contact	Open	Close
H01	Kettle	467	24	Contact	Open	Close
C01	Medication box	471	0	Contact	Open	Close
C02	Fruit platter	434	0	Contact	Open	Close
C03	Cutlery	515	116	Contact	Open	Close
C04	Pots	515	116	Contact	Open	Close
C05	Water bottle	567	170	Contact	Open	Close
C07	Remote XBOX	117	252	Contact	Present	No present
C08	Trash	489	233	Contact	Open	Close
C09	Tap	306	107	Contact	Open	Close
C10	Tank	310	44	Contact	Open	Close
C12	Laundry basket	461	63	Contact	Present	No present
C13	Pyjamas drawer	59	169	Contact	Open	Close

[5] http://www.everspring.com/portfolio-item/tsm04-u-net-doorwindow-sensor/

C14	Bed	140	94	Pressure	Pressure	No Pressure
C15	Kitchen faucet	558	98	Contact	Open	Close
S09	Pressure sofa	130	407	Pressure	No Pressure	No Pressure

Table 2. Details of the set of objects/binary sensors deployed in the UJAmI SmartLab.

In the folder “UCAmI Cup\Pictures\Binary sensors” pictures of each binary sensor can be found. The coordinates of these sensors are illustrated in the file “UCAmI Cup\Layout\Coordinates.docx” and, in addition, the approximate position of each can be found in the file “UCAmI Cup\ Layout \sensors.png”

The files named YYYY-MM-DD-T-sensors.csv contain the following fields:
- TIMESTAMP: This indicates when a sensor sends an event.
- OBJECT: ID of the object associated to the sensor that send the event.
- STATE: Value of the sensor event.
- HABITANT: Person who is performing the activity.

Figure 9 contains an excerpt from a file YYYY-MM-DD-T-sensors.csv.

```
TIMESTAMP;OBJECT;STATE;HABITANT
2017/10/31 11:08:55.0;SM4;Movement;Mario
2017/10/31 11:09:11.0;SM4;No movement;Mario
2017/10/31 11:09:31.0;C14;Pressure;Mario
2017/10/31 11:09:31.0;SM4;Movement;Mario
2017/10/31 11:09:32.0;C14;No Pressure;Mario
2017/10/31 11:09:41.0;C14;Pressure;Mario
2017/10/31 11:09:43.0;SM3;Movement;Mario
2017/10/31 11:09:53.0;SM3;No movement;Mario
2017/10/31 11:09:56.0;M01;Open;Mario
2017/10/31 11:10:06.0;SM4;No movement;Mario
2017/10/31 11:11:21.0;SM4;Movement;Mario
2017/10/31 11:11:21.0;M01;Close;Mario
2017/10/31 11:13:15.0;SM4;Movement;Mario
2017/10/31 11:13:40.0;SM4;No movement;Mario
2017/10/31 11:14:58.0;C14;Pressure;Mario
2017/10/31 11:14:58.0;SM4;Movement;Mario
2017/10/31 11:14:59.0;C14;No Pressure;Mario
2017/10/31 11:15:01.0;C14;Pressure;Mario
2017/10/31 11:15:57.0;D07;Open;Mario
2017/10/31 11:16:12.0;SM3;No movement;Mario
2017/10/31 11:16:18.0;SM3;Movement;Mario
2017/10/31 11:16:22.0;C10;Open;Mario
2017/10/31 11:16:22.0;C08;Open;Mario
2017/10/31 11:16:30.0;C08;Close;Mario
2017/10/31 11:16:30.0;C10;Close;Mario
2017/10/31 11:16:34.0;SM4;Movement;Mario
2017/10/31 11:16:35.0;D07;Close;Mario
2017/10/31 11:17:04.0;SM4;No movement;Mario
2017/10/31 11:17:19.0;C09;Open;Mario
2017/10/31 11:17:22.0;SM4;Movement;Mario
```

Fig. 9. Excerpt from the file sensors.csv

6. Proximity data

The proximity data was collected through an Android application installed on the smart watch of the inhabitant and a set of 15 BLE beacons with a sample frequency of 0.25 Hz. The beacon model used was the Sticker from Estimote[6].

