Location Based Video Flipping: Navigating Geospatial Videos in Lean Back Settings

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ABSTRACT
A geospatial navigation concept for browsing videos according to their tagged geographic location is proposed. It expands two paradigms for selecting video content: First continuous, yet one-dimensional flipping through subsequent video clips that are ordered in lists. This is state-of-the-art in lean back settings and usually done with a regular HbbTV remote control. Second, the discrete selection of video clips that are positioned on maps according to their tagged location. This is usually done with mouse and cursor in lean forward settings. The proposed application achieves the ease-of-use of a remote control, while providing the means of navigating videos on maps. The four way keys on an HbbTV remote are mapped to the according cardinal directions, while geographical navigation options are previewed on the TV screen. A subsequent qualitative evaluation shows users positive appreciation of the new paradigm, while revealing that the on screen preview needs stronger visual clues.

Author Keywords
Devices & Interaction Techniques; Location Based Video; YouTube API; HbbTV; Remote Control; Lean Back

ACM Classification Keywords
H.5.m. Information interfaces and presentation

MOTIVATION
We introduce the term "location flipping" and aim to establish it as the geospatial equivalent of channel surfing with a regular HbbTV remote control.

Location flipping is hopping through videos on a geographical map while maintaining the ease-of-use of a remote control that is usually seen in lean back settings. While regular flipping refers to hopping through lists of television channels, this posture has been used in more active lean forward settings in recent years. More interactive settings as in Smart TV or Web TV enable users to select videos that are positioned according to the videos geospatial location on a geographic map, but lack the ease-of-use of a remote control. Location flipping aims to combine both paradigms for navigating geospatial content with a regular HbbTV remote control in a lean back setting. These remote controls are equipped - among other keys - with four colour buttons and a four way navigation. As those keys are standard on all "Smart" TV remote controls, they will be used as the pivotal navigation for the proposed paradigm (See figure 1).

The remaining paper is structured as following. First we present related work and inspiration for the design of the application. Second, we briefly discuss the user centered design process for developing the proposed novel lean back interface. This is followed by a short summary of the implementation and a longer description of the interactive prototype. The paper ends with a brief evaluation and future work.

Figure 1: HbbTV Remote (Detail)

RELATED WORK
Flipping channels on a TV set is a well-known task during mindless video browsing. Its equivalent on video platforms in the web is the repetitive consumption of relatively short video clips requiring a more complicated two-step process. A text based query has to be formulated resulting in a computer-generated list for further selection. From a user's point of view the first option has shown to be preferable in lean back settings: a remote control has few buttons and is favorable for flipping through a finite variety of channels. However, lean forward settings allow the navigation of an infinite amount of potentially more suitable video clips with the downside of a more elaborate navigation and subsequent user involvement.

Combining the ease-of-use to navigate small amounts of video clips with simple navigation devices with the benefit of accessing huge numbers of clips is a challenging task [7]. Customized playlists have been proposed to address the

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beforementioned challenge. Here, clusters of similarity are generated [3], e.g. based on popularity, genre or emotion [1]. These are ranked, thus reducing the selection task to a one-dimensional list.

Placing video clips on maps according to their geographic content is another promising way of clustering videos by similarity [6], which has shown to be equally challenging [9]. Thus, making those clips available for an equally uncomplex navigation has been an afterthought. Approaches for selecting video clips that are presented on maps with a remote control exist [2], but are restricted in a couple of ways, lacking video previews being one of them.

All the reviewed proposals share one main obstacle: Users need to filter huge amounts of possible videos in order to obtain manageable results. This is in contrast severely limited by the remote control as navigation device. We propose a solution that has been developed in a participatory design process and that was subsequently implemented as an interactive prototype.

USER CENTERED DESIGN PROCESS

The design process was based on various stages. First a questionnaire was conducted to determine user expectations of location based flipping. This first stage was used to generate insight and to find appropriate participants for the following workshop where an analog prototype was developed and evaluated.

The questionnaire was conducted with 26 people, 12 female, 14 male between the ages of 19 to 76 years exhibiting a broad range of variation with respect to both frequency as well as aim of use of television and web-videos. Only two users took advantage of interactive services in TV. In summary, most users mainly watched web-videos on YouTube recommended by other users. Few of them could imagine a service for geographic related videos and the automatic recommendation of relevant geographic locations. Therefore, the closest affirmation of a use case was an active search for locations.

