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Research and Innovation Action

CANTO

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Deliverable 4.2
User Profile Repository (Final)

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Authors: Maurizio Marchese (UNITN), Marcelo Dario Rodas Britez (UNITN), Ivo Ramos (ATOS), Ingo Brauckhoff (ATOS)
Internal reviewer: Andrew McNeil (Northumbria)

Dissemination Level		
DEM	Demonstrator	**X**
CO	Confidential, only for members of the consortium (including the Commission Services)	

Contents

Executive Summary

This document describes the final implementation of the user profile repository based on the evolution of the user profile model developed in WP2. The user profile intends to centralize data coming from different sources: data coming from personal information, preferences, interests, health status, mobility constraints, and information about previous activities. A second source of data is the measurements provided by the sensors and monitoring data collected in the ACANTO Cyber Physical Social Network (CPSN). In this last implementation of the user profile model specific entities have been extended or added to capture and store both data sources. More specifically the main additions between the preliminary and final version of the user profile repository have been the design and implementation of novel dynamic entities in the final version of the model, namely: (i) Mobility Record to store data coming from ACANTO CPSN; (ii) the refinement and evolution of Tags entity; (iii) the design and implementation of the Circle entity; (iv) the implementation of the IS_MEMBER relationships and (v) the implementation of the LIVES_IN relationships.

In section one, we present and describe in some details the evolution and final definition of the user profile model based on the last version presented in the related deliverable 2.4 "*User, activity and environmental description: Final release models for user, activity and environment*". Our focus here is mainly related to the design and implementation of the novel and extended entities.

In section two, we present the evolution of the architecture and data flow of the Cyber Physical Social Network (CPSN) and the technologies used to implement the user profile repository. The implemented models presented in this deliverable are a part of the on going software engineering work and may undergo changes during the evaluation phase. However, all foreseen components are now available to be used and evaluated in realistic settings and use cases.

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1. User Profile Model (Final version)

1.1. Evolution of the User Profile Model

The user profile repository has been implemented in the present task 4.1 based on the last version of the user model presented in the related deliverable 2.4, "*User, activity and environmental description*" [1]. For more details about the final user profile model, please see the specific deliverable 2.4.

The user profile model is the general description of the data representation and relationship for the users of the system. The user profile aims to collect data coming from different sources such as personal information, preferences, interests, mobility constraints and previous social activities. This static part of the profile model – described in detail in Deliverable 4.1 "*User profile repository (preliminary)*" [2] – has been enriched by the ability to include dynamic data mainly obtained through

(1) a systematic collection of electronic information and continuous observations obtained real-time by WP3;

(2) the continuous evolution of personal information about social, cultural, commercial interests and preferences

The main components of the user profiles are the personal information (first name, family name, complete name, birthday, civil status, the social profile (likes, dislikes and preferences), the mobility profile (constraints and prescriptions) and the mobility data coming from the sensors of WP3. They are described in the diagram included in Figure 1. The diagram uses a style similar to the UML class diagram, but actually reflects the graph database schema. The similarity is useful since *orientDB* [3] describes its schema with classes as well. The color-key to the diagram is:

- light blue = vertices
- green = edges,
- light red = embedded documents
- purple = indices