When the smart watch reads the signal from a BLE beacon, it collects a Received Signal Strength Indicator (RSSI). Each BLE beacon must set a broadcasting power with which it broadcasts its signal. The smart watch has the capability to read the RSSIs from several BLE beacons when they are in range. The proximity between a wearable device and a BLE beacon impacts upon the RSSI. The greater the RSSI received by the smart watch, the smaller the distance between it and the BLE beacon.

15 BLE beacons were deployed in the UJAmI SmartLab as presented in Table 3. For small items, for example a toothbrush and medicine box, the BLE broadcasting power (measured in decibels) was set to a smaller range in an effort to reduce/avoid false positives.

Name	Broadcasting Power (Db)
1- TV controller	-12
2- Book	-12
3- Entrance door	-12
4 - Medicine box	-16
5 - Food cupboard	-12
6 - Fridge	-12
7 - Pot drawer	-12
8 - Water bottle	-12
9 - Garbage can	-12
10 - Wardrobe door	-12
11- Pyjama drawer	-12
12 - Bed	-12
13 - Bathroom tap	-12
14 - Toothbrush	-16
15 - Laundry basket	-12

Table 3. Details of the set of BLE sensors deployed in the UJAmI SmartLab and their respective BLE broadcasting power.

In the folder “UCAmI Cup\Pictures\BLE sensors” pictures of each BLE sensor according to the code of each sensor can be found. The coordinates of these sensors are illustrated in the file “UCAmI Cup\Layout\Coordinates.docx” with the approximate position being specified in the file “UCAmI Cup\Layout\proximity.png”

[6] https://estimote.com/

The files named YYYY-MM-DD-T-proximity.csv contain the following fields:

- TIMESTAMP: This indicates when the data of a BLE beacon is read.
- ID: Unique identifier of the BLE beacon associated to an object.
- OBJECT: Object where the BLE beacon has been deployed.
- RSSI: RSSI read by the smart watch.

Further information relating to the methods that are used to obtain the proximity and the RSSI from the BLE beacon can be found in the product's SDK [7]. Figure 10 illustrates an excerpt of a file YYYY-MM-DD-T-proximitiy.csv.

```
TIMESTAMP;ID;OBJECT;RSSI
2017/10/31 11:11:26.831;8108b9e0bcd42be1;WARDROBE DOOR;-95
2017/10/31 11:11:31.967;8108b9e0bcd42be1;WARDROBE DOOR;-95
2017/10/31 11:11:42.796;472c18626db5d102;BED;-68
2017/10/31 11:11:47.966;472c18626db5d102;BED;-84
2017/10/31 11:11:53.312;472c18626db5d102;BED;-83
2017/10/31 11:11:58.563;472c18626db5d102;BED;-83
2017/10/31 11:11:58.564;fc0a68ebcdb1ab7c;PYJAMAS DRAWER;-100
2017/10/31 11:12:03.813;472c18626db5d102;BED;-83
2017/10/31 11:12:03.814;fc0a68ebcdb1ab7c;PYJAMAS DRAWER;-100
2017/10/31 11:12:08.909;472c18626db5d102;BED;-83
2017/10/31 11:12:14.253;472c18626db5d102;BED;-81
2017/10/31 11:12:19.705;472c18626db5d102;BED;-67
2017/10/31 11:12:25.054;472c18626db5d102;BED;-82
2017/10/31 11:12:30.469;472c18626db5d102;BED;-67
2017/10/31 11:12:35.752;472c18626db5d102;BED;-85
2017/10/31 11:12:41.092;472c18626db5d102;BED;-85
2017/10/31 11:12:46.438;472c18626db5d102;BED;-83
2017/10/31 11:12:51.670;472c18626db5d102;BED;-85
2017/10/31 11:12:56.941;472c18626db5d102;BED;-85
2017/10/31 11:13:02.157;472c18626db5d102;BED;-86
2017/10/31 11:13:07.502;472c18626db5d102;BED;-84
2017/10/31 11:13:12.713;472c18626db5d102;BED;-84
2017/10/31 11:13:18.085;472c18626db5d102;BED;-84
2017/10/31 11:13:23.453;472c18626db5d102;BED;-84
2017/10/31 11:13:28.863;472c18626db5d102;BED;-83
2017/10/31 11:13:34.218;472c18626db5d102;BED;-84
2017/10/31 11:13:39.755;472c18626db5d102;BED;-82
2017/10/31 11:13:45.239;472c18626db5d102;BED;-82
2017/10/31 11:13:50.699;472c18626db5d102;BED;-63
2017/10/31 11:13:55.837;472c18626db5d102;BED;-93
```

