The project aims to enhance the experience of watching documentaries by exploiting the affordances of the digital medium (procedural, participatory, spatial, and encyclopedic) and by recreating the current uni-sequential format in a navigable and interactive format. Documentaries present complex issues and there may be many documentaries on an issue, these documentaries tend to present different perspectives and focus on a sub problem. In the current model, it is difficult for viewers to find connections between such documentaries. Documentaries address issues that involve a number of actors like people, places, organizations, opinions, and events. It is challenging for viewers to keep track of all these actors in the course of the documentary and have trouble in recollecting their role towards the subject of the documentary. Current viewing model does not provide any supporting information while these actors are introduced or reappear.

Documentaries are currently presented in a uni-sequential format, limited by the prevailing media conventions. They are still watched the same way on a computer/tablet/internet-connected device as they are watched on a television, which has limited interaction capabilities as compared to a computer. Documentary playback model on computers does not exploit the complex interactions permissible by the affordance of the digital medium. The uni-sequential format limits our ability to dig in and explore the topic and its relation to other events, to find patterns, to ask and answer questions about the things being shown on the screen. The content is organized in a sequence based on the editor and director’s perception of the flow of events, largely influenced by the point in time in which the events occur. The current form of watching documentaries does not exploit the fact that a user might be watching the same documentary again, out of interest or to find out more about the subject in depth, thus providing a general user experience that is not customizable.
A documentary is a powerful genre for informing people about complex issues which unfold over a long duration and if a user wants to navigate between scenes in the documentary, it can be only done using the seek bar, which does not provide any additional information while the user looks for a particular scene and users have to skip and pause at scenes, understand what the scene is about and then move on to the scene that they are looking for. People now expect on demand content which can be selected from a large archive of content, however, the current viewing model does not show any connections between the constituents of this vast archive of content. An analogy can be drawn with a Wikipedia article, as the article itself contains hyperlinks to other articles, such that if readers are curious to know more about a topic, they can do so by clicking on its hyperlink to get in depth information.

In the current format, while watching a set of documentaries on an issue, it is difficult for viewers to grasp the big picture, as they are only aware of the things that they have grasped by viewing a subset of these documentaries. This viewpoint may change over time as later events may contextualize earlier ones and roles of actors are understood differently over time as more of the documentaries are watched. There may be parts in a documentary that viewers would like to visit later, the current model does not allow for bookmarking/favorites, so that it is easier for users to reach to points of interest quickly.

Characteristics of targeted users are that they are interested in current affairs, have watched some kind of documentary before, they have previously experienced watching TV shows or movies online for e.g. on Netflix, Hulu etc. The users have basic proficiency in using a tablet computer and English reading and comprehension skills.
For the proposed solution, documentaries that fall in the category of ‘War on Terror’ have been chosen from PBS’s Frontline. Frontline divides documentaries into categories, taking documentaries within a category would allow for representation of the complex relationship between them. The motive behind choosing Frontline is that it has an archive of a large number of documentaries subdivided into categories and its documentaries are regarded to be unbiased and comprehensive about the topic.

With the advent of the iPad and other tablets and smart internet connected television, the idea of using the iPad as a remote control seems very natural, where the television and the tablet synchronize harmoniously to provide a richer experience to the viewers. This two-screen setting can fill the holes in the current viewing model by providing a supporting information exploration structure on the iPad when viewing content on the television. The iPad would be the primary interactive and controlling agent, where the users would navigate through documentaries on various topics and select a documentary. The iPad would then allow the users to explore the documentary in depth and provide ancillary information about the documentary. Information can then be organized and navigable so that people have a context about what they choose.

If the user decides to watch the documentary, they may do so on the television. While the television plays the documentary, information and articles related to the current playtime would be available to interact on the iPad. Interviews are an important part of documentaries. It is sometimes difficult for viewers to understand the role of a person in a scene, which is common in documentaries as it involves many interviews with different people about the subject, a viewer may hence find it difficult to keep track of these people and their role. A bio of the interviewee appearing on the iPad when the person is on screen along with an ability to explore their relationship with other actors would address this problem.

Such a solution would require accessible metadata for each scene of each documentary. There is no current standardized vocabulary and structure and would require manual analysis and tagging of each individual scene from the selected pool of documentaries.
The coding scheme at the documentary level includes
- A documentary id
- General theme id of the documentary
- Air date
- Ids of other related documentaries

The coding scheme for Scene level
- A scene id
- Scene start time
- Scene end time
- Speaker id in the scene
- Ids for places referred to in the scene
- Ids for events referred to in the scene
- Ids for people/organizations referred to in the scene
- Interview date
- Ids of other related documentaries with this scene

The navigational and interactive views are:

**Timeline view**
This view allows for exploring a documentary based on the sequence of events in it and solves the problem of seeking more informatively within a documentary and provides finer granularity at the scene and event level. A collective timeline view for all the events in a theme (like War on Terror) addressed by a set of documentaries allows users to see how the story develops over a period of time and provides coarser granularity.

**Filtered List view**
Documentaries are tagged with keywords, an interface allows for filtering of the documentaries based on their tags and presents the documentaries in a grid of row and columns.

