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An architecture of a Web recommender system using social network user profiles for e-commerce

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Abstract—**In this paper we propose a concept of a web e-commerce system that collects and uses, in the process of making recommendations, data obtained from social network profiles of its users. This architecture modeling approach was developed within the project of a mashup Web application that integrates with Facebook API. We describe which data could be obtained from Facebook, propose the way to store it and suggest how the information from user profile could improve the effectiveness of a e-commerce recommender system.**

I. Introduction

NOWADAYS more and more e-commerce platforms use recommender modules to propose their clients products that they would presumably buy, therefore expecting to increase their sales and incomes. Web e-commerce systems have access only to limited scope of demographic data, which users provide when registering.

These data are insufficient to use most of methods of recommendation. To widen this area, web platforms provide advanced user tracking, gathering all information about user activity in the system like searched phrases and browsed products. With the growing need of knowing more about their clients, e-commerce extends social network marketing and pursues to stay in touch with their clients on social services. Analyzing clients activities on social network services gives e-commerce an opportunity to create more personalized offer and help their clients to cope with huge informational overload problems continuously occurring in Internet shopping.

II. Recommendation Methods

Among many approaches to recommendation problems authors of [6] list most popular methods as follows:

- demographic filtering (DF),
- content-based filtering (CBF),
- collaborative filtering (CF),
- hybrid approach (HA),
- case-based reasoning (CBR),
- and rule-based filtering (RBF).

Modern web e-commerce systems mostly compute recommendations with the use of a hybrid strategy which for the most part is a mixture of three basic strategies called demographic, content-based and collaborative filtering [1, 2].

Demographic filtering is the group of least precise methods [13] that aim to find regularity among profiles of users who like particular object.

In content-based filtering strategy, an object is classified as relevant to a user, if it is similar to objects that, in the past, were recommended to him and accepted by him. System implementing CBF approach builds recommendations by analyzing a set of data previously rated by a given user.

Collaborative recommenders differ from content-based ones in that user opinions are used instead of content. CF approach assumes that an object should be suggested to a user, if it was rated as relevant by a group of users (neighbours) with a profile similar to the given user, provided that it has not yet been rated by him.

Despite the widespread use, above-named methods has two major limitations related to sparsity and scalability [5]. Sparse data environment causes that recommendation methods can't properly identify the products to recommend. Data derived from social network services can extend and enhance input data sets for demographic, content-based and collaborative filtering strategy.

III. Concept of the System

Fig. 1 presents the overview of the e-commerce system integrated with the social network service.

A. E-commerce

E-commerce platform (EC) contains core modules for implementing functionalities supporting the transaction of goods or services through electronic communication. These features include product catalogue, category browsing, product searching, basket and checkouts, online payments, order tracking, etc.

B. Middleware

The architecture of proposed system is obviously distributed, therefore we distinguish the special tier that links core e-commerce module with Facebook web services. This middleware provide an uniform interface for the system to request for data from social network service and send them back to e-commerce system in the proper format, facilitating collaboration of both parts. Acquired data are stored in the profile system within the e-commerce platform.

Fig. 1 Architecture of a Web system integrating e-commerce platform with Facebook

The role of middleware and example of its part in communication between both layers of the system is presented on Fig. 2.

C. Social network service

Facebook, like most of Web 2.0 applications, moves towards Representational State Transfer (REST) based communications. Last year (2010) Facebook introduced new changes within its Open API, implementing the Open Graph Protocol [15] and the next generation of programming interface - Graph API.

Graph API provides developers a set of objects, on which they can operate to search data. This list includes: [14]

- all public posts,
- people,
- pages,
- events,
- groups,
- places,
- checkins.

The API is RESTful, therefore, when the agent has sufficient permissions, it can access to those objects simply by using HTTP request:

```
https://graph.facebook.com/search?
q=QUERY&type=OBJECT_TYPE
```

IV. Profile System

A. Data structure

Fig. 3 presents the data structure model for the profile system. Clients of e-commerce platform who have Facebook account (and decided to provide us access data at registration or later, editing their preferences) and use social network service are additionally stored in *User* table in the profile system. Profile system collects keywords used by client and/or his friends and tries to determine the proper fields of his interests. Gathered keywords can have various context based on user activity in social network service or activity of his friends. All keywords are also categorized by the source of appearance on Facebook (e.g. post, link, comment). Profile

