

Agent Oriented Framework for Making Websites Adaptive

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Abstract – Whenever any user visits over the internet searching for some information, hundreds of pages are returned on the same topic with vast amount of information which may not be of interest to the user. Most of the returned pages are based on the keywords used in the query and are not relevant to the context of information searched. It would be very beneficial if user could find all relevant information at a single page. In present time information overload has become a very serious problem for the naïve customers who spend most of their precious time traversing links from one web page to the other searching for their desired information. To solve this problem a bit web developers are focusing on developing adaptive websites that can adapt and change based on user requirement. This work proposes a novel agent based framework for developing adaptive websites.

Index Terms – World Wide Web, adaptive website, intelligent agents, web mining, search engine.

1. INTRODUCTION

World Wide Web is a large pool of information on every possible topic of interest, including information in its every possible form like text, audio, video, images etc. A website is an important part of web which provides information or knowledge about any particular topic within a limited amount of space. There are thousands of websites that provide information on the same topic in a variety of ways. When any user search for any topic, he come across many websites providing information on that topic out of which some may be relevant and some irrelevant. So it would be better for users if they get a bunch of pages with relevant information on the same page.

There are many websites that help users by providing relevant information without roaming here and there over the web. Such websites are called adaptive websites. Perkowitz et al in [8] have described adaptive websites as websites that semi-automatically improve their organization and presentation by learning from visitor access patterns. Adaptive websites make

user's surfing experience more interactive one and serves as a guide to user.

In this paper we have emphasized the role of agents in the development of adaptive websites. The goal of such agents is to collect information from various collaborated search engines on the related topic that particular page of the website in response to actions of the users. These agents search for the similar pages at various search engines and select them and display them in a frame under that page. Agents are adaptive, autonomous and robust in nature. Agents adapt the behavior of the users by learning from their actions. This work proposes a framework that deploys agents. Whenever a user visits homepage of a website and either enters a query or surfs links of that web page for information, our proposed framework becomes active and apart from displaying information from current website also display links to other similar pages. Rest of the paper is organized as follows; Section 2 outlines the literature in the domain under consideration. Section 3 describes the proposed work covering role of agents in bringing out the relevant links at front end, a flowchart, depicting the overall process and algorithms, showing the steps involved in accomplishing the processes are described. We have concluded our research work in section 4 and have also discussed the future research directions.

2. LITERATURE REVIEW

Many websites allow their users to customize the site according to their taste like changing background color, arranging their data in some order. Some websites take feedback from users and improve structure of the website. But not all users fill up the feedback form. Many users avoid visiting such websites as they find it time consuming, may be wastage of their time. In such scenario it would be better if websites predict the interest of users and presents relevant information to the users on their own. Many researchers have proposed many techniques [3], [8] to predict future path of users. There is always some kind of relationship among various pages which a user visits during a

single session. By discovering the criterion relating various pages user's next move may be predicted. Pazzani et al in [3] have made use of agents to identify the relationship among pages. They highlighted that agent know the four reasons that relate one document to another. These are:

2.1. Similarity

The document is similar to another as determined by comparing the TF-IDF representation [14] of the documents using the cosine similarity metric.

2.2. Reference

The document contains a hypertext link (or citation) to another.

2.3. Referenced By

There is a hypertext link from another document to this one (or the document is cited by another document). Since the agent has knowledge of the inverse of every link, it can recommend documents that link to the current document.

2.4. Downloaded-with

The document is frequently accessed in combination with another during the same session. This information is obtained from web logs.

For creation of adaptive websites Mobasher et al in [9] has described a technique which is based on association rule discovery and usage based clustering. They discover common user profiles using this technique and then use this knowledge to perform real time personalization. Another important aspect of adaptive websites is that the pages which are considered to be related should be displayed in some order. There must be some criterion to arrange pages in some order, so that users get to read the highly related pages first. Xue et al in [10] has proposed a re-ranking method which is based on user logs. Sometimes users provide ambiguous queries which results in irrelevant results. Their work developed a log mining model to discover generalized association rules. This model is used in search engines for full text searching method to find web pages that match the query words.

