User Model Ontology in Personalized Search Application for Social Web

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ABSTRACT— ***Personalized search systems and precisely ontology-based ones are increasing nowadays in order to offer personalized search results to users according to their contexts and profiles. In fact, when ontologies are used in these systems, they permit to model knowledge in an understandable manner by human and machine. Social web and especially social network sites permit to people to connect and search for information and for persons. In order to model concepts for the social network, we use concepts from the FOAF ontology. In this paper, we create an ontology for user model in social web and handicraft domain. Then, we integrate it in our personalized search application. We enrich our ontology with SWRL rules and concepts from FOAF ontology. SWRL rules have the power to infer explicit knowledge from implicit one. We apply rules in order to classify handicraft women and to give recommendation according to context and profile of handicraft woman. We give main modules related to our prototype with evaluation and discussion..***

Keywords— User model Ontology, Personalization, Context, SWRL rules, Social network, Handicraft domain

1. INTRODUCTION

Nowadays, we notice the growth of data on the web. This is due to the fact that Web users are not only consumers but also producers. This is remarkably observed on social networking sites, blogs, etc. The advent of the semantic web made it possible to model the data in a structured form using the languages derived from XML as RDF and OWL. The most widely used method is ontology as a tool for the knowledge representation. Indeed, the data will be represented in the form of concepts and relations between them with the addition of some restrictions as cardinality restriction, etc. to keep as much as possible the desired semantics of this representation. Several works have been carried out at the base of these notions as ontology based information retrieval; ontology based personalized information retrieval and personalized information retrieval in social networking sites. We have noted that the authors of these works have relied on the user profile in order to assure personalization but have not well dissected the user context in their studies. In our work, we combined the use of user profile and user context in a unified model which is the user model. The importance of this model lies in the fact that it is designed to be used in an application for a given domain. The representation that we have chosen is based on ontology. This is explained by the fact that it can be enhanced with SWRL[1] (Semantic Web Rule Language) rules serving to reason on these concepts for more customization.

This work is involved in the BWEC (Business for Women of Emerging Country) project that treats handicraft women from Tunisian and Algerian countries. In order to improve the socio-economic situation of these women, an interactive system will be built based on many works. Handicraft women need to perform some tasks in order to achieve their work such as buying raw material and production tool, searching for exposition, etc. In order to model handicraft women profiles and contexts, we proceed to use ontologies. We are based on textual document which are interviews carried out with handicraft women to extract main concepts related to handicraft domain. To represent user model we are based on works from literature like GUMO (General User Model Ontology) [3], UPOS (User Profile Ontology for situation) [8], etc. Although these models are well established, we found that we need our own model. The reason for that is these ontologies are dedicated to one domain for example we can find a user model ontology but without concepts for Handicraft domain or we can find ontology for social network but that did not explicit concepts for user model. Thus, we analyzed these anterior works and we created our own model. Handicraft women in the era of ICT (Information and Communication Technologies) technologies, connect to social network site like Facebook[2]. They search for valuable information concerning some product, provider, etc. For handicraft women, social networking sites can provide many benefits. In

[1] https://www.w3.org/Submission/SWRL/
[2] www.facebook.com

fact, social networking sites act for these handicraft women as a means of promotion and marketing. Handicraft women assume that social media especially Facebook is very efficient, effective and inexpensive in the fulfillment of their requirements. In fact, they consider that through Facebook, they can save a lot more time, effort and cost. Therefore, we exploit some information concerning handicraft women connection and search, in order to return to them pertinent results. Hence, we enrich this model from FOAF (Friend Of A Friend) [1] ontology which contains concepts describing persons and other information. In this paper, we propose a user model ontology for the handicraft domain. Then, we enrich our proposed ontology with concepts from FOAF ontology. For personalization purposes we propose some SWRL rules.

In the rest of this paper, we present some related works in section 2. Then, we present our ontology modeling to explicit knowledge from social network in the context of handicraft domain in section 3. After that, we give the main modules related to the personalized search application that we developed based on the proposed ontology with evaluation, in section 4. We conclude our works in section 5 with giving some perspectives.

