# User-centered social network profiles integration

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Abstract: Large scale online social networks (OSNs) such as Facebook, Twitter, LinkedIn, have become an important part of our every day life. Users are connected to multiple OSNs in which they maintain their different profiles including a lot of personal and social information. As the number of friends of a given user may grow so rapidly, it becomes impossible to manage all updates from friends' profiles to filter relevant information. We present a FOAF-based profiles aggregation model, which is able to align different user profiles available on OSNs into aggregated profiles within a single triple store. The aggregated profiles are then linked together by friend connection. We illustrate the applicability by the presentation of some applications supposed to provide users some effective help in information searching.

## 1 INTRODUCTION

In recent years, social Web sites, Social networking sites and Social media sites, have become extremely popular (Kim et al., 2010). Facebook, Twitter, and LinkedIn are the most well known examples. These OSNs attract millions of connected users by facilitating building relationships, staying connected to friends, family members and work colleagues, finding people who have had similar experiences, discussing common topics of interest.

OSNs' main function is allowing users to set up visible profiles and to link to other individuals' profiles. The user profile is a unique page where one can type oneself and displays an articulated list of "Friends" (Boyd and Ellison, 2007). This page might include frames, where different kinds of information may appear such as user activities (i.e. posts, statuses, tags, messages, etc.). One user may be connected to multiple OSNs and has a lot of friends, not necessarily the same, on each OSN. Thus, numerous personal and social information is available on OSNs.

As the number of Friends may grow so rapidly that it becomes impossible to sort and filter all heterogeneous information from Friends profiles according to the user's current interest. To cope with this problem some cross-system tools have been developed to give users useful information such as recommendation systems (Abel et al., 2011), social search services (Zhou et al., 2012).

In this paper, we explore this idea of the aggregation of user profiles with the objective to provide the user with relevant information aggregated from the user's social networks, which are directly related to his/her current interest. We have first based our work on the Friend of a Friend ontology (FOAF) to model users. This model will be later extended to other standards such as the Relationship Vocabulary or the Dbpedia ontology, to enrich the aggregated profiles.

The paper is organised as follows. In the next section we present work related to the aggregation of user profiles from OSNs. Then we present our *general social user model* and its *FOAF-based profiles aggregation*. We will introduce a *use case* to illustrate the applicability of aggregated profiles. An implementation is also presented in the *application* as a proof of the concepts. Finally, we conclude and present our future work.

## 2 RELATED WORK

Over the last few years, the increasing growth of OSNs leads the distribution of a lot of user data within isolated data silos. A new research challenge then emerged, seeking solutions for sharing and reusing user data available across OSNs.

A relevant related work has been published in (Abel et al., 2010). The author has shown that FOAF can be used as domain specific vocabulary for aggregating user profiles from OSNs. The gathered profiles have been aligned to FOAF by means of hand-crafted

rules, however it has only investigated a reduced number of properties (e.g. name, photos, homepage, etc.).

A new user model, *Social Web User Model*, supposed to be adapted to the needs of the Social Web applications, has been introduced by (Plumbaum et al., 2011). The model has been intended to include the most frequent user dimensions and attributes available in 17 social applications. However, the *social relationship* aspect has been not considered.

Other interesting works focus on some specific aspects of user profiles : (1) Modeling user interests, for example (Abel et al., 2011; Orlandi et al., 2012) by combing user information profiling and the Semantic Web (especially using DBpedia) ; (2) Utilizing user preferences for collaborative recommender systems (Shapira et al., 2012) ; (3) Modelling user expertises and weighting user relationships for social search engine (Zhou et al., 2012), (Vu and Baid, 2012).

In our approach, we extend the profile aggregation proposed in these works to larger public domain applications. We propose therefore a basic common profile model, which can be extended to a more complete profile, in as much as the user has provided an access authorisation to certain protected data. Finally, we intend to link the aggregated profiles together in order to implement more useful applications.

# 3 PROFILES INTEGRATION

In this section, we first introduce our general social user model a at aggregating social user profiles. We then present the FOAF ontology upon which we have based our user profiling. A use case is also included to illustrate the model utility.

## 3.1 General social user model

We have studied the most frequent propertie handled on their respective user profiles from the top social networks : Facebook, Twitter, LinkedIn, Google+ and OpenSocial. We have thus organised them into six dimensions, which are listed below :

- *Personal Characteristics* includes a large range of personal information such as name, current city, email, gender, birthday, photo, etc.
- *Friends* includes connections established between an OSN member and others.
- *Interests* could be a topic (e.g. Social_Networks) or a specific entity (e.g. WEBIST_2013) that the user is interested.
- *Groups* contains information about groups, based on attended school, hobby, interest, cause, profession, etc., in which the user has been involved.
- *Studies* and *Words* describe respectively the school and academic experience and the professional experience of the user.
- *User-created contents* (UCCs) denotes contents posted by users on OSNs. (Kim et al., 2010).

