**iPreviews**: Abstracting Multimedia Content Collaboratively in Peer-to-Peer Networks

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**Abstract**

Users need an attractive mean of retrieving movies of choice from VOD providers that provide thousands of digital movies. The paper presents a framework within peer-to-peer recommenders system to recommend personalized movie trailer, thereby condensing digital content, by using a novel collaborative algorithm. Personalized trailers can provide abstracted and succinct representation of digital movies through a combination of video segments. Movie previews that match user’s tastes tend to stimulate online movie-buying, enrich the users’ experience and improve content providers business. Further, we use a distributed incentive scheme for collaborating users, in which users obtain incentive that is proportional to user’s contribution in content preview development. Our work builds upon prior research on recommender systems, by adding information in recommendation list exchanges rather than specifically focusing on the accuracy of individual recommendations. Our pilot analysis showed the merits of our approach. We present simulation based on Matlab to show results of our novel model.

1. **Introduction**

In recent years, IPTV networks have been deployed to offer TV services over the IP backbones. Such IPTV networks that have been powered by the phenomenal progress provide guaranteed service quality (QoS), channel switching capability, and rich user experience along with internet browsing. The growing accessibility of multimedia content creates a strong requirement for smarter frameworks to match user’s tastes and preferences. Internet Protocol Television (IPTV) and Video-on-Demand (VOD) service providers that offer video service over IP broadcasts and broadband IP content delivery network (CDN) need smarter frameworks to improve service quality and user experience. VOD service providers make available thousands of digital movies and high-definition premium video content to IPTV users. To increase their business and achieve the desired result of increased sale, many VOD service providers are turning towards added functionality such as personalization, recommendation, and web integration [1–4]. Recommender systems that are based on peer-to-peer (P2P) architecture [5] are employed to present personalized services. A peer-to-peer based recommender systems introduce collaborative intelligence to deal with the problem of overloaded information and benefit users by making to them intelligent suggestions on multimedia items based on their taste and preferences. These systems leverage the existing p2p network for data exchange among a large number of nodes. Each node maintains user-profile repositories that can be shared with other p2p nodes. Henceforth, the peer-to-peer based recommender systems generate suggestions about new multimedia content or predict the utility of a specific multimedia content for individual user based on similarity with other users in the network. However, it is usually a tedious task for users to browse and find out really desired multimedia content even among refined and personalized content provided by recommender systems. To overcome these difficulties, frameworks built over existing recommender system under the P2P architecture can offer solutions for the above target.

![Peer Networks Optimization](https://example.com/peer_nets_optimization)

**Fig. 1.** Smart Preview Generation Framework

This paper makes an exploratory study in this field, and investigates the key technical issues in designing and implementing personalized preview generation under P2P based recommender systems. Personalized content preview can be a short video version or subset of key-frames selected by other similar users acting as recommenders for an individual user. In this paper, we will discuss related work in the field of video abstraction, summarization and personalization in section II. We discuss the framework to abstract multimedia content in collaborative manner in peer-to-peer networks; establish a formal model within an optimization framework in section III. The implementation and results of our model is discussed in section IV. In Section V, we conclude the paper with our scope of future work.
2. Related Work

2.1 Collaborative Filtering in P2P Network

Collaborative filtering (CF) [6] is such a personalized recommendation technique that has been very promising both in research and industry. CF leverages the usage history of groups of similar users in order to make recommendations to a target user [7]. CF based recommender systems work by aggregating user assessment for multimedia content and matching together users who share the similar tastes. Users share their rational assessments and opinions regarding multimedia content that they view so that other users can better judge which content to view. In this manner, CF based recommender system provides interesting users a meaningful personalized multimedia content recommendation. However, regardless of its success, conventional collaborative filtering suffers a number of shortcomings. One of the most important aspects argued has been that finding recommendation is relatively easy; however, finding a good way to present recommendations is hard. Consequently, the user interface was argued to be representing about 50% of the relevance of a recommender system while the algorithm only 5% [8]. [8] further observes that accuracy was not enough and that higher accuracy does not automatically mean better experience. Therefore, our work considers such relevance in the model design.

2.2 Video Abstraction

There has been prior research on generating video skims. The MoCA project [9] worked on automatic generation of film trailers. [9] used heuristics set of rules on the trailers to determine objects or events. Certain research papers have have proposed methods to capture interesting regions based on viewer behavior along with sentence detection from video. However, to the best of our knowledge, no work has specially developed micro-personalized content preview in the collaborative manner for P2P based recommenders. In this paper, we study next-generation IPTV architectures, where IPTVs are integrated so as to form a P2P based distributed system. We explore how fundamentals of a P2P can complement existing IPTV architectures to support advanced functionalities.