2. RELATED WORKS

As we studied some works in literature about ontology-based personalized information retrieval, we can find some works like [13] [14] [17] [9] [15] [10] [16] [12] [11]. Authors, in [13], proposed an ontology-based approach for networking domain related courses on different perspectives like security, performance, and communication. Their networking ontology can be employed in recommender systems to help users to recommend courses related to networking domain after identifying the learner's needs and area of interest. Afterward, a framework, which will use this ontology as knowledge base has been proposed. [14] integrated food, health, nutrition domain ontologies and the user's profile ontology to be used by their semantic Web-based personalized retrieval system based on the user's health conditions and food preferences. [17] proposed a method of personalization based on the combination of domain ontology for information extraction from data sources and the Case Based Reasoning tools for learning and query formulation process. [9] proposed a refined ontological profiling method based on user's information search within a collaborative learning system. According to learners' profiles, the most relevant contributions of other learners will be proposed to them, which will take into account the explicit and implicit interests of the learners and by searching only in similar profiles contributions. [15] introduced an ontology based video recommender system that exploits implicit relevance feedback to capture users' evolving information needs. The system exploits a generic ontology to organize users' interests. [10] proposed and discussed the benefits of the introduction of ontologies for an enhanced representation of the relevant knowledge about the user, the context, and the domain of discourse, as a means to enable improvements in the retrieval process and the performance of adaptive capabilities. [16] presented an approach to personalized search for building ontological user profiles and user context by assigning interest scores to existing concepts in a domain ontology. These profiles are maintained and updated as annotated specializations of a pre-existing reference domain ontology. A spreading activation algorithm is used to maintain and incrementally update the interest scores based on the user's ongoing behavior. [12] presented an application called Semantic Search which is built on supporting technologies and is designed to improve traditional web searching. They provided an overview of TAP, the application framework upon which the Semantic Search is built. They described two implemented Semantic Search systems which, based on the denotation of the search query, augment traditional search results with relevant data aggregated from distributed sources. [11] reported on research that adapts information navigation based on a user profile structured as a weighted concept hierarchy. A user may create his or her own concept hierarchy and use them for browsing Web sites. Or, the user profile may be created from a reference ontology while they browse. Authors investigated the interaction between the user profiles and conceptual search wherein documents are indexed by their concepts in addition to their keywords. Those presented works treat ontology based personalization systems. However, our system differs from these systems by its ability to permit information retrieval through Web and Facebook social network and improving search query by information extracted from their profiles. It differs also by using SWRL rules in the process of personalization and using SWRL custom built-ins in recommendation to handicraft women. The last particularity of our system is the domain of application of the proposed ontology which is handicraft domain.

3. APPROACH FOR ONTOLOGY MODELING

We propose an approach in order to create an ontology for user model in handicraft domain and in order to assist handicraft woman in their search in social network. This approach is composed of three steps which are knowledge extraction (from interviews made with handicraft women from Tunisian and Algerian countries) and preprocessing. The second step is ontological modeling of extracted knowledge. The third step is the enrichment with SWRL rules and concepts from FOAF ontology. This approach is presented in figure 1.

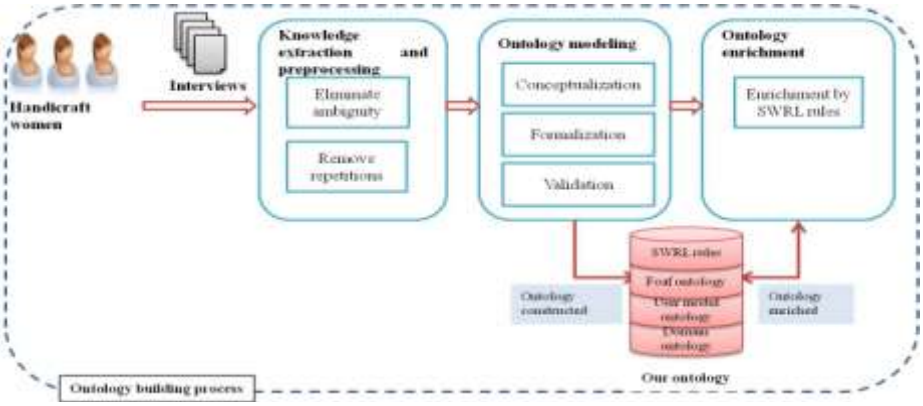

Figure 1: Ontology building process

3.1 Knowledge extraction and preprocessing

In this step, we collected information about handicraft women. This is established through the use of interviews. In fact, a series of interviews are made with handicraft women in many areas of Tunisian and Algerian countries. We obtained a set of interviews in textual form and in natural language. We preprocessed these interviews through many manual operations to eliminate ambiguity and repetition from interviews. Then we extracted most useful information that is related to the domain, to the personal information and to ICT use. This useful information concern mainly personal information about women (name, age, etc.), information about their work (production tools, raw materials, etc.), their readiness to use new technologies, interests, etc. The analysis of the answers to our questions in interviews allows us to determine the relevant concepts. Among these concepts, we define Handicraft woman, Actor, Preference, Competence or skill, Organization, Product, Environment, Resource, Coordination tools, Ability to use ICT, Personal information, Raw material, Production tool Supplier, Customer, etc. Concepts definition is explored later.

