DESCRIPTION OF UMA MOBILITY DATASET

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Abstract. This document describes the files containing the mobility traces generated by a group of 17 experimental subjects that emulated a set of predetermined ADL (Activities of Daily Life) and falls. The traces are aimed at evaluating fall detection algorithms and can be freely downloaded from:
http://webpersonal.uma.es/de/ECASILARI/Fall_ADL_Traces/UMA_FALL_ADL_dataset.html

1. Description of the testbed

The experimental testbed was developed by Jose Antonio Santoyo-Román for his Msc. Thesis (presented in June 2016), which was supervised by Eduardo Casilari, associate professor in the University of Malaga (Spain).
During the execution of the movements, the subject transports a network consisting of five wireless nodes: an Android smartphone (which is located in a trouser pocket) and four motes attached to different parts of the body (ankle, wrist, chest and waist) through elastic bands, as it is illustrated in Figure 1.

Fig.1. Location of the sensors (red arrows) and the smartphone (green arrow)

The motes were implemented in SimpleLink Multi-Standard CC2650 SensorTag units of Texas Instruments, which are provided with a Bluetooth Low Energy (BLE) interface and a multi-chip MPU-9250 module by InvenSense, housing a tri-axis accelerometer, a triaxial gyroscope and a magnetometer.
During the tests, two different smartphone models were employed. The models and characteristics of the built-in accelerometers are presented in Table 1.

Smartphone Model	**Integrated Accelerometer**	**Range**	**Resolution**
Samsung S5	*MPU6500 (Invensense)*	$\pm 2\ g$	$6.103515 \cdot 10^{-5}\ g$
LG G4	*LGE Accelerometer (BOSCH)*	$\pm 16\ g$	$1.213651 \cdot 10^{-4}\ g$

Table 1. Characteristics of the employed smartphones

The orientation of the sensors (SensorTag and Smartphones), which is sketched in Figure 2, was the same for all the experiments. The picture indicates the orientation of the sensors for the five considered locations when the subject's body is standing up with the hands down. In the case of the wrist, x-axis is parallel to the arm length.
Please remark that in the measurements captured by SensorTags x-axis represents the direction that is perpendicular to the floor while for the smartphone the equivalent axis is y-axis.

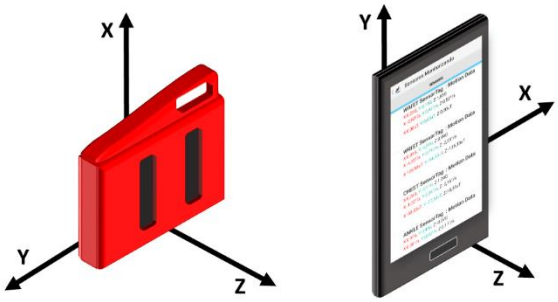

Fig.2. Orientation of the onbody sensors during the experiments

All the experiments were executed in a domestic environment (see pictures in Figure 3), including a bedroom (A), a living room (B) and scales in an apartment block. Falls were mimicked on a mattress on a terrace.

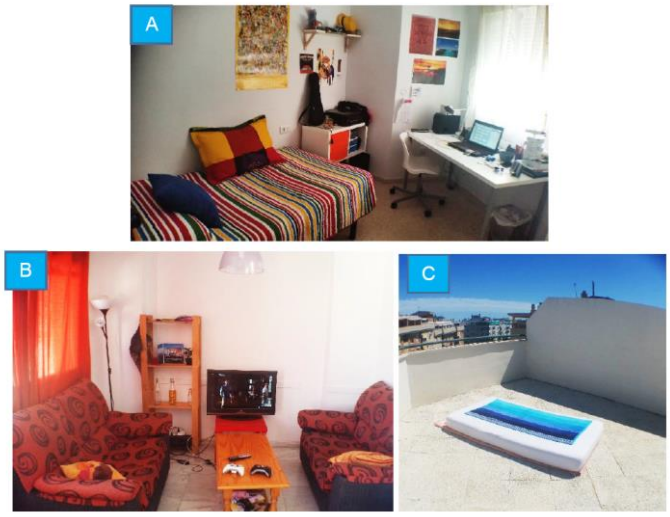

Fig.3. Domestic environment where the experiments took place

In the deployed architecture, as soon as every experiment is initiated, the four Sensortags and the Smartphone activate their embedded mobility sensors (accelerometer, gyroscope and magnetometer), which periodically capture the corresponding magnitude. The sampling rate in the smartphone was fixed to 200 Hz, while the employed rate in the SensorTags was 20 Hz.
The program running in the SensorTags sends via BLE the captured samples to a specific app running in the smartphone. The app, which was specifically designed for the testbed, is in charge of storing the measurements transmitted from the four Sensortags as well as those captured by the smartphones. For every received sample, the smartphone associates a timestamp and the Bluetooth MAC address of the mote that transmitted it. For each