A number of initial user profiles have been generated after answering to the initial questionnaire and can be evolved subsequently with information provided by formal caregivers, relatives and medical doctors.
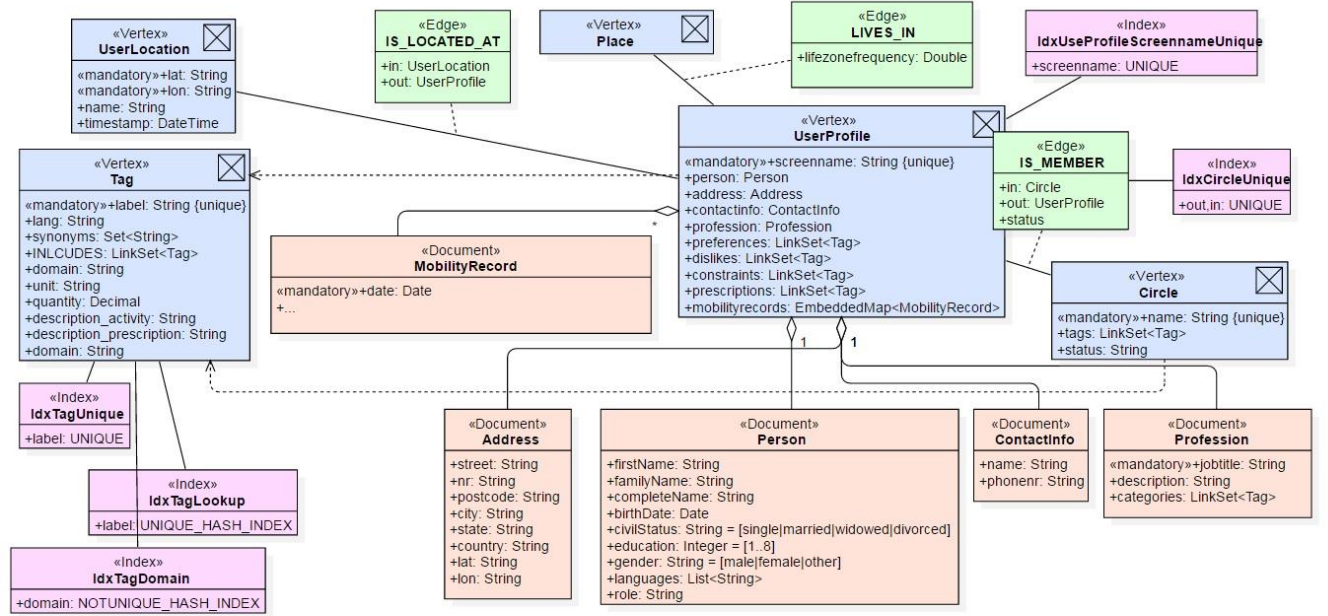
Figure 1: User profile schema

With respect to the preliminary user profile model and implementation presented in D4.1 "User Profile Repository (Preliminary version)" [2], the main work done in the past months – and reported in this deliverable – is related to the design and implementation of the novel dynamic entities in the final version of the model, namely:

- <Document> Mobility Record
- <Vertex> Tag
- <Vertex> Circle

And the following relationships:

- <Edge> IS_MEMBER
- <Edge> LIVES_IN

In the following section we will present and discuss in some detail the above novel entities.

<Document> Mobility Record

The **MobilityRecord** structure is embedded into the *UserProfile* as a Map (*mobilityrecords* property) whose keys state the date of the day the record is related to in '`yyyymmdd`'-format. The linked document of class *MobilityRecord* has a property *date* which matches the key of the Map.

The **MobilityRecord** entity will store the various indices coming from the User State Model developed by WP3. This information will be used to derive some statistics as well as enrich dynamically the information used for the recommendation systems (for circles and for activities). The User State Model aims to capture, condense and evaluate the plurality of data collected by the different user-centric sensing devices and methods identified by WP3, in order to deliver semantically meaningful information that will help the activity evaluation as well as future recommendations.

In brief (more details in D3.2 [4]), the data stored in the **MobilityRecord** entity will include:

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- **Activity Index**: based on a number of inputs from collected data (e.g. steps, climbed floors, active versus non-active time, burned calories per day, current heart rate, the Activity Index will merge them into a numerical value from 0 (non-active) to 10 (very active)
- **Vigilance Index**: based on sleep quality, arousal (from eventual camera set-up) gait analysis, "vigilance" is also represented by a numerical value from 0 (non-alert) to 10 (highly alert)
- **Stress index**: based on time asleep, time awake between sleep cycle, arousal and pain (from eventual camera set-up), current heart rate, walking speeds etc., "stress" is also represented in our *MobilityRecord* by a numerical value from 0 (calm) to 10 (stressed)
- **Physical indication** is connected to both Vigilance and Stress index and will initially mainly focus on high current heart rate and inconsistent gait. Again, the monitored information will be merged into a numerical value from 0 (no indication) to 10 (alert for physical indication)
- **Emotional Balance** is defined in D3.2 as a feeling of personal well-being without considering short term "Physical indication". Again, the monitored information will be indicated as a numerical value from 0 (unstable) to 10 (relaxed).