3.2 Ontological modeling

After collecting information about handicraft women, we need to model them in a structured manner. In order to represent this information, we need to use a model that is performing and efficient for manipulating knowledge and deducing new facts. For that, we use ontological modeling. Main concepts are extracted from interviews already established and preprocessed. Women interviewed are actually representative of the handicraft women population thanks to the diversity of their activities, their ages, their intellectual levels, their socio-economic situations, etc., and their origins in different cities of the Tunisian and Algerian countries. To create an ontology, we followed few steps that are necessary to have an accurate and validated ontology. There are different methodologies to create an ontology. We followed the Methontology methodology proposed by [2] which primarily considers three steps that are Conceptualization, Formalization and Validation. Conceptualization requires the ontology objective definition and the definition of its concepts, relationships and constraints. The formalization is to express the ontology in a language and code in a specific tool. Finally, the validation is performed by the instantiation of ontology with actual instances on the user.

3.2.1 Ontology Conceptualization

Before presenting the proposed ontology model, we collected all the necessary concepts. Initially, we begin with creating ontology in [4]. In this ontology, we defined concepts related to domain ontology (which are customer, supplier, handicraft woman, raw material, production tools and products.) and concepts related to user model which is composed of user profile and user context. Concepts related to user profile are skills, capability, preferences, interest and personal information. Concepts related to the context are User Context (Activity, Ict_use and Intellectual_level), Computing Context (Device) and Physical Context (Location, Time and Environment). We have only described domain concepts and user model concepts without social network concepts. Then we enriched this ontology by SWRL rules for personalization purposes.

Our main contribution in the project is to create an ontology that permits to model handicraft domain concepts in one hand. In the other hand, it permits to model the handicraft woman profile and context (user model). The system that we create is an effective application of the ontology that we created. It permits to demonstrate the ability of the proposed ontology to infer relevant knowledge about handicraft woman, to return relevant information in their search and in minimum lapse of time. In the following, we describe the three models that we propose for user model, for handicraft domain and for social network.

Handicraft domain model

We noticed that several ontologies emerged in the e-commerce domain, although we didn't find for handicraft ontologies especially. In our previous work [4], we created an ontology for user model and for handicraft domain. Thus, in order to reuse existing ontologies, we reused some concepts and properties from commerce ontology[1]. Accordingly, we

add in this work some concepts related to handicraft domain such as organization, supplying and commercialization. This model is presented in figure 2.

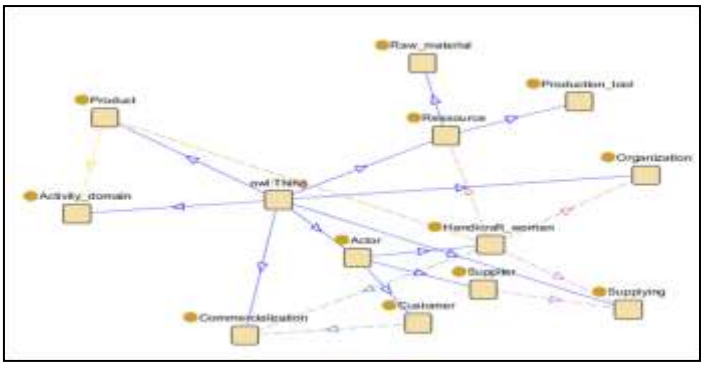

Figure 2: Handicraft domain ontology

User model

In the previous proposed ontology, in [4], we adopted that the concepts context and profile are disjoint but it reveals that these two concepts are close to each other and may one be subclass of the other. Therefore, we opted for the context is the upper class and the profile is the subclass of it. In fact context is the upper concept of three concepts, in our work, that forms the set of contextual dimension. These concepts are profile environment and platform. We have noticed that the profile gives information about the user so we defined five concepts that may describe the user profile in a personalization system which are Personal information, Interests, Preferences, Skills and Abilities. This model is presented in figure 3.