Based on this analysis, we have built a general social user model which aims at facilitating the user profile information aggregation. The model covers the five first dimensions previously described. The UCCs dimension is not included since it only contains raw data. However, it is possible extract from UCCs user's current interests which might enrich the *Interests* dimension over time (Abel et al., 2011). Our user model follows new trends from the *Semantic Web* approaches in social user modelling (Noor and Martinez, 2009; Orlandi et al., 2012). The advantage is that the model is not static and can be easily extended. At the present time, we have mainly based on FOAF for profiling users and linked data (i.e. URI), web resources (i.e. URL), for referencing the entities of interest such as school, location, interest.

## 3.2 FOAF-based user profiling and aggregating

FOAF was first introduced in 2005 (Brickley and Mille, 2005). FOAF makes it possible to build and manage a structured representation of users, the links between them. A FOAF user is described through different properties.

The *FOAF basic* (name, gender, age, birthday, location, email, photo) dimension is the same as our *User personal characteristics* dimension. The "foaf:knows" property allows to describe Friends connections. Our *Interests* dimension can be represented by the "foaf:interests" or "foaf:topic_interest" property. The "foaf:member" property enables to associate a user to a "foaf:group". The user's *studies* and *works* are not really specified in FOAF, but it is possible to define the places of studies and works thanks to two properties "foaf:schoolHomepage" and "foaf:workplaceHomepage" respectively. The Figure 1 shows that FOAF can handle our user profiling in a very simple way but enough representative.

Therefore, based on FOAF our user model can aggregate user profiles available on OSNs to create aggregated profile. Each of gathered information is mapped to a specific FOAF property by means of a set of hand-crafted rules (e.g. Table 1).

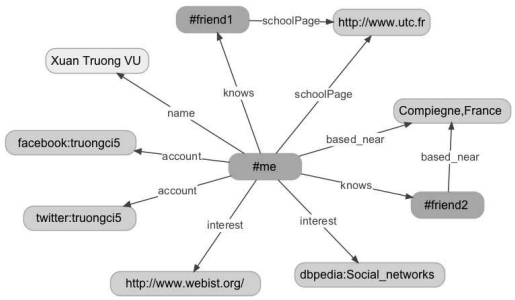


Figure 1: The user #me, named Xuan Truong Vu and based in Compiegne,France, has linked his Facebook and Twitter accounts to his aggregated profile. He is interested in the Social networks and the WEBIST conference. He knows two other users #friend1 who is also at the UTC university and #friend2 who is in the same town.

Table 1: Facebook - Twitter - FOAF mapping rules

| **Facebook User Information** | **FOAF Person Property** | **Twitter User Profile Information** |
|---|---|---|
| User.name | foaf:name | User.name |
| User.username | foaf:nick | User.username |
| User.gender | foaf:gender | |
| User.birthday | foaf:birthday | |
| User.photo | foaf:img | User.profile _image |
| User.location | foaf:based_near | User.location |
| User.friends | foaf:knows | User.friends |
| User.groups | foaf:member | User.lists |
| User.likes | foaf:topic_interest | |

The model has not kept trace of either the provenance nor the adding time of any information yet. Moreover, there may be conflictual values for a given property. In this case, this is the user who decides later, which information should be kept or deleted.

The friends of a user are initially saved as the reduced instances of [foaf:Person] class (only contains a name and a profile page). Some of these friends would be later deduced "owl:sameAs" the users who have created aggregated profiles. Two aggregated profiles will be also linked, if their respective users are friends on at least one social network.

## 3.3 Use case

We illustrate, in this subsection, the applicability of the previous model.

### 3.3.1 Topic-related friends searching

The function required is to suggest the friends from amongst all of a user's contacts, who can give useful information about a given topic. For example, a user intends to attend WEBIST 2013, 9th International Conference on Web Information Systems and Technologies, in Aachen, Germany. The user searches for "Aachen, Germany" and "WEBIST 2013" (the application might also be able to detect this need for information by matching a message posted by the user on OSNs to some predefined pattern). Upon the query reception, the application browses all profiles of the user's friends and looks whether they are linked to any entity whose labels contain "Aachen, Germany" or "WEBIST 2013". The application finds out : (1) two contacts also express their interest in the conference. Moreover, one of them is a work colleague and the other share with the user a same interest for *Social_Networks* ; (2) one contact is based near *Aachen_Germany*. The first kind of information pushes for meetings before, during the conference . The second information, though it is peripheral to the conference, is useful for planning the trip.

### 3.3.2 Topic-related information watching

Conversely to the preceding feature, this is for watching over the user's network in order to filter information that the user may be interested. For example, the user is interested in Web and some of their contacts sharing the same passion. The user has annotated these contacts with a series of tags (e.g. web, technology, system) so that the application follows their profiles and filters any information matching the tags. Suppose that one of these contacts posts on OSNs the link to the WEBIST 2013 conference, the application will detect it and send a notification to the user.

# 4 Application

We present in this section a prototype of our FOAF-based user profiles aggregation. The prototype has been tested with Facebook and Twitter, which are recently the two most popular OSNs. Both of them make it possible for their users to grant selected third-party applications an access to user data via their own APIs. With respect to this policy, the prototype always asks users for permission to access their profiles.