As soon as the data collected in WP3 will be available, they will be imported and stored in this *MobilityRecord* entity in the User Profile.

<Vertex> Tag

Tag nodes: throughout the ACANTO system we are using *tags* to classify or categorize the nodes they are linked to, and therefore tags provide a semantic layer in our knowledge repository. Specifically, they are used by the recommender systems to match comparable **UserProfile**s, group them into **Circle**s or find appropriate **Activities** for a given user or circle of users. The important feature about them is their concise way to describe an activity or a person with just one or two words, easily to understand and interpret and most importantly, to limit the amount of different descriptions used to a smaller and controllable vocabulary.

The final properties of the Tag nodes have been reported in D2.4 [1]. We include them again here for completeness in the following table:

label	**String**	the name of the tag, semantic purpose
lang	**String**	the language in which the label is given; optional
synonyms	**Set<String>**	collection of labels with the same meaning
domain	**String**	a domain name to separate different applications of tags, defaults to "" (empty) as free domain and can take value "mobility" for use with the mobility profiling system.
description_activity	**String**	**mobility domain only**: an explanatory description for the tag, in contrast to the concise way of the label. This description will be used when tagging *Activity* nodes.

description_prescription	**String**	***mobility* domain only**: an explanatory description for the tag, in contrast to the concise way of the label. This description will be used when tagging *UserProfile* nodes.

As an example of a practical use of the tag nodes, we show in Table 1 some examples of "preferences" tags used in the synthetic dataset of ca. 30.000 user profiles used for testing the ACANTO users' circles recommendations system in D4.6 "User communities' creations based on user's profile matching (dynamic and adaptive profile)" [5].

rid	label	num
#22:10	Fishing	16565
#24:27	Sewing	11964
#24:21	Painting	6755
#23:27	Card and board games	6690
#22:20	Scrapbooking	6689
#24:28	Dances	6678
#21:29	Educational programs	6632
#21:10	Exercise, yoga or tai chi classes	6626
#22:2	Picnics	6606
#22:28	Photography	6591
#22:30	Trips	6590
#22:4	Treasure hunts	6588
#21:1	Lectures	6578
#23:22	Drawing	6574
#22:12	Arts and crafts	6540
#22:11	Gardening	6519
#24:18	Knitting	6506
#23:19	Crocheting	6506
#22:1	Support services and resources for seniors	6503

Table 1 Example tags from the synthetic dataset

<Vertex> Circle

Circles are used to group *UserProfile*s in clusters of user profiles with common affinity (preferences, mobility profiles, etc.) and state only the name and most prominent grouping features. The grouping is realized by connecting one or more *UserProfile* nodes to the *Circle* node through **IS_MEMBER** edges. A *UserProfile* can be part of a *Circle* only once – this is guaranteed by the unique index **IdxCircleUnique**, which is generated on the *in* and *out* properties of the *IS_MEMBER* edges.

A first implementation of the **Circle** entity has been described in D4.6 [5]. Circles are first generated automatically between people with compatible profiles and with common interests. Then they evolve through the interaction of the involved users and the data collected during and after the activities (feedbacks, evaluations, etc.). At present the current circles recommendation implementation uses an artificial dataset of ca. 30.000 static user profiles specifically created for our testing purposes. The results of our circle recommendations are input to the Social Network for further interactions with the users and to the social activities recommendation systems from Task 4.4 and detailed in Deliverable 4.8 [6].

Table 2 shows a generic exemplar, presented in D4.6 [5] and presented also here for description purposes - of a recommended Circle of 5 users (in order to be easily readable), using the full

population output of a given clustering execution on the above mentioned 30.000 static user profiles dataset.

The name of the Circle is defined by the first two more frequent preferences tags in the cluster (in the following example: Exercise, yoga or tai chi classes + Scrapbooking).

Then in the table we report the preference information for each of the 5 users, including the overlap percentage in this specific case among the personal preferences tags of the 5 users.