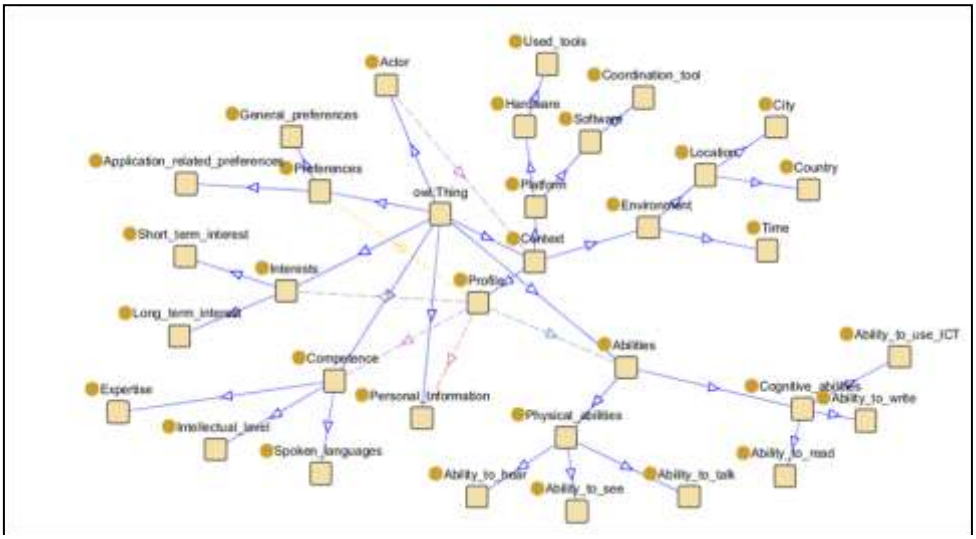

Figure 3: User model ontology

Social network model

Our system permits to personalize search results based on information from user social network profile or account. Thus, we need a structure to save this important information. FOAF ontology [1] is known as an ontology that represents persons (foaf:person) and relations between them (foaf:knows). It contains concepts that we need to express information about a person, his relationship with others and his online account (which can be a social network account) such as (foaf:person), (foaf:online_account) and (foaf:project) which can describe information about handicraft woman, her social network profile and her products respectively. Thus, we reused some concepts from FOAF ontology. We already proposed in our previous work [5] an enrichment of our initial ontology with FOAF concepts with bridge axioms and semantic relationships.

3.2.2 Ontology Formalization

The ontology was formalized using the OWL[2] language of ontology (W3C Web Ontology Language (OWL 1.0)), and was created using Protégé[3] framework. The code of the created ontology could be found in the website[4].

3.2.3 Ontology Validation: instantiation

This step is necessary to have a populated ontology. It can be done manually or automatically. For manual instantiation, to validate the ontology, we create various instances based on real examples of handicraft women. These instances were collected from interviews. For automatic instantiation, we have proposed an approach that consists of three phases. The first phase is the construction and the preprocessing of a corpus. Corpus building permits to import text documents, namely the interviews conducted as part of an Algerian-Tunisian project designed to improve the socio-economic status of handicraft women. Thereafter, we analyze linguistically this corpus to move from Tokenization, to Syntactical analysis, to the Named Entity Recognition (NER). The second phase involves the construction of a Classifier. This phase combines information extraction and classification of this corpus. This phase is relevant because it allows the extraction of candidate instances supposed to be added to the ontology. The third phase is to generate an OWL file of populated ontology. To implement this contribution, we proposed a functional architecture for achieving our approach. The proposed architecture is based on NLP techniques and JAPE rules provided by the GATE tool to identify instances from interviews, and Jena API for the ontology instantiation.

3.3 Ontology enrichment

This step is necessary in order to have personalized search results. In fact, we add SWRL rules that permits to classify users (Handicraft Women). Then, we add SWRL rules that permits to generate recommendation to them.

3.3.1 Enrichment by SWRL rules for classification

Enrichment by SWRL rules is proposed in order to classify handicraft women into categories and to personalize search results according to their category. We noticed that the main differences characteristics that we can be based on to do this classification are intellectual level, ICT_use and experience. Thus we define the first rules that permit to designate if a handicraft woman is illiterate, primary school level, secondary school level or university level. The second classification gives to types of handicraft women whether she is using ICT technology or not. The third classification leads to classify handicraft woman according to their expertise. They may be whether beginner or expert in her work. Some SWRL rules are described in previous work [4] to personalize query results sent by her through our system.

Figure 4 shows these SWRL rules. The first criterion is based on the intellectual level. The second criterion is based on ICT use which means that some women use internet and ICT technology and others don't. The third criterion is experience. If the women have less than 4 years of work in this job so she is a beginner otherwise she is an expert in this domain.

