DynaLine: A Non-Disruptive TV User Interface for Passive Browsing of Internet Video

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ABSTRACT
The Internet provides a rich source of interesting and entertaining video content. Yet, the ability to access this content on the device most appropriate for viewing it – the TV – is limited by the constraints of that device. This paper presents a novel, low-interaction and non-disruptive user interface for the exploratory browsing of Internet video on TV. The system employs contextually filtered lists of related videos and familiar TV design metaphors. The reported user study demonstrates this approach to browsing is significantly preferred by users over conventional list-style user interfaces.

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General terms: Design, Human Factors

Keywords: Interactive television, digital video, information retrieval, visual design

INTRODUCTION
As the availability, diversity, and quality of Internet video continues to grow, innovative methods for discovering and viewing these videos are required. Internet video provides diverse content from professionally produced news shows to unstructured, user-generated video blogs and personal video galleries.

The typical mode of accessing Internet video is the personal computer (PC) – a device that was not specifically designed for enjoying such content. Television was designed for watching video on, but is awkward for accessing most Internet video websites. Additionally, the effort and interaction required to browse the typically long search result sets of a video search is unnatural within a passive TV-watching context.

In this paper, we present DynaLine, a user interface technique that leverages familiar television metaphors to allow the passive perusal of Internet video while watching TV. This is done by using the current video context to implicitly infer the set of videos that a user would be most interested in. This set is then presented to the user in a non-disruptive fashion that allows concurrent viewing of the main television show together with a targeted list of related videos.

The paper begins with a brief discussion of related work before discussing the motivation for the DynaLine interface. A detailed design of the DynaLine interface is then presented, followed by results of a user study evaluating its effectiveness. The paper concludes with a summary and an outline of future work.

RELATED WORK
User interface research on digital video information retrieval such as [4, 6] has focused primarily on PCs. Less work has been done in the TV domain, where less user interaction is preferred. [5] guides information retrieval via contextually relevant feedback, but still requires PC-levels of user interaction. [1] provides information retrieval through a TV but only allows the viewing of metadata.

[3, 7, 9, 11] provide insights into desirable design features for interactive TV, such as low disruptiveness, access to multiple data sources, and remote control usage.

Navigating a media space without the use of traditional search has been researched using various implementations of hypermedia links [10]. Navigating these types of links usually requires precise pointing devices and high user involvement. Further, difficulties in authoring such links have hindered their popularity.

Unexplored in the literature is an interface designed appropriately for use with a TV and a conventional remote control that supports access of the Internet video corpus as it exists.

INTERNET VIDEO ON TV
One common method of discovering and browsing videos on the Internet is via interactive search. Users skim thumbnails, titles, and filenames, and then review several candidates before finding an interesting video. Doing the same with a remote control on TV poses several usability problems [9]. For example, keyword-based search requires text entry and both subscriptions (e.g. RSS) and structured hierarchies require long sequences of interactions.

Using Lists

Lists of hyperlinks are another common of way of discovering and browsing videos. Common lists of Internet video include "Popular", "Related", or "What's New". These lists can be either automatically generated using information retrieval techniques or manually constructed.

The simplicity of lists makes them good candidates for use in the TV domain. While many kinds of lists would be useful on interactive TV, the present work studies how to best display and interact with lists of "Related" videos.

Simplifying access to Internet video, it is hoped, will improve the experience of using TV by providing access to a rich source of non-commercial content inaccessible with traditional TV. For example, if a user is watching a video about Indian politics, related Internet videos may include Indian local news as well as more unconventional content like a backpacker's video blog or Indian home videos.

StaticList

These observations inspired the design of a TV interface called "StaticList". The interface (shown in Figure 1) allows the user to press a button at any time to display a list of Internet videos related to the currently playing video (herein called the 'source video'). Source videos can be digital TV programs or video from the Internet.

An informal study showed users understand the concept of the StaticList interface but find browsing the list (particularly when it is long) disrupts their TV-viewing experience. Another problem is that for source videos that contain many topics (e.g. news) the list can contain items about future topics that the user has not yet seen. For example, if the user has only watched the golf section in a show about golf and surfing, they will feel confused if the related video list contained surfing videos.