3. System Design

3.1 Algorithmic Realization

To realize the system model, IPTV users define actions over a peer-to-peer recommender system stack in the multimedia video content. One of the main assumptions, we make is that IPTV user assists the system to demarcates or rates the scene segments of the multimedia video content. This assumption mentioned above is justified as in future IPTV sets movie content would be stored in the personal video recording (PVR) unit.

3.2 Collaborative Section

We use the Pearson formula we find the correlation between the specific IPTV user and the rest of the IPTV users:

\[
r(x,y) = \frac{\sum (R_{x,m} - \bar{R}_x)(R_{y,m} - \bar{R}_y)}{\sqrt{\sum (R_{x,m} - \bar{R}_x)^2 \sum (R_{y,m} - \bar{R}_y)^2}}
\]

\(R_{x,m}\) is the evaluation of user x for multimedia content m, and \(\bar{R}_x\) represents the mean value of the evaluations of user x. The correlation \(r(x,y)\) is lies within the range [-1, 1]. We describe our problem and mention the clustering methodology in Sections B. We represent selected scene content by a normalized histogram over content timeline. In problem definition: we assume the presence of a P2P based recommender system, \(U = \{u_1, u_2, \ldots, u_M\}\). We are given N video contents \(\{m_1, m_2, \ldots, m_N\}\). We aim at collecting scene in video content \(m_i\) that is collaboratively liked by similar peers as shown in Fig. 2 and Fig. 3. Both scene selected or annotated by IPTV users are represented in the scene matrix \(S = (s_{ij}), \ i = 1, \ldots, M \ j = 1, \ldots, TL\).

Here TL represents Time-Line of the content \(m_i\). Similarly, each video content \(m_i\) is represented by scene matrix formed by temporally segments which may be non-overlapping or overlapping. These temporally segments \(s_{1j} \ldots s_{lj}\) represented by histograms \(h_g[1], \ldots, h_g[n]\) in \(\mathcal{R}\) as illustrated in Fig. 4. The content is represented on timeline as following matrix:

\[C = (c_{ij}), \ j = 1, \ldots, TL\]

Using the correlation \(r(x,y)\), we assign weight W to recommender-peers and their associated scene selection matrix. Clustering of video segments from various users using matrix multiplication as following:

\[T = WS\]

Our goal is to merge, sort and select video segments from various similar users to get the most relevant segment boundaries which is represented as below:

\[F = (f_j)\] where \(f_j = t_jc_j\) and \(t_j = \sum_{i=1}^{M} s_{ij}w_i\) is jth component of TL.

Fig 2: Recommender-peers’ Scene Likeness Vs Content Timeline Segments of Interest in the video content that have been liked by similar users are merged in an unsupervised fashion by choosing the most weighted segment boundaries among the merged output of segments of all users as illustrated in Fig.2.
The approach is briefly described as following:

1. Normalize each individual peer-recommender’s selection by weight. We proportionate by take the certain confidence values.
2. Use an agglomerative clustering algorithm to group together the closest boundaries.
3. Select the highest weighted representative. In case of a tie, we selected the segment with more number of users.
4. Joint significant timeline is calculated as a weighted sum of the different user’s relevant marked scene segment matrix.
5. Optimize the final merged segments under timeline constraints.

4. Simulation

The whole approach was implemented using the Matlab environment. Short scene time-lengths (below a system defined threshold) in the output are discarded, as they are hard to perceive and rather disturbing in the final preview. We set a limit of 5 Recommender-Peers for the scene likeness demarcation as shown in the Fig. 3 while the Fig. 4 shows the aggregated scene liked by all the Recommender-Peers on the timeline.

Fig 3: Scene Likeness Marking on Timeline(Recommender-Peers)

Fig 4: Aggregated Scene Likeness on Timeline

We later apply timeline constraints and optimizing rules to discard irrelevant section and retain relevant section based on weight as shown in the Fig 5. Longer timeline lengths are split into several shorter segments (in accordance to scene change) in order to increase the number of different clips in the selected segments. This results into several shorter scene time-lengths instead of fewer longer ones.

4. Conclusion

We described our work towards a peer-to-peer based recommender system capable of extracting of scene segments and associated information that were liked by peers using IPTV. This system model over underlying recommender system enriches user experience. Our system maps scenes with other recommender-peers, enriches user experience, and improves recommendation viewing. The model we construct is useful to both IPTV users, and Video-on-Demand and Content Providers. Our model helps content service provider and users to benefit from micro-personalization of the video recommendations.

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References