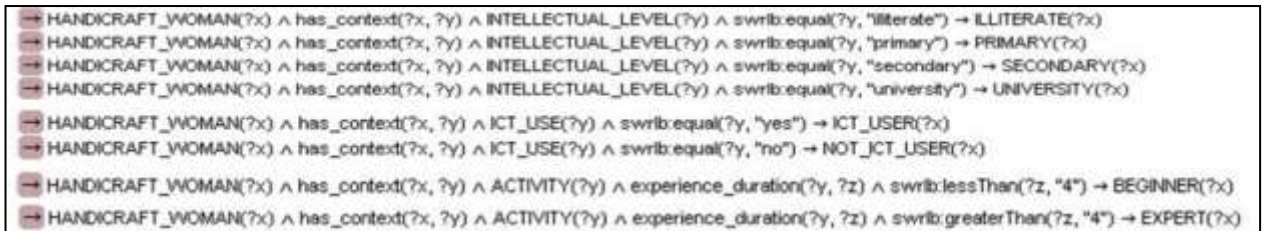

Figure 4: SWRL rules for classification

3.3.2 Enrichment by SWRL rules for recommendation

Recommendation based on handicraft woman category

In order to recommend a given service we have to know the age of the handicraft woman. For instance, if she is beginner we can propose to her Basic training containing the basic notion of the technical knowledge concerning a chosen business. Then if she is expert we can propose to her an Advanced Training containing more detailed information about her business (she would have a bigger experience than the first one and she would have an ability to learn detailed notions or new available techniques).

The use of new technologies can facilitate the life and also the job for a handicraft woman. For that if we want to improve the socio-economic level of the handicraft woman, we should know if she uses ICT or not. In fact, if she uses these new technologies then we can propose to her training, on internet and in French, for instance. These rules are illustrated in figure 5.

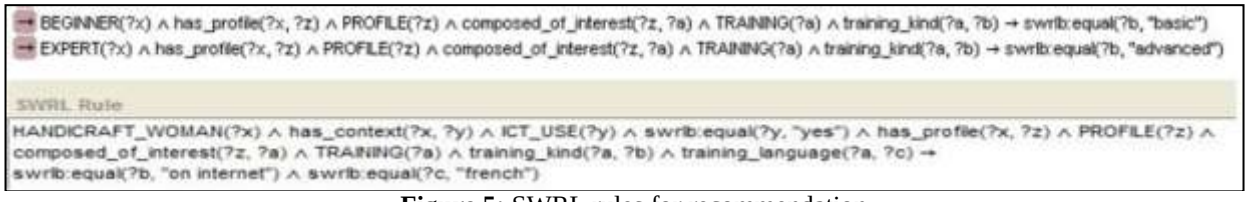

Figure 5: SWRL rules for recommendation

Recommendation based on handicraft woman context

In the first type of recommendation, we suggested some training according to the context of handicraft woman without considering the context of other handicraft women. If we consider the other handicraft women contexts, we can recommend some raw materials, production tools, suppliers names, or other information that can help her in her business. In this step, we recommend an item to the handicraft woman after comparing the contexts. The user searches the social network via our application after logging into his account on the social network. The profile and context of the handicraft woman are saved in our ontology. After logging into her account via our application, we compare its context and other contexts of other handicraft women. If they have similar contexts, they probably need the same raw materials, for example. Otherwise, we do not recommend items for her. This recommendation is mainly based on the SWRL rules that we have defined [6].

Recommendation based on handicraft woman search history

This proposed rule permits to infer some links to the user based on his previous search results. As a matter of fact, query terms (keywords) used by a user in his searches reflect his short term interests. This is why, in our ontology, "short_ term" interests' concept is composed of a couple which is "user_query" concept and "search_results" concept. These concepts are dynamically alimented from the application. According to that, each time the user enters his query, both query keywords and results are saved in the ontology.

$$\text{Handicraft\_woman}(?x) \wedge \text{has\_context}(?x, ?y) \wedge \text{Profile}(?y) \wedge \text{has\_interest}(?y, ?z) \wedge \text{User\_query}(?z) \wedge \text{has\_sresults}(?z, ?v) \wedge \text{Search\_results}(?v) \wedge \text{title}(?v, ?t) \wedge \text{url\_s}(?v, ?u) \wedge \text{has\_recommendation}(?x, ?p) \wedge \text{Recommended\_links}(?p) \rightarrow \text{url\_r}(?p, ?u)$$

4 PERSONALIZED SEARCH PROCESS

The objective of creating ontology is to model concepts in a structured form and to facilitate its use in a system. Our system has the aim to personalize query result and to recommend item to users according to their contexts and profiles. In this step, we integrate the ontology in an interactive system. We tackle different modules implemented based on the use of this ontology: knowledge extraction module, ontological user model alimentation module and personalized search module. Figure 6 presents our process for personalized search.