These web pages are then re-ranked by association rules so that users get more relevant results. This way websites are made more user-friendly and adaptive. Lee et al in [1] have stated that a website is adaptive if it is capable of changing its original design to fit user requirements. They have concentrated on calculating operating efficiency of a website. They have developed an algorithm to calculate the efficiency of a website and to increase it for user operations. Through this mechanism efficient new links can be added and less efficient links can be removed to allow users to arrive at their target page more quickly. Implementation of this technique automatically changes the website structure according to user requirements. More tactical way of developing adaptive websites is the creation of index pages that provides links to related pages.

Perkowitz et al in [8] and [7] have proposed an index page synthesis problem. They have proposed a PageGather algorithm which works on the sub-problem of index page synthesis problem i.e. generating the contents of the new index page. PageGather takes web server access log as input and applies cluster mining to produce index-page contents as output. Conen et al in [6] have also proposed a framework for self-adaptive websites. They have described strategic adaptations having long term effect on the structure of the website as well as tactical adaptations which do not affect the structure of the website. Koutri et al in [2] have also highlighted the need for adaptive interaction and have presented a review of existing approaches for developing adaptive websites.

Many researchers have emphasized use of agents in adaptive website development such as Letizia [14] and WebWatcher [15] which is tedious from user perspective. Both these intelligent agents record the user browsing behavior and provide recommendations to the users. Only difference between the two is that users communicate with the system and gives feedback in WebWatcher. From above literature review it is clear that users are demanding for adaptive websites and they are reluctant to contribute towards it. Thus there is need of mechanism which could automate the process of website adaptation as per user requirement. This provided us motivation for the present work. The next section elaborates our proposed mechanism.

3. PROPOSED FRAMEWORK

In this paper we have proposed a framework deploying agents as the working components for displaying the context relevant link recommendations for the user. However this framework requires user to create an account on the website for personalized recommendation. This framework involves three agents namely Interface Agent, Mobile Search Engine Interaction Agent and Review Agent that maintain the overall process of collecting the query related links and displaying them to the users.

This framework being designed around agents thereby it is termed as Agent Based Recommendation Framework (ABRF) and is depicted in Figure 1. Functionality of each agent is described as follows:

3.1. Interface Agent

It is the first agent that comes in to action as soon as user log in the website and is responsible for approving the user as an authorized user. Interface Agent maintains a user table which contains the details of the user such as user name, password, interest, history etc. Every time when user enters the website, these values are referred from the table, some values such as username and password remain constant most of the time, while some values like interests are updated after every session in the table. Interface Agent can get values back from the user table whenever required.

When user enters any query, interface agent activates MSEIA by passing query to it. It also activates review agent. This way interface agent is responsible for user requirements, getting relevant links searched and presenting them to the user.

3.2. Mobile Search Engine Interaction (MSEI) Agent

This agent receives the query from interface agent and searches for the pages matching the query entered by the user. This agent searches the relevant results from various search engines. MSEI agent creates its replicas to all collaborated search engines and searches for the relevant pages. This way each search engine provides a number of related web pages. MSEI agent thus has a large number of query related pages. It is the task of MSEI agent to reduce those pages in a limited number so as to display them to the user and to arrange them in an order, displaying highly related pages at the top of the list. This is achieved by, re-ranking of the collected pages making use of association rules as described by Xue et al in [10].

Once the list is prepared, it is handed over to the interface agent, which then provides those page links as recommendation to the user. However, the actual display of those pages may vary from one website to the other, links may be suggested either in the form of bunch or pages.