experiment, all the samples from the five mobility sensors (the four SensorTags and the smartphone) are stored in a CSV (Comma Separated Value) file.
Thus, each CSV file includes the measurements of the 5 sensors for a single movement (ADL or fall) executed by a particular subject. All the movements are monitored during 15 seconds.
The whole dataset includes 528 files, which are compressed in the file: *UMA_ADL_FALL_Dataset.zip*.
The typology of the executed movements can be visualized in a set of videos which can be downloaded from the same Web page of the traces.

1. Information of the CSV file names

The name of the CSV file with the traces indicates:
-The **numerical ID** of the subject (from 1 to 17) that executed the movement. The personal features (gender, Age, Height and Weight) of each subject are presented in Table 2.
-The **type** of the movement (ADL or FALL).
-The **subtype** of movement (typology of the ADL or fall). The samples include 9 different typologies of ADLs and 3 different types of falls.

- Types of Executed ADLs: 1) normal walking, 2) light jogging, 3) body bending, 4) hopping, 5) climbing stairs (up), 6) climbing stairs (down), 7) lying down and getting up from a bed, 8) sitting down (and up) on (from) a chair.
- Types of Emulated Falls (on a mattress): 1) lateral, 2) frontal 3) backwards)

-The number of the **trial** of the same type and subtype executed by that user (as long as subjects may repeat every movement up to 18 times).
-The **date** (year, month, day) and time (hour,min, sec.) in which the experiment was conducted.

Subject ID	Gender	Age	Height (cm)	Weight (kg)
Subject 01	Female	22	167	63
Subject 02	Male	27	173	90
Subject 03	Male	23	179	68
Subject 04	Male	24	175	79
Subject 05	Male	28	195	81
Subject 05	Female	22	167	57
Subject 07	Male	55	170	83
Subject 08	Male	19	178	68
Subject 09	Male	26	176	73
Subject 10	Female	51	155	55
Subject 11	Female	14	159	50
Subject 12	Female	22	164	52
Subject 13	Male	26	179	67
Subject 14	Male	21	173	77
Subject 15	Female	27	166	66
Subject 16	Male	24	177	66
Subject 17	Female	23	163	93

Table 2. Personal features of the experimental subjects.

3. Content of the files

Header. Every CSV file begins with a header describing the characteristics of the experiment: the features of the Subject, the type of movement (ADL, fall), a Boolean value indicating if the experiment corresponds to a fall, the movement subtype, the number of the trial, the number of employed sensors (5), the characteristics of the employed accelerometers and the Bluetooth MAC addresses, ID and location of the five nodes that integrate the network (the smartphone and the four SensorTags). The header
All the lines in the header begins with the character '%'.

Traces

After the header, every line in the files corresponds to a measurement captured by a particular mobility sensor of a determined node (mote or SensorTag).

The format of the lines, which is also explained in the file header, includes 7 numerical values separated by a semicolon:

-The time (in ms) since the experiment began.

-The number of the sample (for the same sensor and node).

-The three real numbers describing the measurements of the triaxial sensor (x-axis, y-axis and z-axis). The units are g, °/s or μT depending on whether the measurement was performed by an accelerometer, a gyroscope or a magnetometer, respectively.

-An integer (0, 1 or 2) describing the type of the sensor that originated the measurement (Accelerometer = 0 , Gyroscope = 1, Magnetometer = 2)

- An integer (from 0 to 4) informing about the sensing node (the correspondence between this numerical code and the Bluetooth MAC address and position of the motes is described in the file header).

The lines are ordered following the source (sensor/mote) of the samples. So, the lines corresponding to the samples for the same sensor and mote are presented at a stretch. So, two samples from different sensors and/or motes that were measured at the same time are separated in the files.