The questionnaire was followed by a design workshop based on the concept of an Unfocus-Group as proposed by [5]. Four distinct participants of the questionnaire where asked to take part in the following workshop. Two of them had proposed an interesting variety of ideas for geospatial navigation, while the other two where chosen because they could not imagine a location based video service at all. The fifth participant is a designer, specialized in interactive TV-solutions, the sixth is a computer scientist, specialized in developing HbbTV applications. The workshop was conducted on two days in an informal setting in one of the labs at the authors department. This design workshop was structured around three areas of inspiration. The first area consisted of the questionnaires findings as an information base of user expectations. The second area was a brief summary of the state-of-the-art of remote controls for Smart TV. In addition a variety of remote controls was brought to the workshop by the participants and subsequently discussed. The third area was a brief presentation of various inspirations from information visualization. The Focus and Context paradigm [4], specifically those proposals that enable the browsing of dense information clusters with the metaphor of a rubber sheet, e.g. [10], were hypothesized to be a possible direction for the design. During the design workshop a variety of prototypes has been developed in two teams of three people. Each team proposed one final design to the group, where one design was choosen to be refined by the whole group. A digital rendition of this prototype is shown in figure 2.

Figure 2: Digital Rendition Of First Prototype

The aim is fast browsing and flipping through video clips within the four cardinal directions of their geographic relation to each other. The prominently shown video in the middle is the video nearest to the users current geographical position. Four thumbnails are positioned in the cardinal directions relational to the users position. Each of these has two smaller thumbnails that present a preview of videos that can be reached after another step of flipping. Selecting a direction is like steering in the corresponding cardinal direction. Other functions can be reached with the four colour buttons. A couple of possibilities for those have been proposed: selecting another reference point, saving a favorite video, filtering the genre, showing the underlying map, restricting time or radius for the video search.

IMPLEMENTATION

The interactive prototype was implemented as a native application for manipulation via remote control and presentation on a regular TV screen. In a first step, a web-server with a database and a retrieval system was developed. Second, georeferenced video clips were obtained to form an extensive library of video clips. Third, the native application was developed.

Navigation Scheme

A navigation scheme of the final application is shown in Figure 3. The middle of the screen shows the current video clip. The four way navigation of the HbbTV remote is mapped to the four cardinal directions and allows flipping through videos depending on their geographic location. The four colour keys are linked to further functions, which are a

geographic map, filtering of the presented video clips, a list of those clips and a menu for further options.

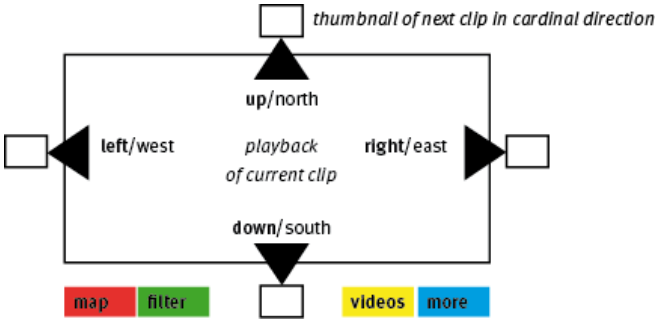

Figure 3: Navigation Scheme

Client-Server

Following the huge success of HbbTV in Europe [8], we implemented the prototype in CE-HTML for presentation in a native HbbTV application. We did unload the spatial calculation of videos and their subsequent retrieval from the client application to a web server. The transfer of results is done with JSON objects using AJAX. So the client on the TV is dedicated to DOM manipulation and video playback.

Obtaining Videos

All videos are provided by the YouTube Data API v2. This API allows the retrieval of only those video clips from the video service that already contain a geographic annotation. The main advantage of this approach is that videos are georeferenced, while the main drawback is the potential irregularity of those metadata: We have to rely on their correctness, as there is no automatic way of confirming the validity of those user-generated tags.

Obtaining Geographic Position

We automatically read out the users current geographical position via IP address. Based on this information, an initial search retrieves only geographically close clips.

Spatial Position

The calculation of the spatial positions on a map is done by cutting the circumscribed circle of a given location into four parts. Each part is a sector of 90 degrees and points to a cardinal direction. (See figure 4). All retrieved clips are assigned to a sector based on their coordinates. The clip with the shortest distance from the center is selected as the next reachable entry for each sector. Thus, each video has four direct reachable neighbors.

When a user navigates in a direction, the set of available videos will be updated with new results based on the location of the selected video. To sustain a continuous presentation in the main view, the client sends queries with updated coordinates to the server. Empty sectors do not enforce an extension of the query. In case there are items that share the same location, a queue will be initiated for subsequent items. Only the first item will be used for calculation and presentation.