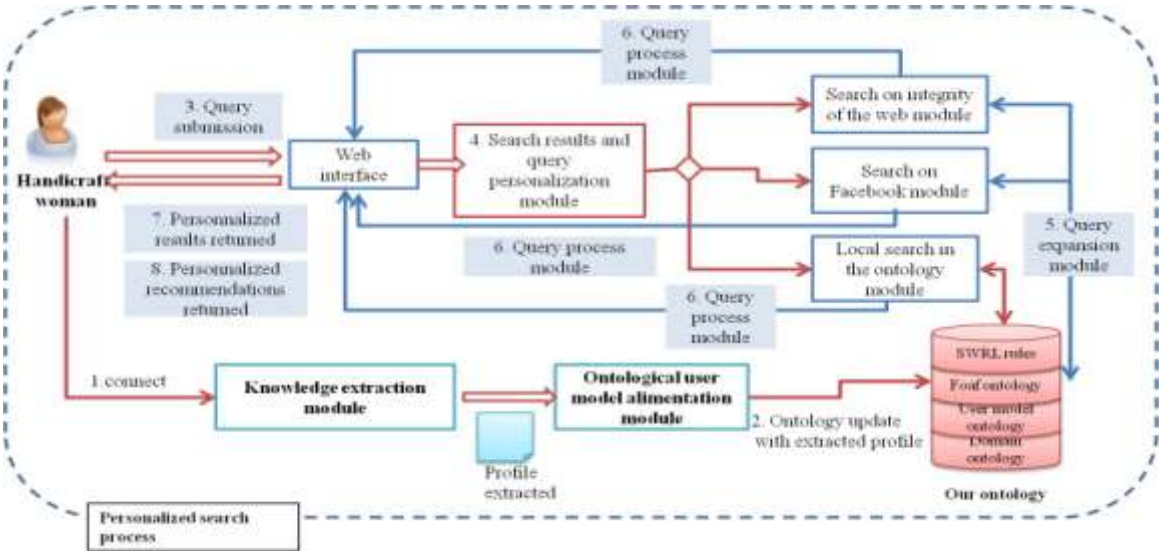

Figure 6: personalized search process

4.1 Knowledge extraction module

To create a personalization system, it is necessary to acquire information about users. The information can be simple or complex. Acquiring knowledge about users is an important step for personalizing search results. For that, we need to collect information for the characterization of handicraft women. User profiles have been used to extract information about users' interests for personalization. The information collected may be explicitly input by the user or gathered implicitly. This step represents implicit extraction of user information from his social network account. This information is personal that can be gender, date of birth, language, etc. and contextual that characterize the situation of the user such as location, current time of seeking information that we can use in the search method. This information is saved by the majority of users in their profiles and can be extracted. However, other information can be stored in non-user profiles and are not extracted. The information collected in this step helps us to find improved results in information retrieval. Facebook Login is the fast and more convenient way for people to login to our web application. When a person logs into our

web application via Facebook Login, we can access a subset of that person's information stored on Facebook. A person's privacy settings combined with Facebook permissions will determine what information we can access. Then the access token is returned to us. Access Token is a temporary token that provides secure access to Facebook APIs when someone connects with an application using Facebook login.

4.2 Ontological user model alimentation module

In this step, the knowledge extracted, implicitly from Facebook permissions and explicitly from data provided by the user through the form interface, is stored in an XML file and is then used for the ontology instantiation. We can cite some concepts used from the ontology such as "Handicraft_woman", "Profile", "Interest", "Skills", etc. We model this knowledge and save it through the use of ontology. In fact, ontology is not only an effective mean for modeling digital information and user context, but also, it can be a very useful tool for improving navigation effectiveness as well as personalized search results and query refinement because it represents an overview of the domain, related to a specific area of interest. The information gathered about the user and represented by our ontology, will be instances of concepts in the ontological user model.