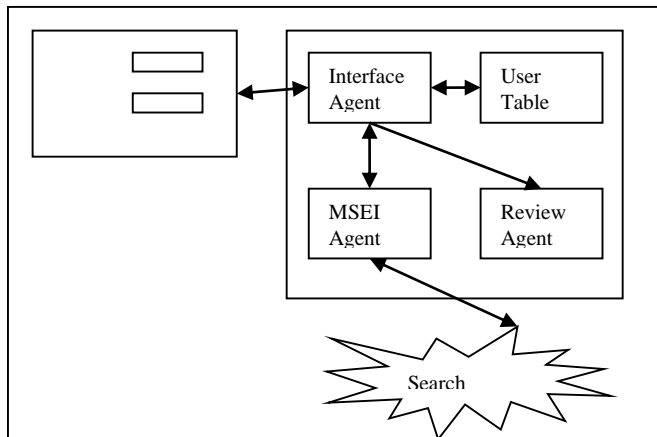


Figure 1 Agent based recommendation framework

3.3. Review Agent

Once the user session is over, interface agent supplies the session detail to the review agent for reviewing the information accessed by the user. Based on the information accessed user interests may be modified in the user table and related information may be provided to the user in the next session. This agent helps make the website adaptive for the user by learning user interests and providing related information to the user in the next sessions.

3.4. Flowchart and algorithms

Figure 2 given below represent the flowchart depicting the work flow among the three agents.

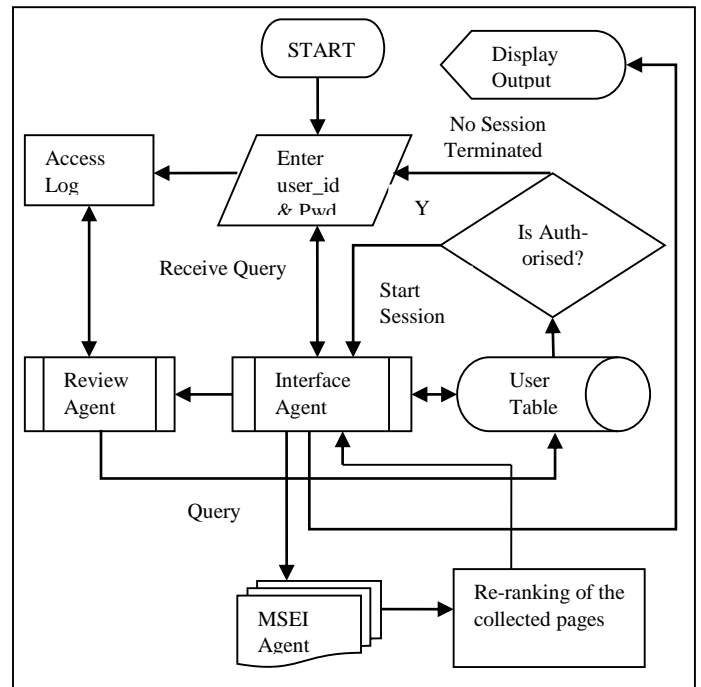


Figure 2 Flowchart representing the work of ABRF

Algorithms for all the three agents are depicted in Algorithm. 1, 2 and 3 respectively.

```

Interface Agent ()
{
    Read user_id & pwd and verify it from user table;
    Read input query & pass it to MSEI agent;
    Accept shortlisted documents from MSEI agent;
    Display shortlisted document to the user;
    Pass the search record to the review agent;
}
    
```

Algorithm 1 Interface agent

```

MSEI Agent ()
{
    Accept query from interface agent;
    Creates its replicas to various search engines;
    Searches for the query related result from those search engines;
    Re-rank the collected pages;
    Provide re-raked pages to the interface agent;
}
    
```

Algorithm 2 MSEI agent

```
Review Agent ()
{
  Read user access log;
  Apply mining techniques on access log;
  Update user table if required;
}
```

Algorithm 3 Review Agent

4. CONCLUSION AND FUTURE DIRECTIONS

In this paper we have represented the use of agents in the development of adaptive websites. This agent based recommendation framework will help users find query related documents while staying at a single page. The major advantage of this work is that the user doesn't get disoriented while searching. This framework will provide user with a frame containing related links. This framework is suitable for websites that provide information to users on any particular topic of interest and helps user in selecting the best from the bunch. Further advancements can be made in this framework to develop adaptive websites which not only provide user with a set of related documents but also reorganize their original structure as per user interests.

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