A COMMUNITY RECOMMENDATION METHOD BASED ON SOCIAL NETWORKS FOR WEB 2.0-BASED IPTV

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ABSTRACT

Web 2.0-based IPTV is a new Internet Protocol Television (IPTV) infrastructure that allows users to participate in content creation and consumption through Web-based communities that are formed based on user interests. However, there are some limitations in making users actively participate in creating and utilizing communities. First, users need to explicitly create and manage their communities. In addition, it is difficult for users to identify and join communities that meet their needs. This paper proposes a method to identify and recommend potential IPTV communities for users by using their social relationships and preferences. The main goal of this method is to motivate users to actively participate in creating and sharing their contents through recommended communities. We have implemented a prototype of Web 2.0-based IPTV that allows users to share their contents and build relevant knowledge regarding the contents through blogs and Wiki-based communities.

Index Terms — IPTV, Web2.0, Social Networks, Community Recommendation

1. INTRODUCTION

Internet protocol television (IPTV) is a digital television service that delivers media contents such as video, audio, and images through IP networks that ensure the quality of service (QoS) [1]. One of the major challenges of IPTV is to provide an infrastructure that enables individual users to participate in creating and delivering their contents, to work together to produce information about IPTV contents, and to easily find and consume appropriate contents based on their needs.

To meet these challenges, there have been many attempts to apply the Web 2.0 [2] paradigm to the IPTV domain. Joost, Babelgum, and Metacafe are such examples [12, 13, 14]. The main concepts of Web 2.0 include interaction, collaboration, and personalization. In other words, the Web has become a platform in which many people can work together to build a “collective intelligence,” which is an open and scalable knowledge base for a certain domain. In addition, in Web 2.0, it is possible for users to consume contents in a personalized way so that they can easily locate and access contents that are appropriate to their interests and needs. We call the IPTV that supports these Web 2.0 concepts as Web 2.0-based IPTV.

In Web 2.0-based IPTV, users become the center of content production and distribution. Users can directly contribute in creating contents, and exchange their comments and opinions about the contents. As we have experienced in other Web 2.0-based services in different domains such as Facebook, Flickr, and Google, motivating user participation will be the key to the success of Web 2.0-based IPTV. Web-based communities play an important role in motivating users to actively participate in accumulating relevant contents and share their opinions.

However, there are some limitations in making users actively participate in creating and utilizing communities. First, users need to explicitly create and manage their communities. Although there are users who have common interests, it is normally difficult for them to identify such user groups that can become potential communities. Another limitation is that it is difficult for users to dynamically identify and join existing communities based on their changing needs. In order to join appropriate communities, users need to put a lot of efforts into finding communities that reflect their preferences and interests the most.

To solve these problems, we propose a community recommendation method based on social networks. The proposed method makes it possible to identify potential IPTV communities by analyzing the social and personal characteristics of users. It effectively motivates users to make communities by recommending them along with potential groups of users who have similar preferences regarding IPTV contents. In addition, the proposed method provides a community referral mechanism, by which users can perform social filtering on IPTV contents based on their social relationships and interests.

We have implemented a prototype of Web 2.0-based
IPTV that allows users to share their contents and build relevant knowledge regarding the contents through blogs and Wiki-based communities. By using this prototype, we have successfully showed an effective scenario of using the community recommendation method to enhance user participation and collaboration in Web 2.0-based IPTV environment.

The rest of this paper is organized as follows. The next section explains the previous efforts toward supporting communities in Web-based IPTV and video on demand (VoD) services, and discusses their limitations. Section 3 proposes an approach to recommend IPTV communities dynamically based on social-network information. Prototype implementation is described in Section 4, followed by the conclusion in Section 5.

2. PREVIOUS WORKS

In this section, we explain the major IPTV applications that provide some of the Web 2.0-base IPTV features. In particular, we explain their community support capabilities and discuss about the limitations of those capabilities in terms of community creation and utilization.

Joost [12] is one of the most popular IPTV applications on the Web, and provides users with video streaming services that are supported by commercial broadcasting companies such as CNN, Viacom, and Sony. Joost allows users to create their own personalized channels by collecting their favorite contents. Users can then make their favorite channels sharable with other users by creating groups that can be joined by other users who have similar preferences on contents. Within a group, users can add tags and write comments regarding the contents for bookmarking their favorites and sharing their opinions.