Please note that the majority of the data presented in table 5 are internal data for the recommendation system. Only some of them will be accessible and visualized to the final user in the appropriate graphical user interfaces developed in WP6

Table 2. Example of a generated Circle

Circle Information (Circle number 34):
• Name = Exercise, yoga or tai chi classes-Scrapbooking circle • Total number of users = 5 • Total number of used preferences = 12 • Total number of not used preferences = 34
Preferences Information of one element (User #37:38) of the Circle (size=5): • Preferences and percentage of users with this preference: 1. Scrapbooking=100%; 2. Exercise, yoga or tai chi classes=100%; 3. Educational programs=80%; 4. Treasure hunts=60%; 5. Card and board games=20%;
Preferences Information of one element (User #37:85) of the Circle (size=5): • Preferences and percentage of users with this preference: 1. Scrapbooking=100%; 2. Exercise, yoga or tai chi classes=100%; 3. Treasure hunts=60%; 4. Photography=20%; 5. Support services and resources for seniors=20%;
Preferences Information of one element (User #37:471) of the Circle (size=5): • Preferences and percentage of users with this preference: 1. Scrapbooking=100%; 2. Exercise, yoga or tai chi classes=100%; 3. Educational programs=80%; 4. Knitting=20%; 5. Sewing=20%;
Preferences Information of one element (User #37:553) of the Circle (size=5): • Preferences and percentage of users with this preference: 1. Scrapbooking=100%; 2. Exercise, yoga or tai chi classes=100%; 3. Educational programs=80%; 4. Trips=20%; 5. Lectures=20%;
Preferences Information of one element (User #37:697) of the Circle (size=5): • Preferences and percentage of users with this preference:

1. Scrapbooking=100%;
2. Exercise, yoga or tai chi classes=100%;
3. Educational programs=80%;
4. Treasure hunts=60%;
5. Painting=20%;

<Edge> LIVES_IN

Another dynamic element of the last version of the user profile is the collection of dynamic location data using smart phones – provided that the users install a specific app for geolocation - developed in ACANTO for testing purpose - and agrees on the sharing of their position data - and used to define "life zones", i.e. regions inside the environment in which prominently the users carry out their daily social activities.

This information is captured in the Environment model that represents the definition of the "life zones", and is related to a particular User Profile that is stored as <Edge> LIVES_IN in the KnowledgeBase as indicated in Figure 2. For more details on the Environment and definition of LifeZones, please refer to deliverable 2.4 [1].
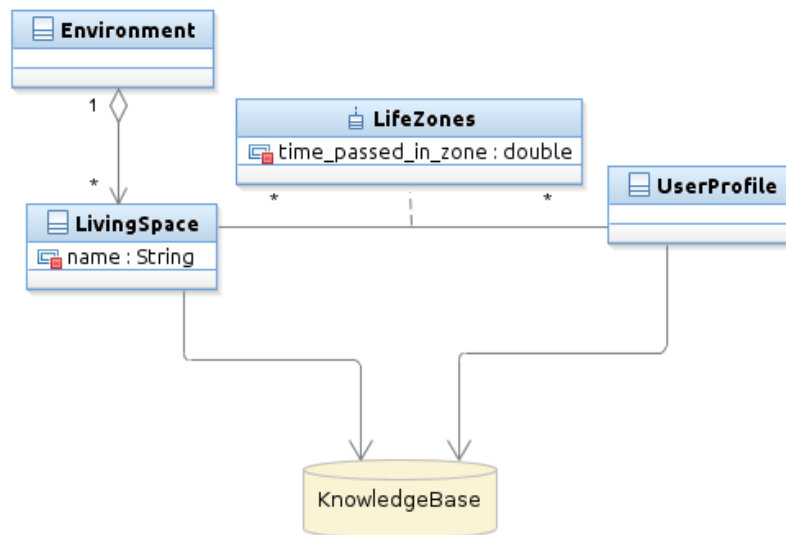

Figure 2: Life zones, users profile and their connection with the knowledge base

2. User Profile Repository (Final version)

2.1. ACANTO Overall CPSN System Architecture

The User Profile Repository is a component of the overall ACANTO CPSN infrastructure depicted in Figure 3. In fact, one of the purposes of the proposed concept in ACANTO of the Cyber Physical Social Network (CPSN) is to support the creation and evolution of a community of users. The user information is collected within the CPSN, specifically in both – the Liferay community engine and the Environment (via sensor data and evaluation of the activities) – and stored in the KnowledgeBase. The physical observation results will be combined with information provided initially by the user to bootstrap the recommendation systems.