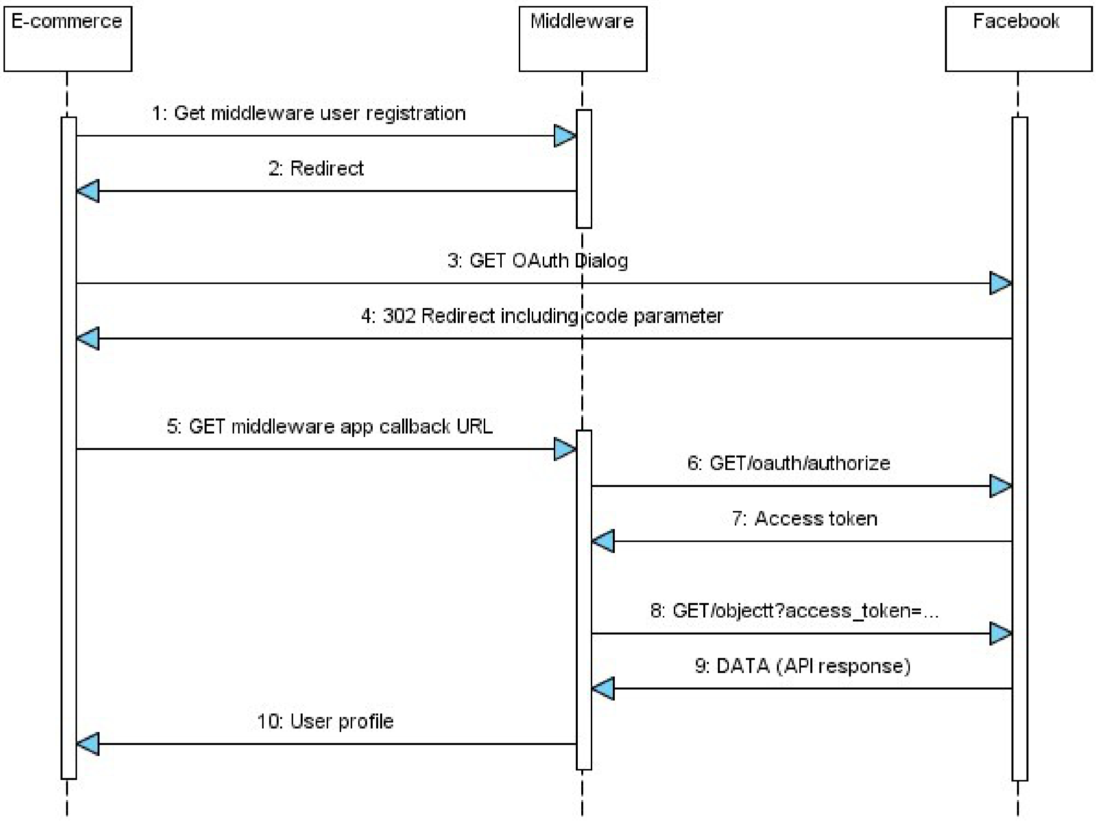

Fig. 2 Communication between tiers in e-commerce platform using Web services

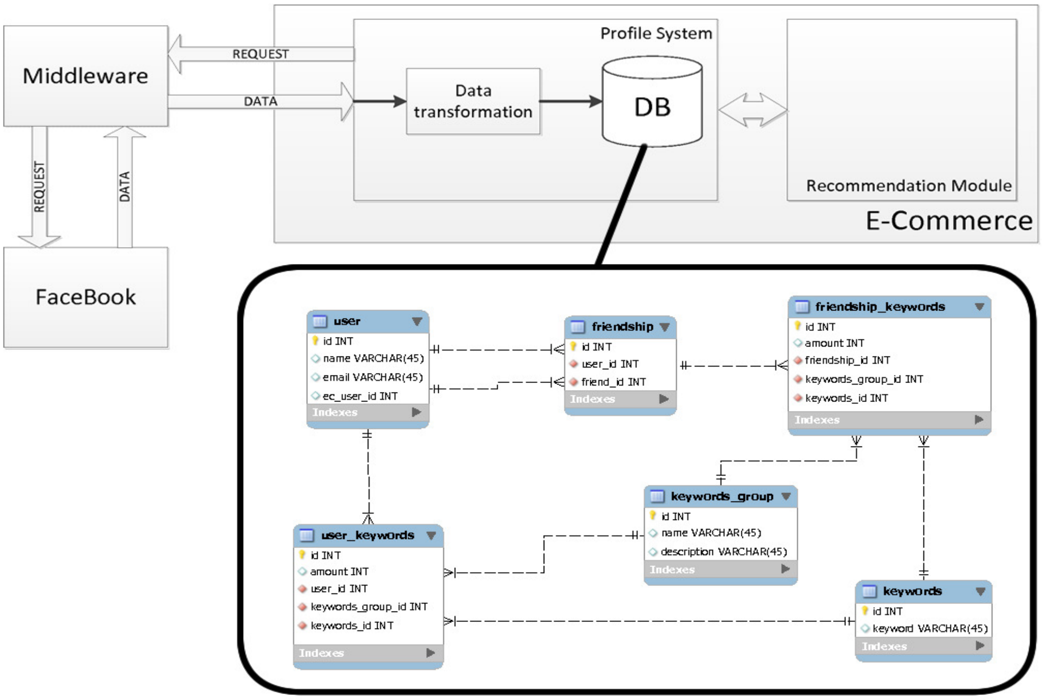

Fig. 3 Database model of profile system in e-commerce platform

system module is connected with the rest of e-commerce aplication by the *ec_user_id* key in *User* table.

In the profile system single client is identified by an email address that is used as a login to Facebook account. This gives us the possibility to automatically recognize, whether the user friends are already registered in e-commerce system. With this information final recommendation process can be improved.