Babelgum [13] is a European effort to provide a P2P-based IPTV service. Babelgum also allows users to share their contents via communities. In order to enhance user participation, Babelgum provides special communities that are generated based on special events such as ‘Online Film Festival’. Users can also make their own communities according to their interests.

Metacafe [14] is a Web-based VoD application. One of the main characteristics of Metacafe is that it provides a blog-based environment where users can organize their customized information regarding video contents. By using a Wiki-based interface, users can write comments and add ratings on the contents. Although Metacafe does not allow users to explicitly create communities, users who participate in making the blog pages can be regarded as potential community members.

These examples provide certain types of community support. However, they still have some limitations in making users actively participate in creating and utilizing communities. They require users to explicitly create and manage communities. In addition, it is difficult for users to dynamically identify and join communities based on their preferences, which may change over time.

3. A COMMUNITY RECOMMENDATION METHOD BASED ON SOCIAL NETWORKS

In this section, we explain our approach providing users with potential communities and referral communities in order to motivate them to participate in community creation and utilization. First of all, we define the requirements that are essential to overcome the limitations that we discussed above. We explain the overall process and important aspects of analyzing user interests and social relationships in order to identify potential communities. We also explain how to extract social-relationship information out of user interaction data.

3.1 Requirements of the Community Recommendation Method

To overcome the limitations of the previous approaches that we discussed in Section 2, we have identified the following items as essential requirements to be met.

- **Potential community identification**: users can be aware of user groups that might be organized as communities.
- **Community accessibility**: users should be able to effectively find and access communities that are appropriate to their preferences.

For potential community awareness, it is required to encourage user participation in community creation because it helps users to recognize other users who have similar interests in certain topics. If there are some users who tend to produce and share their contents, and they are easily aware other users who have similar interests, there will be a greater chance for a related community creation. In the case of community accessibility, it makes users easily find communities that meet their preferences. Hence, it improves the community utilization by users.

3.2 Overall Process of the Community Recommendation

In order to satisfy the requirements, the proposed method recommends groups of users who have similar interests as potential communities for the users. It also provides users with existing communities that are preferable to them. Both can be provided by manipulating the social relationships of users as well as their preferences. Hence, users need certain ways to represent their preferences and social relationships.

We consider the Web 2.0-based IPTV that we mentioned at the beginning of this paper as an applied domain of the method proposed herein. As shown in the following figure,
Web 2.0-based IPTV basically consists of blogs and communities.

![Image 1. Organization of Web 2.0-based IPTV](image1.png)

In Web 2.0-based IPTV, each blog is given to a user which enables the user to upload its contents, make related tags, and watch the contents. Users who have a common interest can organize a community for a corresponding issue or topic in order to share their contents and information. Users can also establish social relationships with their family, friends, and colleagues, as we can see in the above figure.

The proposed method, which recommends users with potential and referral communities in this environment, can be implemented using three processing steps. The following figure shows the overall process of the proposed community recommendation method.

![Image 2. Flow of the IPTV Community Recommendation Method](image2.png)

First of all, the proposed method extracts related data to retrieve user preferences and their social-network information. In this paper, user preference is used to imply topics in which users are interested. Such data about what kinds of content a user prefers to watch can be used to deduce user preferences. Such information of a user’s referral by others, as well as the user’s explicit relations including his friends and colleagues, can be used to retrieve the user’s social-network information.

In the second step, the proposed method organizes a semantic social network based on the retrieved user preferences and social-network information. The semantic social network consists of a user who is the center of the network, and other users who have similar preferences and social relationships with the user. The proposed method recommends the semantic social network to users as a potential community.

Finally, the proposed method collects the existing communities that are referred by users from the semantic social network in the previous step. The proposed method then filters them out based on user preferences and recommends remaining ones to the users as referral communities.

### 3.3 Semantic Social Network Extraction

The main functionality of the proposed method is recommending appropriate IPTV communities to users dynamically. For this purpose, the proposed method manipulates user preferences and their social-network information including familiarity, favorability, and similarity as essential factors to organize semantic social networks. In this section, we explain what each of the factors means and how to retrieve and utilize them.

- **Preference** is used to imply user interests meaning what kinds of contents users prefer to produce or consume.