Figure 3 shows the main components of the developed ACANTO CPSN Infrastructure Architecture where the UserProfile Repository is maintained. The UserProfile repository, as well as the CPSN Architecture and Data Flow, did not undergo any changes since the last version presented in D4.8 – "Social Activities Recommendations" [6]. In particular, the UserProfile Repository is related to component 1 in the figure, i.e. LifeRay community engine for static data collected at registration and updated during the lifecycle of the social network activities, and component 6 in the figure, i.e. data ingestion from diverse sources.

We consider that the repetition of the detailed description of the CPSN Architecture and Data Flow would not be needed. For further details, we recommend reading the description in D4.8 – "Social Activities Recommendations" [6].

A first synthetic dataset of ca. 30.000 user profiles has been created in D4.8 [1] and used in both D4.6[5] and D4.8[6] for testing the overall architecture and recommendation systems (circle recommendations and social activities recommendations).

In order to get more "realistic" data we have also created a "User profile" form and have circulated it among our project partners, especially universities (UNITN, UNAN). The idea is to create a set of realistic user profiles with locations around Madrid, Trento and Northumbria in order to feed the system while waiting from real data from WP8. A screenshot of this "User profile" form is provided in the annex of this document.
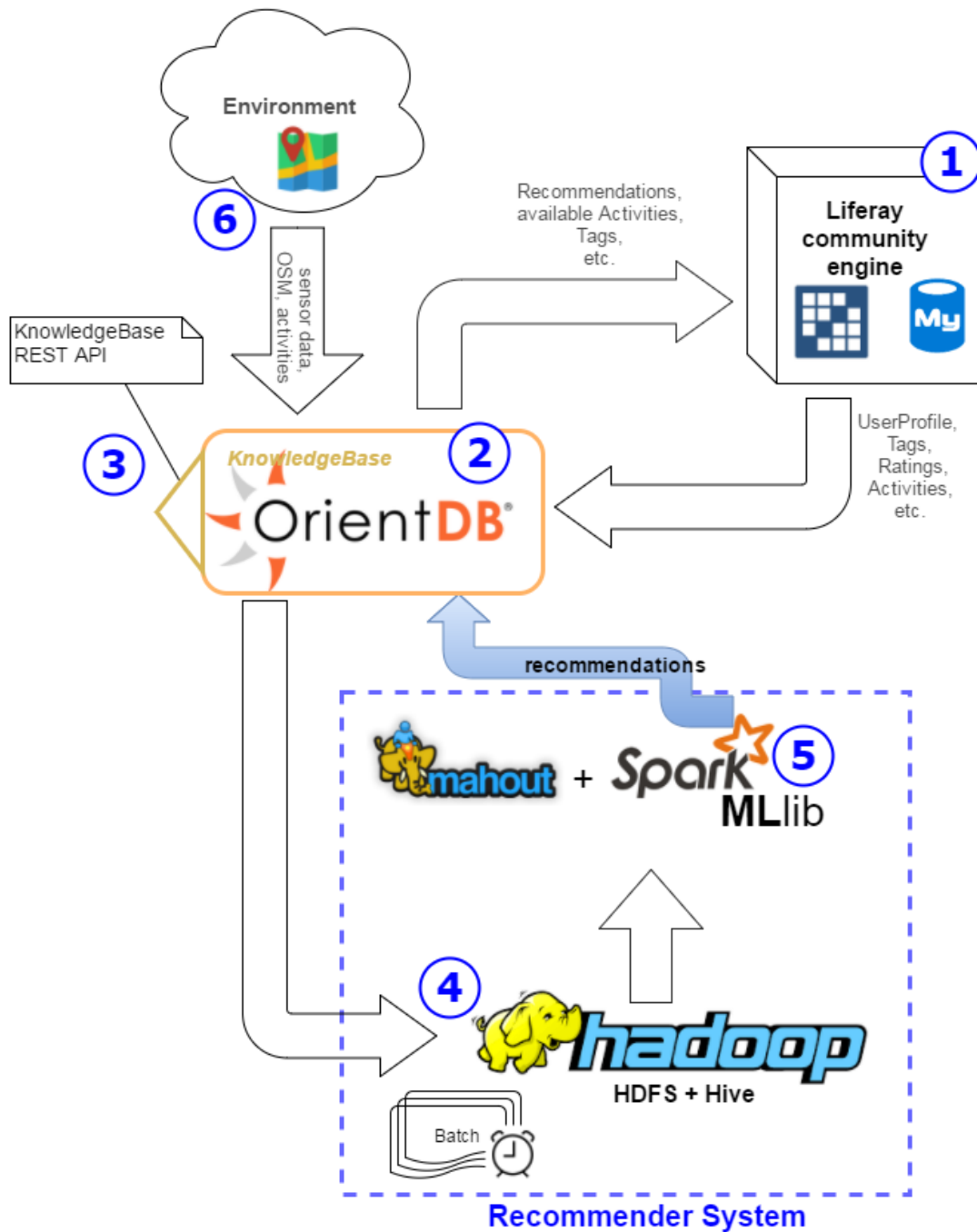
Figure 3. Architecture of the ACANTO CPSN, and main Data Flow streams.