Fig. 10. Excerpt from a proximity.csv file

7. Acceleration data

The acceleration data has been collected through an Android application installed on the smart watch of the inhabitant. Data was collected with a sample frequency of 50 Hz. The acceleration data has been collected in three axes, which are expressed by meter per second squared (m/s^{-2})[8].

The files named YYYY-MM-DD-T-acceleration.csv contain the acceleration data collected that have been generated by the smart watch while the habitant carried out the different activities.

[7] https://estimote.com/products/

[8] https://developer.android.com/reference/android/hardware/SensorManager.html#SENSOR_ACCELEROMETER

The files named YYYY-MM-DD-T-acceleration.csv contain the following fields:

- TIMESTAMP: This indicates when the data is collected.
- X: The acceleration in the x-axis.
- Y: The acceleration in the y-axis.
- Z: The acceleration in the z-axis.

Figure 11 illustrates an excerpt from a file YYYY-MM-DD-T- acceleration.csv.

```
TIMESTAMP;X;Y;Z
2017/10/31 11:11:22.807;-1.4513855;-9.44754;-0.8767853
2017/10/31 11:11:22.826;-1.4359131;-9.6284485;-0.9148712
2017/10/31 11:11:22.846;-1.3978271;-9.915283;-0.97676086
2017/10/31 11:11:22.867;-1.2347717;-10.162842;-0.8089447
2017/10/31 11:11:22.886;-1.2347717;-10.003357;-0.637558
2017/10/31 11:11:22.907;-1.3168945;-9.918854;-0.2900238
2017/10/31 11:11:22.928;-1.3621216;-10.08786;0.07060242
2017/10/31 11:11:22.946;-1.2859497;-10.366364;0.27650452
2017/10/31 11:11:22.965;-1.1645508;-10.548462;0.47288513
2017/10/31 11:11:22.986;-1.1502686;-10.774597;0.8275604
2017/10/31 11:11:23.006;-1.1538391;-10.895996;1.1631927
2017/10/31 11:11:23.024;-1.165741;-10.732941;1.3048248
2017/10/31 11:11:23.044;-1.249054;-10.367554;1.0798798
2017/10/31 11:11:23.064;-1.3145142;-9.936707;0.9358673
2017/10/31 11:11:23.084;-1.3930664;-9.653442;0.76805115
2017/10/31 11:11:23.104;-1.5834961;-9.25235;0.69664
2017/10/31 11:11:23.123;-1.9441223;-9.070251;0.3443451
2017/10/31 11:11:23.143;-2.358307;-9.057159;-0.03175354
2017/10/31 11:11:23.163;-2.4773254;-9.035736;-0.39118958
2017/10/31 11:11:23.183;-2.4213867;-8.856018;-0.54234314
2017/10/31 11:11:23.202;-2.3249817;-8.665588;-0.50782776
2017/10/31 11:11:23.223;-2.308319;-8.696533;-0.46498108
2017/10/31 11:11:23.241;-2.6380005;-8.877441;-0.57566833
2017/10/31 11:11:23.262;-2.897461;-8.860779;-0.73158264
2017/10/31 11:11:23.282;-2.8034363;-8.944092;-0.3888092
2017/10/31 11:11:23.302;-2.6844177;-9.057159;-0.11506653
2017/10/31 11:11:23.321;-2.6713257;-9.25116;0.07060242
2017/10/31 11:11:23.341;-2.7474976;-9.464203;0.15986633
2017/10/31 11:11:23.366;-2.7201233;-9.468964;0.09916687
2017/10/31 11:11:23.382;-2.6249084;-9.4808655;0.12059021
```