![Image 3. How to retrieve User Preference](image3.png)

In order to retrieve user preferences from activities on their blogs, the proposed method uses tags that users have made, favorite contents that users have bookmarked, and contents that users have watched.

- **Familiarity** indicates the precision of how well users know each other. This implies mutual relationships. Examples of these kinds of social relationships are family, friends, colleagues, etc.

![Image 4. How to detect the Familiarity between users](image4.png)

Familiarity between users can be detected and measured by using the number of mutual visits, comments, content scrapings, content viewing, and blog subscriptions.
• **Favorability** represents the precision of a user’s favorability to others. For example, assume that there is a user who has lots of interesting contents. Many other users may then prefer to visit their blog even though the user doesn’t know them. In the real world, people look forward to products or contents from specific specialists, actors, or musicians.

![Fig. 5. How to detect the Favorability of users](image)

For user favorability, the proposed method uses the number of one-way visits, comments, and content views. If a user’s blog is referred by many other users, his favorability will be high, meaning he can be chosen as a target of new community creation recommendation.

• **Similarity** is used to organize the user groups that have similar interests such as hobbies, food, and favorite genres even if there are no explicit social relationships between users.

![Fig. 6. How to measure the Similarity with other users](image)

Similarity with other users can be measured using the number of common preferences and their semantic distance.

Based on the retrieved preferences and social-network information, we can extract the semantic social network as shown in the following figure.

![Fig. 7. Semantic Social Relation Extraction for a new IPTV Community](image)

The proposed method keeps the corresponding social networks for familiarity, favorability, and similarity. When there is an IPTV community recommendation request for a certain preference, the proposed method projects the preference of keeping the social networks and extracts their subsets. Finally, the integration of the subsets becomes a semantic social network that meets the preference.

### 3.4 Potential and Referral Community Recommendation

Based on the semantic social network extracted above, the proposed method recommends users potential and existing communities, which are called referral communities, preferable to them.

The first recommendation is to encourage a community creation. Users can be aware of which and how many users have similar preferences and social relationships through the semantic social networks. Users can make new communities using the information.

Next, existing communities, which are called referral communities, are recommended to the users. The referral community filtering is based on the principle of social filtering [4, 5, 6]. By using semantic social network nodes, users can reach the communities. The outer-right cloud in Fig. 8 contains the referral communities based on the potential community with social filtering. The referred relations are also as the dotted lines.

Using the proposed method, we can expect that various communities reflecting user preferences can arise more dynamically so that the various user preferences can be satisfied. In addition, more user interactions in communities can occur, spreading valuable contents to other users. Consequently, a user can reach another user who has possibility to share contents that is closer to the community based on the new communities and more user interactions.

### 4. PROTOTYPE IMPLEMENTATION

To show the effectiveness of our community recommendation method, we implemented a prototype called Web-based Open IPTV 2.0. In this implementation, we developed the prototype in ASP.NET as a web application with IIS (Internet Information Services) for the web server and WMS (Windows Media Services) for the media server.

This prototype concentrates on the base environment in which the user can participate in content creation and consumption. Blogs and wiki-based communities, which reflect the Web 2.0 concepts as previously mentioned, are used for user participation in our environment. The detailed features of our blog and wiki-based community are as follows.

• **Blog**: A blog is allocated to users who are members of our Web-based Open IPTV 2.0 service. In the blog,
users can freely upload and manage user created content (UCC) through a template-based content manager to support various types of contents and their metadata including basic information and tags, and summarized introductions of the contents. Also, bookmarking or subscribing to favorite contents that have similar preferences as other blogs is available for collecting and viewing different contents easily. Such contents can be shared and discussed interactively among the users. Based on this interaction, a user can present his own preferences and create explicit and implicit relationships with other users. Therefore, these relationships can be a bridge between different users and reflect social activity in Web-based IPTV 2.0.

- **Wiki-based community**: A Wiki-based community can be made by members of the Web 2.0-based Open IPTV 2.0 service, and all members can participate in this community. Contents within a similar topic of the community are added and shared through user activity efficiently, and such content metadata can be enriched based on Wiki concepts with user participation collaboratively. The Wiki-based community provides various collaborative features to evaluate and enrich contents metadata such as rating, discussing, tagging, and storing the history of user activity in the community. The enriched contents can reflect well the gathered user preference in the Wiki-based community.