The current infrastructure shown in Figure 3, provides a number of tools and User Interfaces (in particular the Liferay component) to create, edit, update, delete as well as view the current repositories (e.g. user profiles) and related data. As an example we present in Figure 4 a screenshot from Liferay Dashboard of the list of circles for a specific user.

However, it is important to underline that the developed IT cloud infrastructure is designed to provide a number of services that will be used by the specific User Interfaces of the ACANTO applications that will run for instance in the FriWalk/FriTab prototypes. The current user interfaces and related dashboard are only used for internal development and testing environments.
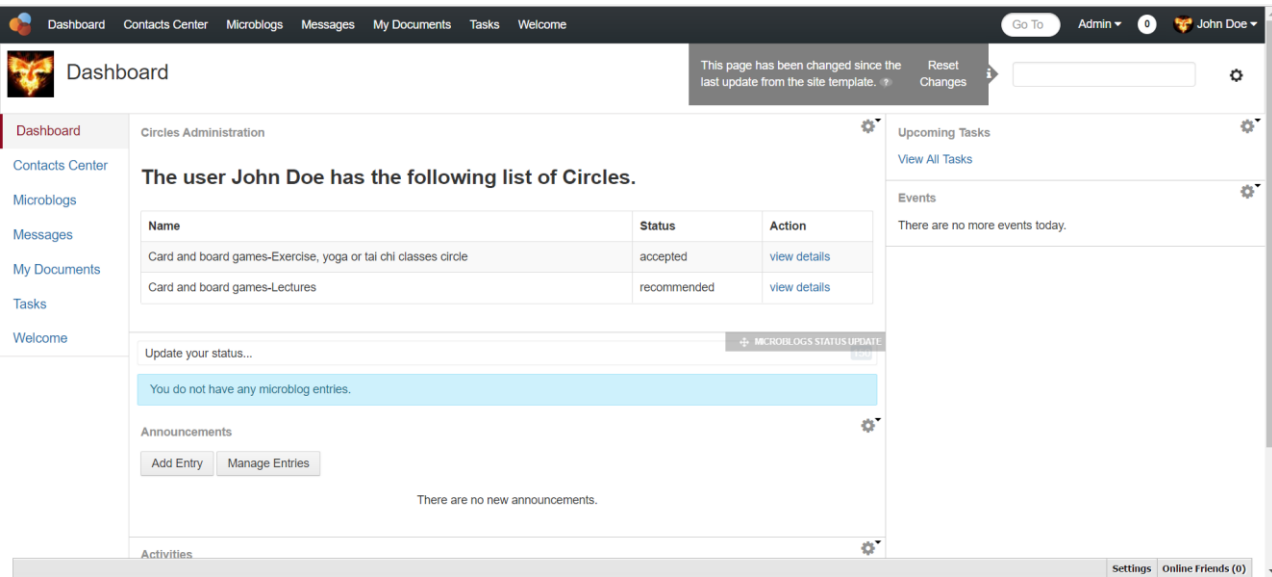
Figure 4: Screen shot from Liferay Dashboard of the list of circles of a specific user

Relation with other work packages

The work of this document is strongly related to a number of other work packages.