4.3 Personalized search module

In this work there are mainly three types of search:

- *Search in (local) ontology*: performed when searching handicraft job descriptions or when searching for users with contexts similar to the context of the current user (recommendation of raw materials from suppliers of production tools, etc. .)
- *Search in the web*: performed when choosing the user to search throughout the web.
- *Search in the social network Facebook*: performed when choosing the user to search in Facebook.

We create three search engines categories that focus on different sites. Once we have defined our search engines, they can be accessed throw a search box in our web application to help users make searches from our web application. At the first place, the user has to choose which search modality he wants to use. He has two choices which are searching in "Facebook" or in the integrity of Web "Google". In this step, and after the selection of search type, the user will be able to input his query. Then, after collecting data related to the user in the previous step, the user selects the information that can help him to improve search results and uses them in search. The selection focuses on the information and data that are appropriate to seek the word. Then, search results are provided to user in a personalized way to fit his needs and preferences. If a user selects refinement labels, or categories of search results, we append his queries with additional search terms to help him retrieve more targeted results or redirect him to a different page. So that, he can refine his searches and get quick answers.

4.3.1 Query expansion module

There exist several models and algorithms used in the search for information. We rely on the query reformulation (expansion) model. This model is necessary to target the search for relevant documents by increasing the query terms from the user profile. There exist several algorithms used in this model among these algorithms we use Rocchio algorithm for our personalized search in the Facebook. Search based on this algorithm identifies the user profile as a pair of concepts from an ontology and operates in the query reformulation. The first concept represents the relevant concepts from the user and the second concept represents the irrelevant concepts selected. In our approach we use the same principle of Rocchio algorithm in the query reformulation using terms from the user profile. We proposed an extension of the formula used in this algorithm. We identify the user profile as being a pair of concepts through an ontology. The first concept is the profile which is composed of personal data and the second concept is the context which is composed of context data. The query reformulation is made by applying the equation as follows: $Q_2 = \alpha Q_1 + \beta \, Prf + \gamma \, Cont$;
In this formula, Q1 represents the original query, Q2 represents the new query, Prf is a vector of terms representing the concept of profile and Cont is a vector of terms representing the concept of user context. The factors α, β, γ are weights associated with, respectively, the original query, profile concept and the concept context such as: $\alpha + \beta + \gamma = 1$ and $\alpha = \beta + \gamma$;

4.3.2 Search in the ontology (local search)

We proposed to personalize information returned to users based on search query expansion method. In fact, this method permits to enrich user query by a set of predicates contained in his profile. So we integrate elements defined in his profile such as preferences, interests, etc. These elements permit to have more personalized queries and to better answer users according to their profiles.

4.3.3 Search in the web module

If the user selects search on integrity of the web, for the search results and query personalization, we used the Google Custom Search Control API that enabled us to create a Custom Search Engine (CSE) and then to embed the resulted custom search element in our web application. Moreover, custom search enabled us to append search terms to our users' queries (rewrite queries) and this was possible to be implemented through refinements labels in order to get relevant

searches and quick answers. After that, we attributed weights to the inclusive labels. This was helpful to promote or demote a tagged site so that to adjust the ranking of the search results provided by our search engine. This type of search is well detailed in previous work [7].

4.3.4 Search in Facebook social network module

If the user selects search in Facebook social network, the search results will be displayed according to the chosen type. In this step, the user must select the type of results he prefers. The result type must be either page or group or user. This step determines the type of results displayed to the user adapted to its needs. We added another type of search based on enriching the query by contextual and personal information (stored in our ontology) to reformulate the query and to ameliorate the search results. The purpose of this module is to obtain different types of results with the use of profile and context of the user to improve the search. To retrieve information from user context, we extract information that characterizes the context namely location and time. Then, we apply search by selected type of search and using the profile and contextual information extracted in the previous step. We choose the profile information and user context information that has a relationship with the personalized search to improve performance and to meet the user needs.

4.3.5 Personalized recommendation module

The recommendation module is based on the search type. This module permits to recommend an item to the user when returning results to user for his search query. If he searches in social network, then after logging into his account on the social network, his profile and context are saved in our ontology. So, we compare its context and other contexts of other users stored in the ontology. If they have similar contexts, they probably need the same raw materials, for example. Otherwise, we do not recommend items for him. This recommendation is mainly based on the SWRL rules that we have defined in (section 3.3.2). If he searches in the integrity of the web, we recommend item based on his search history saved in our ontology.

4.4 Results and Discussion

For the first type of search, on the integrity of the Web, we can conclude that the results given after personalization are better than the ones delivered at the beginning for the reason that they increase, as we have demonstrated in [7], the satisfaction of the users of our system with a short time response. These results are presented in figure 7.