Using these blogs and Wiki-based communities, users can be satisfied with the experiments, which are the activities of creating, enhancing, consuming, and sharing contents. The following figure shows the passage of a usage scenario.

![Fig. 8. Usage Scenario of the Web 2.0-based IPTV](image)

- **Step 1**: The user uploads contents and their metadata onto his own blog through a template-based content manager. The contents and metadata are stored in each repository.

- **Step 2**: The user collects contents he is interested in from others using bookmarks and subscriptions and manages all of the contents in the blog in order to view the interested content list based on dynamically changed preferences each time. Also, another user who has a relationship with the user or is a favorable person can be added into the user’s own friends list.

- **Step 3**: The user visits and joins a Wiki-based community share similar interests or is suitable to the user’s intention. In this community, a user adds contents with similar interests of the community from his own blog and shares the contents with other members of the community for discussion and evaluation.

- **Step 4**: The Wiki-based community supports Collaborative Knowledge Construction (CKC) tools [9]. The user contributes these CKC tools to manage and enrich the EPG metadata of all contents based on the Wiki paradigm collaboratively. The EPG metadata of changed content is stored in the database as a history, which the user can refer to for help.

- **Step 5**: The user accesses contents and its information without limitation. The contents and metadata are stored in a streaming server operating in the WMS and MS-SQL database to provide seamless and high-quality IPTV service.

This prototype can be a base environment for next-generation IPTV, including the Web 2.0 features we mentioned earlier with blogs and Wiki-based communities. The users manipulate information through the above usage scenario with our prototype, and can obtain the recommended or new potential communities. We have a plan to apply our approach to the prototype for evaluation and improvement using the following algorithm for a future implementation.

**Algorithm 1. The IPTV community recommendation**

1: \(P_{owner} \leftarrow \text{getUserPreference(owner)}\)
2: \(gFam_{owner} \leftarrow \text{getFamiliarity(owner, } P_{owner})\)
3: \(gFav_{owner} \leftarrow \text{getFavorability(owner, } P_{owner})\)
4: \(gSim_{owner} \leftarrow \text{getSimilarity(owner, } P_{owner})\)
5: \(pComm_{owner} \leftarrow \text{merge}(gFam_{owner}, gFav_{owner}, gSim_{owner})\)
6: for user \(\in \text{getUser(pComm} \_{\text{owner}})\) do
7: \(\text{Comm} \_{\text{user}} \leftarrow \text{getHighMatchedComm(user)}\)
8: \(\text{recommComm} \_{\text{user}} \leftarrow \text{recommComm} \_{\text{user}} + \text{Comm} \_{\text{user}}\)
9: end for
10: return recommComm \_{\text{user}} \leftarrow \text{sortHighPrefeMatch(recommComm} \_{\text{user}}, P_{\text{owner}})\)

In this algorithm, the sub social networks are extracted using three kinds of social factors with user preferences and are merged into the potential community. The potential community can be a base to look for referral communities that a user who is a member of a potential community has joined. Consequently, the user can receive a recommended set of communities or a user set to gather new communities.
5. CONCLUSION

In Web 2.0-based IPTV services such as Joost and Babelgum, communities are the centerpiece of the environment where users participate in accumulating relevant contents and sharing their opinions. In this paper, we proposed a method that recommends users with useful IPTV communities based on their social relationships and preferences.

In our approach, social networks are identified based on three major factors: familiarity, favorability, and similarity. The proposed method contributes to the active participation of users in the creation and utilization of IPTV communities. First, it recommends a user’s potential communities, which can be dynamically identified by extracting and integrating the social networks that have similar preferences regarding their IPTV contents, to motivate the user to make new communities. The proposed method also recommends users with existing communities that are referred by other users who share similar preferences and social relationships. It effectively motivates users to join existing communities that meet their preferences.

The prototype that we have implemented allows users to create and share their contents and opinions through blogs and Wiki-based communities. We have also showed a detailed scenario for using the community recommendation method to enhance user participation and collaboration in a Web 2.0-based IPTV environment.

We are currently extending our method by incorporating a semantically-based approach to solve the heterogeneity problem of representing and comparing user preferences and interests in identifying and recommending useful communities to users.

ACKNOWLEDGEMENT

This work was supported by the IT R&D program of MKE/IITA. [A1100-0801-3015, Development of Open-IPTV Technologies for Wired and Wireless Networks]

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