B. Data source

Keywords obtained from Facebook can be categorized by their source of appearance:

- from user posts,
- from links published by the user,
- from comments added by the user,
- from user friends posts that the user likes (marked with *'I like it'*),
- from links published by user friends that the user likes (marked with *'I like it'*),
- from comments added by user friends that the user likes (marked with *'I like it'*),
- from user messages (sent and received).

Each group presented above has its own weight representing significance of occurrence of words from particular group.

C. Web service application

The activity diagram of the middleware is shown on Fig. 4.

At first, the EC platform executes middleware application by sending a request for user data. Middleware makes a series of various Facebook API calls, dependent on how many data source sorts mentioned in part B are available for a given user. After receiving each response, data are parsed from Facebook JSON format and processed. In this process, the combined user profile is being created in a middleware data layer. This temporary scheme reflects the structure required to integrate acquired data with EC user data. When the process is complete, the prepared user profile can be exported from temporary database structure and resend to EC platform in JSON format. This last call could also remotely invoke procedure that will update EC user profile subsystem with the latest obtained data.

D. Technical implementation notes

As it was mentioned earlier, Facebook gives developers access to the RESTful API, therefore the simplest way to obtain data is to invoke the service by HTTP request. Accordingly, any Web development programming language can be used to implement the middleware (e.g. PHP, Ruby, Java, Python). The authors suggest using PHP due to its stable position as a Web programming language on the market and a full support of Web services by language native libraries. Furthermore, as the most of websites are built with PHP, using this language to create own modified implementations of proposed middleware application could help to facilitate development process (e.g. some parts or single functions of data processing algorithms required by the middleware could already exist in EC platform). PHP is a cross-platform language, which can access various databases through consistent interface of PHP Data Objects (PDO) extension [16]. PDO database-specific drivers include i.a. opensource products like MySQL and PostgreSQL as well as commercial databases MS SQL Server and Oracle. However, such abstract interfaces exist in all modern Web programming languages and the use of Web services represent another abstraction layer. Therefore, the proposed architecture of middleware sys-

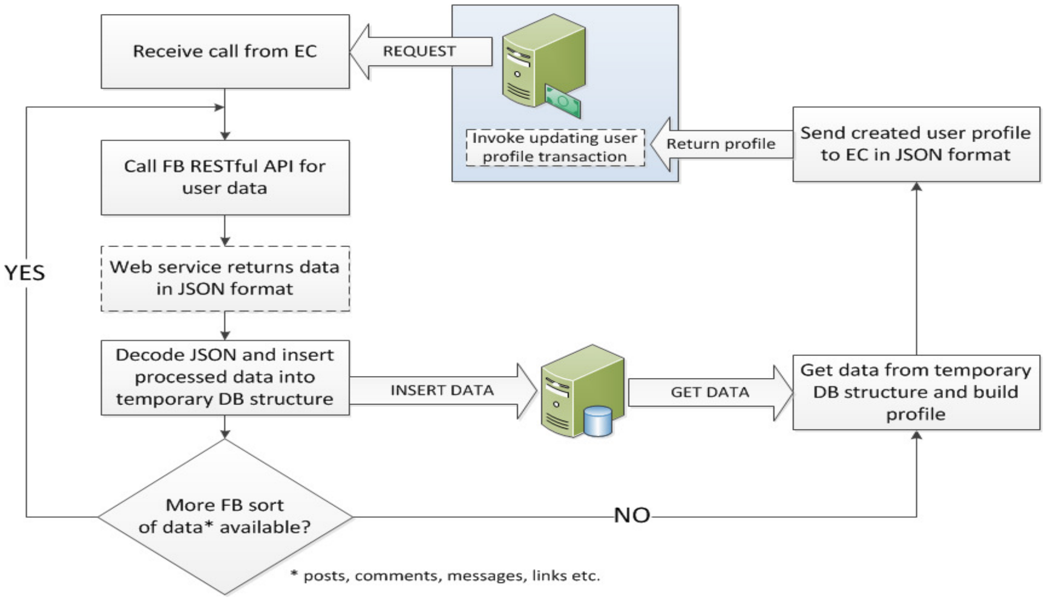

Fig. 4 Web service middleware application activity diagram

tem is flexible and does not require any fixed technical assumption concerning specific programming language and database system used in implementation.

V. Recommendation module in e-commerce system

Proposed system provides list of keywords which add new contexts to data sets. User profiles extended by the data obtained from Facebook are better inputs for demographic filtering.

Information concerning what user likes (objects marked by '*I like it*' on Facebook) can be valuable for content-based approach recommendations.

Due to acquiring information regarding user friends on Facebook relations between users in e-commerce system can be discovered. Basing on those relations, it can be assumed that these users have similar interests. Moreover, this similarity is narrowed down to particular fields of interests based on keywords list in the context of particular friendship. As a consequence, collaborative filtering can be performed on enriched set of data.

VI. Further works

Further works should focus on defining weights for particular groups of keywords. Weights will represent significance of these groups and will have influence on values of keywords in those groups in recommendation process.

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