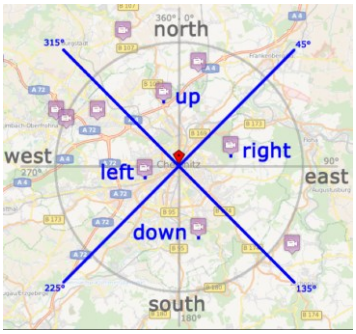

Figure 4: Example Of Calculating The Spatial Position

Searching

Search starts in a radius of one kilometer around the users location. For now this radius is arbitrarily chosen and shall be user definable in future implementations. For performance reasons search results are restricted to 200 clips per request. If a query returns less than 50 videos, the radius is increased stepwise. The maximum allowed radius however is limited to 1000 kilometers by the YouTube Data API.

INTERACTIVE PROTOTYPE

A screenshot of the functional prototype is shown in Figure 5. Upon launching the application, the video clip that is nearest to the viewers geographic position is shown in large and in the middle of the screen and starts playing. Triangles are arranged on all four sides of the video and indicate all four cardinal directions that can be navigated with the four way navigation on the TVs remote control. Next to those triangles are four large thumbnails showing previews of the video clips that are directly west, east, north and south of the selected video clip. Next to those are two more thumbnails for each of cardinal ones, showing brief previews of their subsequent clips. The four colour keys trigger functions that are shown in the lower third of the screen. The red key shows a navigable map of the currently selected area, the green key shows an interface for filtering the retrieved video clips by genre and the yellow key shows a one-dimensional list of all retrieved video clips. The blue key is reserved for yet to be determined features.

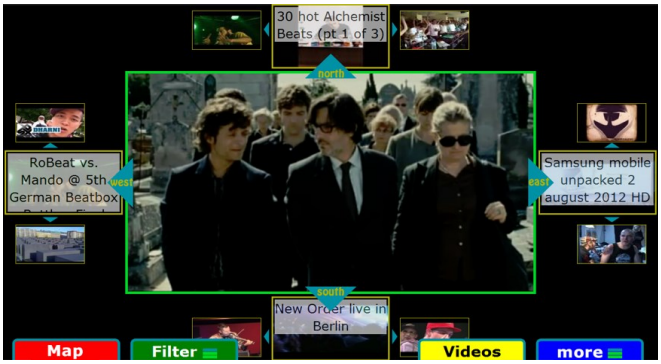

Figure 5: Digital Prototype - As Presented On TV Screen

EVALUATION

A qualitative evaluation of the interface was conducted with a total number of eleven users, six female, five men, aged 19 to 33. All users had previous experience with Smart TV applications, while not all did use those on a regular basis. The study was carried out as an observation study without feedback from the supervisor.

The tests were conducted under real life conditions in a living room using a DVB-S set-top-box, a 42-inch plasma television and a HbbTV remote control as shown in figure 1. Each user shared the sofa with the supervisor, while no other user was present. Users were given five minutes to try out the application before they were asked to perform two tasks. After completion of those, users were asked to rate their experience with the service in a colloquial conversion with the supervisor.

Overall findings have been very positive. All participants used the four way navigation buttons intuitively to access and watch location based video clips. However, three users did not identify the cardinal directions or the spatial position of the thumbnails. Thus, in a future implementation, a more prominent visualization of the connection of cardinal direction-triangle (see figure 4) and four way navigation is needed. Those three users gave valuable insight that will be used for the subsequent redesign.

The first task consisted of limiting the set of video clips to "current news". This was done fast and could be completed by all users. The function for filtering the results via genre was seen by all users as a welcomed addition to their position on a map.

The second task was to find video clips from a city that was different from the users actual location. This prototype did not include a choice of locations for the query, thus the only way was to browse in a persistent cardinal direction and repeatedly check the actual position on the map, accessed via the red key. Five out of eleven users tried to use undocumented buttons on the remote to access a possibly hidden menu for selection. Those five users did experience this task to be lengthy and ultimately disappointing.

For future iterations of the prototype, a function for selecting geographic locations different from the users initial location needs to be implemented.

FUTURE WORK

The goal of the proposed interactive prototype was to determine if users find the idea of location zapping useful and whether our proposed navigation concept for flipping location based video clips is suitable for that application. Although the application has proven to be an efficient and feasible way to do so, especially considering the constrains imposed by a HbbTV remote as a very handy, yet limited navigation device, a variety of future functionalities has to be considered.

Users need to determine the geographic point of their departure, thus making search and input of a position necessary. In addition, parameters like the search distance threshold, duration, creation date, et cetera need to be considered.

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