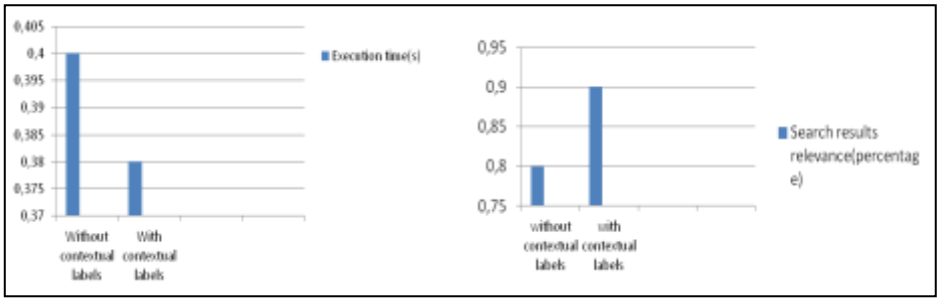

Figure 7: Search on the integrity of the Web comparison

For the second type of search, in Facebook social network, the first results given for our search are the status. The contents of this returned status, related to user search, are written in other unspoken languages which are irrelevant to the user. For this, we added a step that allows the user to select the type of result. The result types are either "pages", "groups" or "users", but they are also not suitable to the needs and preferences of the user. To improve our search, we used the account information in which we find information related to user's profile and context. The user, when he did his search, he can choose the result type and he can add labels which represent his interests and preferences. In this case, we get results more suitable to user needs and significantly improved. We see from these results that search has become more focused and provides relevant results. The search for information in the status is very costly in terms of time consumed to produce results; it can last infinity. For the second type of search, the user can get the information as pages, or groups or users; the execution time information search is four seconds and a half. For the latter type which is based on the use of profile and context and represents our approach, the search results become more appropriate and relevant to user needs and the time of execution of this search type is one second. These results are presented in figure 8.

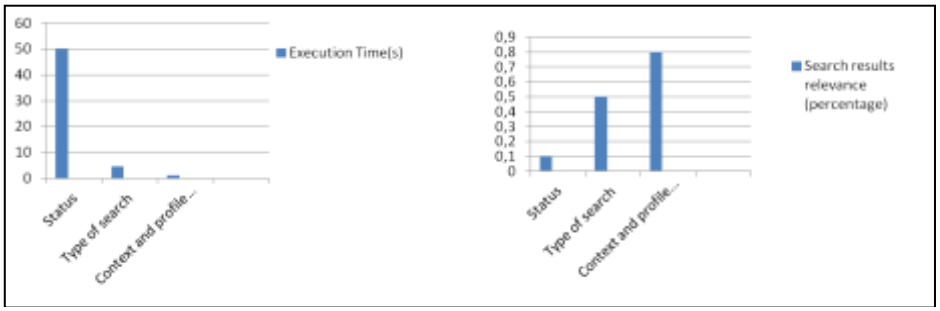

Figure 8: Search on Facebook comparison

5 CONCLUSION

In this paper we create an ontology in order to implement the customization in an interactive system. This ontology is constructed within the framework of handicraft women and their field of work. After having created ontology, we have integrated it into a personalization system. Our ontology serves as a bridge to help us offer personalized content to handicraft women according to their profiles. In addition, we have classified these users into categories using certain SWRL rules. Thus, the information characterizing the user and the SWRL rules are implemented to exploit and to enrich the user's queries. Indeed, this method enriches the user query with a set of predicates contained in her profile. As a result, they can better tailor responses to users based on their profiles. For search results and query customization, we also defined two categories of search engines that covered the search modality in Facebook or in the integrity of the Web. The result of our approach is encouraging. In fact, we relied on the language of the SWRL rules to improve the results of the queries and thus to better meet the needs of the users. In addition, custom search allowed us to add search terms to our users' queries (rewrite queries) and this could be implemented using refinement labels to get relevant and quick search results. In our future work, we aim at adding other contextual and profile information describing a user. This extension will provide users with more personalized results. Second, we seek to examine our prototype and our approach to other social networking sites. We also intend to further formalize our ontology by proposing other SWRL rules. In fact, these rules help us to infer new knowledge, from the user profile model, which is useful to enhance a woman's craft research experience and satisfy it with more relevant personalized results. Another interesting perspective is to implement our contribution in the interactive system of the project. The idea of testing and evaluating the use of our approach in other areas is one of our future works.

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