Fig. 11. Excerpt from an acceleration.csv file

Floor capacitance data

The UJAmI SmartLab has a SensFloor®[9] that consists of a suite of capacitive sensor that lie below the floor.

The floor of the UJAmI SmartLab is formed by 40 modules that are distributed in a matrix of 4 rows and 10 columns. A module is composed of eight sensor fields, each sensor in a module is associated with an id-number. The layout of the SensFloor in the UJAmI SmartLab is presented in Figure 12 together with an example of the id-numbers in two modules.

[9] http://future-shape.com/en/system/)

Fig. 12. Layout of the smart floor in the UJAmI SmartLab.

The files named YYYY-MM-DD-T-floor.csv contain the following fields:

- TIMESTAMP: This indicates when the capacitance data of a module is collected
- DEVICE: Identifies a module, per row and per column of the floor matrix
- CAPACITANCE: Values of the 8 sensors of a module when the capacitances change. The first value is for the sensor with the id-number 1 and the last sensor is with the last sensor with the id-number 8.

Figure 14 presents an excerpt from the file YYYY-MM-DD-T-floor.csv.

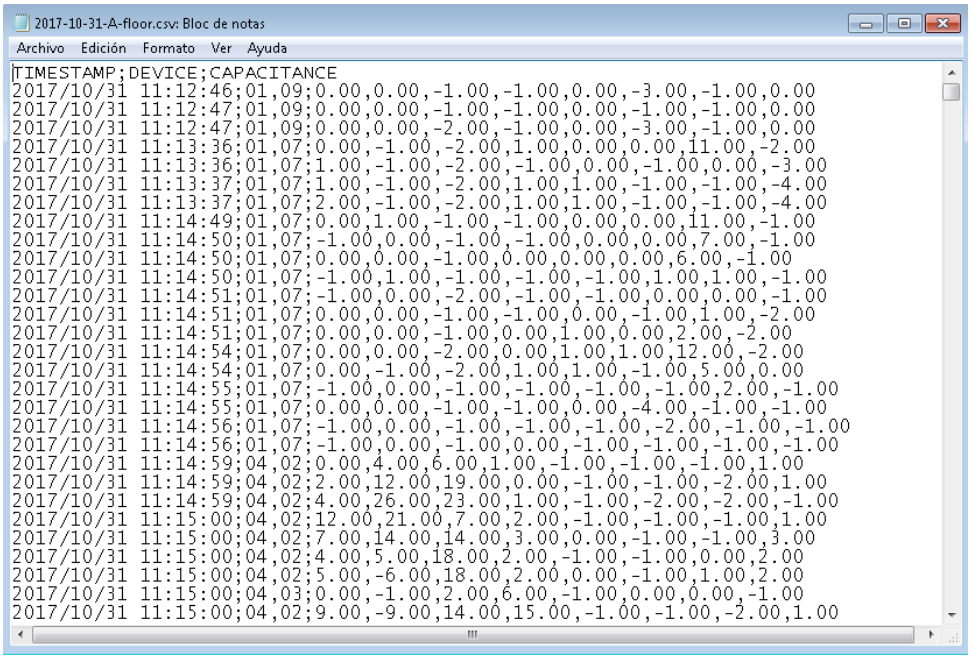


Fig. 14. Layout of the smart floor in the UJAmI SmartLab

In the folder “UCAmI Cup\Layout\” a file named “floor.png” can be found that shows the layout of the smart floor in the UJAmI SmartLab and a file named “floor-modules.png” that shows the layout of the smart floor in the UJAmI SmartLab with the ID of the modules.