

# VecLP: A Realtime Video Recommendation System for Live TV Programs

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## Abstract

We propose **VecLP**, a novel Internet Video recommendation system working for Live TV Programs in this paper. Given little information on the live TV programs, our proposed VecLP system can effectively collect necessary information on both the programs and the subscribers as well as a large volume of related online videos, and then recommend the relevant Internet videos to the subscribers. For that, the key frames are firstly detected from the live TV programs, and then visual and textual features are extracted from these frames to enhance the understanding of the TV broadcasts. Furthermore, by utilizing the subscribers' profiles and their social relationships, a user preference model is constructed, which greatly improves the diversity of the recommendations in our system. The subscriber's browsing history is also recorded and used to make a further personalized recommendation. This work also illustrates how our proposed VecLP system makes it happen. Finally, we dispose some sort of new recommendation strategies in use at the system to meet special needs from diverse live TV programs and throw light upon how to fuse these strategies.

## Introduction

Recent years have witnessed the Internet evolving from "text" to "multimedia". Online TV programs, with their high quality and easy-accessibility, have become users' main source of information and entertainment. Often, when watching a live TV program, the subscribers may have potential needs for certain related and interesting Internet videos to be recommended automatically to them as a supplement. However, many video hosting websites, like *YouTube*, *Vimeo* or *YouKu*, cannot provide such service. Even in most existing systems, many studies have attempted to bring visual content analysis into the scope of content-based video recommendations (Yang et al. 2007), without working for the live TV programs.

Moreover, there are several challenges on video recommendation for live TV programs: (1) Little priori information is known about the live program before it is played, and the only information can be extracted from Electronic

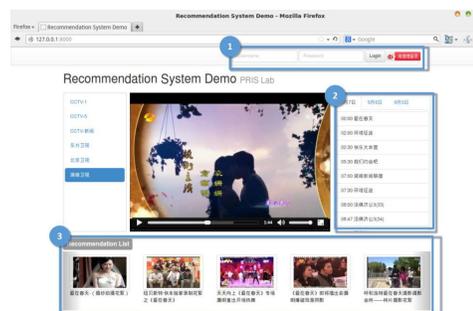


Figure 1: The user interface of our VecLP system. 1-user registration and login module; 2-EPG information of the TV program; 3-Recommendation lists with different recommendation strategies.

Program Guide (EPG), sometimes just a name like *Football World*, which is far beyond the need of traditional recommendation systems. (2) The "cold-start" issue seems to be more serious in the live program case since the subscribers tend to visit an online live TV program page without providing enough personal preferences.

In this paper, we thus propose a novel video recommendation system for live TV programs to handle the above challenges. The major contributions of this demonstration are three-fold: (1) A new application of Internet video recommendation system is proposed in a live TV program situation, which fulfills the potential information needs of TV subscribers. (2) In this recommendation system, we put forward effective solutions to make up the information shortage by means of a user preference model developed from his/her social information and browsing history. (3) Several new recommendation strategies in use at the VecLP system are disposed to fit special needs of different kinds of live TV programs.

## System Design

The VecLP system is divided into two parts: the **offline** part and the **online** part. The **offline** part functions to construct a video and social media library, separately, by searching the Internet according to the expanded EPG information and utilizing the social network information. While the **online**

part tries to analyze the live TV programs to get more real-time video information to match with the candidate videos in the library. All of this can be achieved by the following *four* modules: the data crawler module, the live video analysis module, the user preference module and the personalized video recommendation module. Figure 2 illustrates an overview of the VecLP system. The VecLP system takes the live TV programs as main input, then the key frames are extracted and analyzed, from which the textual and visual information are generated as a representation for the current broadcast. Meanwhile, VecLP checks whether or not the subscriber is a registered user and determines which recommendation strategies could be used, and then searches the video library to make an output, which is a recommendation list of relevant Internet videos for the current TV program.

**Analyzing Live Program Video.** The system auto-extracts the key frames of the live TV program by the image Color and Edge Directivity Descriptors (CEDD) and other features. In addition, much valuable information is carried out in other components, such as textual information, including the superimposed ones on the key frames and closed captions. For example, in sports videos, we employ a method combining face detection and jersey number recognition algorithms, to identify the players, which has vital influence on video indexing. A combined and cooperative analysis of these components would be far more effective in the real-time video processing and recommendation. In the next step, we adapt the visual features combined with the caption and the textual information extracted from the key frames to retrieve or recommend the Internet videos crawled and collected in the video library.

**Modeling User Preference.** We consider the user preference model as a combination of the long-term interests and the short-term ones, in which long-term interests represent users' stable preferences and are extracted from users' social network information, while the short-term preferences are generated by users' browsing histories. The social network information is collected by the data crawler module from *Sina Weibo* and consists of the following content: (1) semi-structured personal information, such as brief biography, personal labels, gender, age, location et al.; (2) microblogs the user has sent out; (3) social relationships (e.g., followers, followings etc). Work on this part is based on the basic idea that the social relationship, especially the follow relationship can be a good representation of the users' interests. In addition, the browsing history, such as the video clips that the user clicked or the score rated by the user, is also recorded in our system to generate users' short-term preferences.

**Fusing Multimodal Strategies.** After the steps above, the VecLP system gets a relatively substantial information on both the live programs and the users, and then the multimodal recommendation strategies can be respectively developed based on the following information: (A) the video search results; (B) the user preference models; (C) the users' social relationships; (D) the users' watching historical data as well as (E) the hot topics from social webcites.

In the VecLP demo system, the live TV programs are divided into 6 groups according to their types, which are *news*,

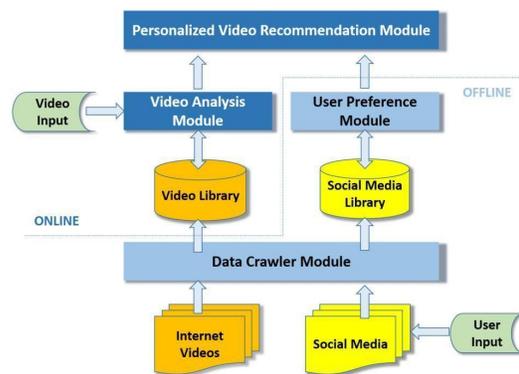


Figure 2: System design with two parts: the offline and on-line part.

*movie, sport, interview, entertainment and advertising*. Each category owns its unique recommendation strategy. Moreover, all the strategies can generally be discriminated into two categories according to whether the subscriber is a registered user or not. If an user visits the live program page anonymously, VecLP only uses the combination of strategies *A* and *E* due to the lack of user information. While for the subscribers logging into the system, the system can easily get users' surrounding information and generate their preference models, and the strategies *B*, *C* and *D* can be added to the fusion recommendations.

**Illustration.** Take a live TV play *Love in the Spring* watched by a login subscriber as an example, our proposed VecLP system may know little about the TV play except for the title in advance. Through the query expansion, the system collects the related information like the actors: *Shan-shan Yuan* or *Haoming Yu* in this play or style *romantic drama* etc., as well as a large number of online videos about these actors to construct the candidate library. Furthermore, by analyzing the subscriber's social network, the system then generates her preference model to obtain her interest in the actors or even the director, and gets a list of her "closest" friends from her social networks. In the end, the system uses several strategies to make a realtime personalized recommendation for her when watching this TV play.

Based on the diverse recommendation strategies, our proposed VecLP system can effectively and efficiently provide realtime personalized recommendation for the subscribers with various needs in task of watching live TV programs.

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