We have used different *aggregators*. Each of them is dedicated to a specific social network and manages the authentication protocols as well as data collection. Only the *basic*, *interests*, and *friends* information are collected. Data is translated into triples before being stored in a triple store type *OpenLink Virtuoso*. We have constructed some generic queries to implement features described in *Use case*.
- Searching for friends who is based near Aachen

```
SELECT ?friend WHERE {
```

```
  <#me> foaf:knows ?friend .
  ?friend foaf:based_near ?town.
  ?town gn:name 'Aachen'. }
```

- Searching for friends who is interested by WEBIST 2013

```
SELECT ?friend WHERE {
  ?friend foaf:topic_interest ?interest.
  ?interest dc:label 'WEBIST 2013'.
  FILTER ( bif:exists ((
  SELECT * WHERE {<#me> foaf:knows ?friend})))}
```

where all aggregated profiles that are linked to an entity whose labels contain 'WEBIST2013', are first retrieved and then only friend profiles are returned.

- Searching for web-related events from right friends

```
SELECT ?interest WHERE {
  <#friend1> foaf:topic_interest ?interest.
  ?interest dc:label ?label.
  FILTER (REGEX (?label, 'web', 'i')).
  FILTER (REGEX (?label, 'conference', 'i')).}
```

The web-based service consists of a personal user interface where the user can choose to connect to their Facebook, Twitter accounts and visualise their aggregated profile with three views *basic*, *interest*, and *friends*. The user can also search friends thanks to a keyword-based search feature. The user's query is translated into a SPARQL query as cited above. For the present time, the prototype is only able to search from aggregated information.

We have tested our prototype with several real users. The size of their merged *friends* list varies from 300 to more than 1000 connections.

# 5 CONCLUSIONS AND FUTURE WORK

In this paper, we have presented a primary social user aggregation based on the FOAF ontology. The FOAF-based user profiling can (1) represent users of OSNs, especially social aspects such as *interests* and *friends*, (2) support the aggregation of user profiles from OSNs, (3) and link aggregated profiles together so that advanced searches could be possible. Our first prototype, implemented for Facebook and Twitter, has shown the applicability of the aggregated profiles. The user is able visualise their aggregated profile and search friends using keywords.

In our future work, we will increase the number of supported OSNs and extend the FOAF-based model to better describe users. Moreover, we plan to utilize global ontologies like DBpedia and Wordnet as a generic cross-domain interest model to enrich and classify the user's interests through different OSNs. It could then be possible to develop more advanced personal recommendation applications in order to evaluate the actual benefits for end-users.

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# REFERENCES

Abel, F., Gao, Q., Houben, G.-J., and Tao, K. (2011). Analyzing temporal dynamics in twitter profiles for personalized recommendations in the social web. In *Proceedings of the ACM WebSci'11*, Koblenz, Germany.

Abel, F., Henze, N., Herder, E., and Krause, D. (2010). Linkage, aggregation, alignment and enrichment of public user profiles with mypes. In *Proceedings of the 6th International Conference on Semantic Systems*, number 11 in I-SEMANTICS '10, pages 11:1–11:8, New York, NY, USA. ACM.

Boyd, D. M. and Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication. doi: 10.1111/j.1083-6101.2007.00393.x*, 13:210–230.

Brickley, D. and Mille, L. (2005). Foaf vocabulary specification. http://xmlns.com/foaf/0.1/.

Kim, W., Jeong, O.-R., and Lee, S.-W. (2010). On social web sites. *Information System*, 35(2):215–236. Spec Section: Context-Oriented Information Integration.

Noor, S. and Martinez, K. (2009). Using social data as context for making recommendations: an ontology based approach. In *Proceedings of the 1st Workshop on Context, Information and Ontologies*, CIAO'09, pages 1–7, NY, USA. ACM.

Orlandi, F., Breslin, J., and Passant, A. (2012). Aggregated, interoperable and multi-domain user profiles for the social web. In *Proceedings of the 8th International Conference on Semantic Systems - I-SEMANTICS '12*, page 41, New York, New York, USA. ACM Press.

Plumbaum, T., Wu, S., De Luca, E., and Albayrak, S. (2011). User modeling for the social semantic web. In *Proceedings of the 2nd Workshop on Semantic Personalized Information Management: Retrieval and Recommendation, in conjunction with ISWC 2011*.

Shapira, B., Rokach, L., and Freilikhman, S. (2012). Facebook single and cross domain data for recommendation systems. *User Modeling User-Adapted Interaction*.

Vu, T. and Baid, A. (2012). Ask, don't search: A social help engine for online social network mobile users. In *2012 35th IEEE Sarnoff Symposium*, pages 1–5. Ieee.

Zhou, M., Zhang, W., Smith, B., Varga, E., Farias, M., and Badenes, H. (2012). Finding someone in my social directory whom i do not fully remember or barely know. In *Proceedings of the 2012 ACM international conference on Intelligent User Interfaces*, pages 203–206, New York, NY, USA. ACM.

[1] http://www.50a.fr/