It is related to WP1 insofar as it reflects the desire of users to have a system that links them with other users based on similar interests (e.g. requirement 29 in D1.7). Such a system must store their data in a repository to enable this linking, as described in this deliverable.

It is related to WP2 since it implements the evolution of the user profile models developed in D2.4. "*User, activity and environmental description: Final release models for user, activity and environment*". These models will be used as input and output language for the Activity Generator and their attributes are initially provided by the user and constantly updated using the information from the activity evaluator implemented at T4.1 – "User profiles harvesting".

It displays the relevant information stored by WP3 in the Knowledge base and related to the User State Model that captures, condenses and evaluates the data collected by different user-centric sensing devices and methods in order to deliver information that will help the activity evaluation as well as future recommendations.

It is also connected to WP7, more precisely, to task 7.2 "Development and integration of the cloud infrastructure" where ATOS is responsible for the Cloud Computing infrastructure of the functional blocks of the project such as those described at section 2.1 "ACANTO Overall CPSN System Architecture" of the present document.

The final version of the user profile model implemented in this deliverable will also be the basis for testing and evaluation in a real setting in WP8 (see D8.2 for details of this testing).

Conclusion

In this deliverable, we started by detailing the updates made to the user profile model previously presented in the deliverable D4.1. Then we described the final version of the user profile repository capturing both data collected about personal information, preferences, interests, and mobility constraints, information of previous social activities, and data collected from the measurements and monitoring stored in the knowledge base by the WP3.

In section two, the final architecture overview of the repository has been presented, together with the related main data flow and a brief description of the selected technologies to use during the development phase.

The user profile repository has been finally implemented in the cloud infrastructure provided by Telecom Italia.

Ongoing work includes: (i) the population of the user profile repository with initial collected data from the validation test beds developed in WP8 in order to test response time and coverage of the user profiles repository; (ii) the population of the user profile repository with real dynamic information coming from WP3.

Bibliography

[1] L. P. Ivo Ramos et al, D2.4 - User, activity and environmental description: Final release models for user, activity and environment, 2017.

[2] L. P. Ivo Ramos et al, D4.1 - User profile repository (preliminary), 2016.

[3] OrientDB, "OrientDB programming language bindings," 2017. [Online]. Available: http://orientdb.com/docs/last/programming-language-bindings.html.

[4] R.L. Vieru et al, D3.2 User state modelling and collaborative platform localisation: Semantic interpretation of user status and activities based on detailed user models and FriWalk localisation based on multiple modalities and across platforms, 2017

[5] M. Marchese et al, D4.6 User communities' creations based on user's profile matching (dynamic and adaptive profile), 2017

[6] L. P. Ivo Ramos et al, D4.8 Social activity recommendations: Definition of the Social Activities recommendation system, 2017

ANNEX 1
A. ACANTO UserProfile Registration Form

The following pages show the initial UserProfile registration form that has been used to populate a first version of the UserProfile repository with more realistic data.

Acanto UserProfile registration

Dear participant!
In order to acquire a realistic dataset to test our algorithms for the Acanto project we need your help!
Please fill in the questions of this form in a reasonable way with data that would match a real person
- so no Mickey Mouse stuff, please! You can repeat the registration creating a different profile as
often as you wish. We need a minimum of 300 user profiles to work with.

Thank you very much!
The Acanto WP4 development team

*Required

1. **First Name** *

   _____

2. **Last Name** *

   _____

3. **Screenname** *
   a (hopefully) unique login name, for example
   'john23' if first name is 'John'

   _____

4. **Email (a made up address)** *

   _____

5. **Date of Birth** *
   Acanto is about elderly people, but not exclusively, so a year of birth in a range between 1910
   and 1960 should be fine.

   _____
   Example: 15 December 2012

6. **Gender** *
   Mark only one oval.

   ◯ Male
   ◯ Female

7. **Civil Status** *
   Mark only one oval.

   ◯ single
   ◯ married
   ◯ widowed
   ◯ divorced

ACANTO

8. **Education level** *

The level of education following ISCED 2011, see
https://en.wikipedia.org/wiki/International_Standard_Classification_of_Education
Mark only one oval.