Contextually Filtered Lists

One way to reduce information overload is to only display the best N related videos. This will result in a shorter list but does not solve the problem of future topics appearing in the list.

Figure 1: List-based access to related videos from the Internet.

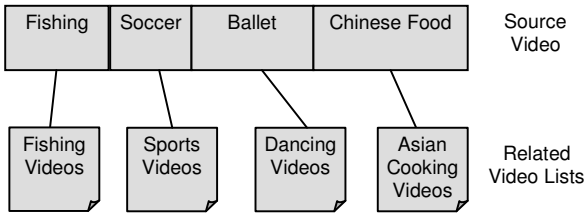

Figure 2: A contextually filtered list displays only videos related to a certain topic in the source video.

An alternate approach is to only show videos related to the current topic in the source video. This shorter list is referred to as a *contextually filtered* list. This method, illustrated in Figure 2, eliminates the issue of future topics while ensuring that the related video list is still short.

DynamicList

"DynamicList" is the result of using the StaticList interface with contextually-filtered lists. Ideally, this shorter list will reduce both navigation time and viewing disruption.

Informal experiments showed that the size of the lists is more manageable than those in StaticList. However, because the lists were constantly changing (based on the current topic in the source video), users frequently displayed the list to see what other videos were available simply out of curiosity. Thus, the overall viewing experience was still disrupted because of the frequent pausing required to review the list.

DYNALINE

The present contribution, DynaLine, attempts to address the shortcomings of the previous designs by using the following design principles:

- *Passive Perusal*: The user is not required to press a button to see the list. Instead, the videos are automatically shown to the user when they are relevant.
- *Non-Disruptive*: Even when using the list, the viewing of the source video is not interrupted.
- *Familiar Metaphor*: DynaLine leverages and repurposes the familiar metaphor of a headlines bar, a standard feature on many TV news broadcasts.

Figure 3: The DynaLine interface with remote control navigation.

When enabled, DynaLine works as follows (see Figure 3):

- A bar at the bottom of the screen is used to display the thumbnail, title, source, and duration of one related video at a time.
- When a new topic in the source video begins, the first item in the contextually filtered list is shown in the bar.
- After 6 seconds, the next item in the list is scrolled vertically to take the place of the current item.
- When the source video progresses to the next topic, the first item in the new topic's related videos list scrolls horizontally from the right.
- Users can cycle through the list manually using the Up/Down buttons on the remote control.
- Users can navigate the set of topics using Left/Right.
- When navigating the set of topics, the temporal position of the source video is synchronized with the DynaLine bar.

A number of shortcomings arise with this approach. In particular, users may find the images and words on the bottom of the screen distracting. Another major concern is that it is not possible to see the whole list at once. Finally, the bar will either obstruct a small portion of the bottom of the source video or the source video must be reduced in size to make room for the bar. Thus users may find the bar irritating. Some of these concerns were tested in the experiment reported below.

Queuing Videos

Pressing 'Record' on the remote control adds the selected related video to a queue. Doing so displays the Guide, shown in Figure 4. To further build upon familiar TV metaphors we used the traditional on-screen 'TV Guide' to represent this queue. As a result, the queue looks and acts like a 'TV channel'. The queue is navigated by the buttons graphically marked "|<" and ">|" on the remote control. In the current design, the Guide only shows upcoming content for the next 10 minutes because many Internet videos are often quite short (2-3 minutes).

EXPERIMENT

An experiment was conducted to observe the performance and usability of a) contextually filtered results and b) passive perusal of those results. The three systems used were:

1. StaticList (Unfiltered, Active)
2. DynamicList (Filtered, Active)
3. DynaLine (Filtered, Passive)

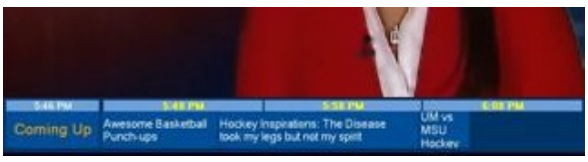

Figure 4: The Guide showing 3 related videos.

Figure 5: 9 buttons on the remote control were used. MORE INFO (A) toggled the visibility of the 'Related Videos' window in StaticList and DynamicList, REC (B) added a video to the queue, GUIDE (C) displayed the Guide, and '|<' and '>|' (D) navigated the queue.