- ◯ Pre-primary
- ◯ Primary
- ◯ Lower secondary
- ◯ Upper secondary
- ◯ Post-secondary non-tertiary
- ◯ Short-cycle tertiary
- ◯ Bachelor or equivalent
- ◯ Master or equivalent
- ◯ Doctoral or equivalent

9. **Languages** *

Choose a number (between 1-4) of languages from the list below.
Tick all that apply.

- ☐ Mandarin Chinese
- ☐ English
- ☐ Spanish
- ☐ Russian
- ☐ Portuguese
- ☐ French
- ☐ German
- ☐ Japanese
- ☐ Italian
- ☐ Wu Chinese

10. **Profession (job title)** *

_____

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11. **Profession categories** *

please select a category that applies to this user's profession:
Tick all that apply.

- ☐ Finance
- ☐ Industry
- ☐ Social_Worker
- ☐ Professor
- ☐ Medical_Doctor
- ☐ Dentist
- ☐ Nurse
- ☐ Pharmacist
- ☐ Accountant
- ☐ Architect
- ☐ Engineer
- ☐ Lawyer
- ☐ Police_officer
- ☐ Military_officer
- ☐ Scientist
- ☐ Driver

12. **Mobility Constraints** *

Select 0-3 possible impairments:
Tick all that apply.

- ☐ balance :: user needs more balance activities
- ☐ visually_impaired :: user has poor eyesight
- ☐ hard_of_hearing :: user has poor hearing
- ☐ needs_assistance :: user needs the assistance of someone
- ☐ blind :: user is blind
- ☐ wheelchair :: user is in wheelchair
- ☐ FriWalker :: user needs a FriWalk
- ☐ deaf :: user is deaf
- ☐ toilets_nearby :: user needs to have toilets nearby
- ☐ no_walk_longer_distances :: user cannot walk long distances (must walk less than 1km)
- ☐ walk_longer_distances :: user can walk long distances (more than 1Km)
- ☐ build_muscle_strength :: user needs to build muscle strength

Address

13. **Street Name** *

_____

14. **House Number** *

if no house number is available, please enter 0

_____

23/05/2017   Acanto UserProfile registration

15. **City** *

_____

16. **Postcode** *

_____

17. **Latitude**
decimal number as delivered by Google Maps
[optional]

_____

18. **Longitude**
decimal number as delivered by Google Maps
[optional]

_____

Social profile

19. **Things I like** *
please select a number of 3-6 categories (tags) of things or activities this user prefers:
Tick all that apply.

☐ Museum
☐ Cinema
☐ Walking
☐ Concert
☐ Picnic
☐ Theatre
☐ Table_Games
☐ Fishing
☐ Shopping
☐ Cats
☐ Dogs
☐ Meeting_People
☐ Music
☐ Cars
☐ Motorcycles

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20. **Things I do NOT like**

please select a small number (1-3) of categories (tags) of things or activities this user DOES NOT LIKE:
Tick all that apply.

☐ Museum

☐ Cinema

☐ Walking

☐ Concert

☐ Picnic

☐ Theatre

☐ Table_Games

☐ Fishing

☐ Shopping

☐ Cats

☐ Dogs

☐ Meeting_People

☐ Music

☐ Cars

☐ Motorcycles

Personal relations I [optional]

In this section we try to capture some relations between the fictitious user profiles you have created, such as 'friend', 'family', 'acquaintance' - so we can set up a social network.

21. **related user profile screenname**

Enter the other profile's screenname that is related to this user profile

_____

22. **Type of relation**

Mark only one oval.

◯ acquaintance

◯ friend

◯ family

Personal relations II [optional]

In this section we try to capture some relations between the fictitious user profiles you created, such as 'friend', 'family', 'acquaintance'

23. **related user profile screenname**

Enter the other profile's screenname that is related to this user profile

_____

24. **Type of relation**
Mark only one oval.

( ) acquaintance

( ) friend

( ) family

Personal relations III [optional]

In this section we try to capture some relations between the fictitious user profiles you created, such as 'friend', 'family', 'acquaintance'

25. **related user profile screenname**

Enter the other profile's screenname that is related to this user profile

_____

26. **Type of relation**
Mark only one oval.

( ) acquaintance

( ) friend

( ) family

Powered by

Google Forms