The remote control shown in Figure 5 was used in all systems. The Guide feature shown in Figure 4 was also available in all systems. All participants used 3.0 GHz Windows XP machines with 19" CRT monitors.

A total of 46 (9 female) expert computer users, average age 25.2, participated in the experiment. On Likert scales of 7, participants answered 0.7 regarding how experienced they were with interactive TV and 2.9 regarding how often they searched the Internet for video.

A 7-minute interactive training video followed by 3 tasks was completed by all participants. For each task, the user watched a 2.5-minute source video that was hand-picked from popular news video sources. Three types of news videos were used: technology, fashion, and sports. One interface was used for each task. The order of the videos and interfaces were both randomized such that each video was used with a different interface. Users were free to add related videos and view them as desired. They were required to watch the source, but not related, videos in their entirety. They were free to navigate the queue during the source video or after its completion.

The set of related videos was generated manually by the authors. An average of 23.7 related videos were chosen for each of the source videos. Each source video had an average of 5.7 topics delineated by hand, with 4.5 related videos per segment. Participants also completed a short post-experiment survey where they ranked each system in ease-of-use, obtrusiveness, and so on.

Results

The experiment results showed strong support for contextually filtered lists over unfiltered lists and passive over active browsing styles. Figure 6 shows the overall user preference ranking of the different systems.

Contextual filtering (DynamicList) was ranked higher than unfiltered results (StaticList), with 30% of users most preferring the DynamicList interface compared to only 9% most preferring the StaticList interface. From user feedback, this can be attributed to the reduction of information overload in DynamicList.

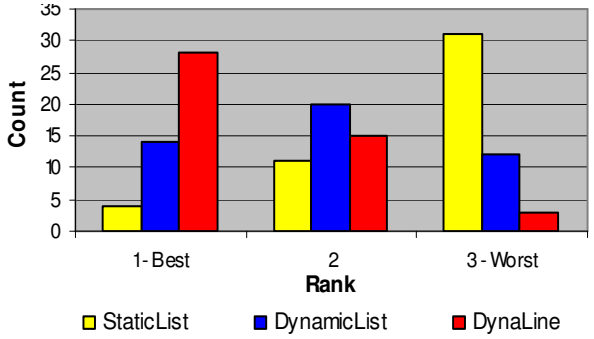

Figure 6: Overall user preference ranking.

Additionally, the average number of videos queued (3.04, SD=1.77) using DynamicList was not significantly different ($p < 0.05$) from StaticList (2.6, SD=1.37). This indicates that when using DynamicList, although users could miss related videos by not viewing the 'Related Video' window for every topic, the shorter lists allowed them to find related videos of interest more easily.

The DynaLine user interface was the most favored interface, ranked most preferred by 61% of users, and was significantly more preferred compared to the other two methods ($p < 0.01$). User comments supported our primary design goals of allowing the passive perusal of related content without requiring the source video to be paused.

Additionally, users did not find the DynaLine bar as annoying as we thought they might; on a Likert scale of 7, participants rated the annoyance of the DynaLine as 2.0 (SD=0.3), with 0 being "Not annoying". However, users did mention there were several types of videos, such as sitcoms and news shows with existing headline bars, where DynaLine would not be appropriate.

Surprisingly, when ranking which *source* video users found "most interesting", those watched with DynaLine were ranked higher than those watched with StaticList ($p < 0.05$) and, to a lesser extent, DynamicList ($p < 0.1$). This suggests that the context switch required to navigate StaticList and DynamicList detracts from the video-viewing experience.

SUMMARY

DynaLine is a low-interaction and non-disruptive user interface for the exploratory browsing of Internet video on TV. The system combines contextually filtered lists of related videos with successful design metaphors to simplify access to Internet video via TV.

The reported user study demonstrated a significant preference for this style of passive browsing over a more conventional, window-based user interface. Additionally, it was also shown that contextual filtering increases user satisfaction without adversely affecting the ability to find related videos.

Future work should look at how DynaLine could be modified to better support other types of programs such as sitcoms and news shows with existing headline bars. Further, the authors plan to experiment using automatically generated lists of related videos.

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