**Playback view**
When a scene is being played on the television, additional information like related documentaries, bios of the speakers, trivia, and related documents would be shown on the iPad, synced with the content of the TV. Description of additional content:
Overview: At the beginning of the documentary, an overview screen on the iPad summarizes the theme and presents the questions being raised and answered.

Extended Video: when video clips are shown in a documentary, the complete extended version of the video can be seen on the iPad. Playing the video on the iPad pauses the documentary to avoid audio interference and division of attention of the user.

Interviewee Bio: when people are being interviewed in the documentary, the iPad provides their bio, their affiliation and the subject that they are talking about.

Recent News Article Updates: documentaries tend to present the recent situation about a topic, which evolves as more events occur from the time the documentary airs. The iPad provides a current perspective on the topic by proving updates in the form of recent news articles.

Interactive Maps: regions mentioned in documentaries are presented as an interactive map on the iPad. For e.g. in the documentary ‘Kill/Capture’, certain regions in Afghanistan are mentioned where the Taliban is know to be active. An interactive map appears on the iPad at that time, which provides the regions of operations of the commanders and their network.

Press Release: Full text of the press releases mentioned in the documentary is available to read on the iPad. The user may pause the documentary to read the release.

Graphics/Illustrations: Graphics and illustrations of statistics that effectively present data relevant to the current content of the documentary appear on the iPad.

Intersecting Documentary: Due to the limited run time of documentaries, some of the topics are not covered in depth, so as to prevent the documentary from digressing from its original theme, but are merely touched upon. Having an archive of documentary, it is possible that another documentary explores the topic more deeply and provides another perspective on the topic. In which case, such an intersecting documentary appears on the iPad.
RESOURCES

The resources needed for the system are divided into three parts:

**Client Side iPad**
- iOS4 or later with Safari
- Broadband Internet connection
- Technologies: HTML5, CSS, jQuery, JavaScript

**Client Side TV**
- A web browser
- Broadband Internet connection
- Technologies: HTML5, CSS, jQuery, JavaScript

**Back End Web Server**
- Apache Web Server for PHP, MySQL Database
- Media server for video files
- Technologies: PHP, MySQL
Motorola Mobility [1] prototyped a companion device experience that enhances TV viewing by providing auxiliary information and media on a second screen. The additional media is semantically related and synchronized, in terms of timeline, to the TV content. A three-week field trial in 11 households was conducted and the participants used the prototype as a companion to their TV shows, the overall feedback to the concept was quite positive with 10 out of 11 participants saying they enjoyed the experience. The researchers concluded that the prototype allowed participants to better connect with their TV shows and have an enriched social life around the TV by providing holistic infotainment. The viewing aid by HBO GO for watching the Game of Thrones on a desktop based one-screen online environment includes information synced with individual episodes [4]. It provides additional interactive information about the characters in an episode, interactive maps, storyboards, props and production details and commentary.

StoryLines [5] from the eTV lab at Georgia Tech explores a timeline-based method of navigating news and episodic television in the context of rich archival resources. Using Battlestar Galactica and news coverage of the Arab Spring as representative content, this prototyping project used a tablet computer as a navigation device. Users could identify individual story threads within a complex multi-threaded story environment by filtering the items on a composite timeline, which then split into multiple timelines. Another application from the eTV lab at Georgia Tech, Story-Map [3] implements a companion iPad application for the FX series Justified. While watching an episode, the application provides synced real time evolving map of characters, with relations between characters shown as connecting lines. The connections have an icon that represents the kind of relationship (enemies, friends, married) and the character thumbnails can be tapped to see a brief bio of the character. The relationship icons can be tapped to bring a set of videos that recap the relationship between the two characters, till the point of time of the current episode. The concept of interconnected documentaries has been explored well in the American Experience [2] project at the eTV lab at Georgia Tech. The proposed implementation would leverage the strengths of the existing system and try to improve on its shortcomings.
STUDY OF USER CHARACTERISTICS AND NEEDS

In a 2011 survey, Nielsen/Yahoo interviewed 8,384 U.S. residents age 13-64, with 5,313 of those being mobile Internet users. Of that 5,313, 86% said they used their device while watching TV. That number grows even higher, to 92%, when you look at the 13-24 year old bracket. When using a handset, 33% were using mobile applications, 37% were browsing the Internet, and 40% were catching up with friends on social networks. Of those using their mobile device, 25% say they are browsing content related to the program they are watching. The survey shows the potential of using a secondary screen to provide playback control and to show additional information about the content while watching television shows like documentaries.

Initially, a target demographic of the users was created. The users targeted were those who were interested in current affairs, have watched some kind of documentary before and have previously experienced watching TV shows or movies online for e.g. on Netflix, Hulu etc. The users should have had basic proficiency in using a tablet computer and English reading and comprehension skills.

Based on the target demographics, semi-structured interviews were conducted with 10 people, 8 male, 2 female, ages 21 – 30, all of whom met the target criteria. Additionally, 5 had watched a Frontline documentary before. The interviews were initially open-ended and unstructured and then proceeded to semi-structured when a common pattern of viewing habits emerged. Interviewees were introduced to the Frontline website and were asked questions about what they think about the website as an archive of the documentaries, If they were able to understand the overall theme of a documentary, and what additional information they seek when watching the documentary. Answers to these questions revealed that users had to browse a few documentaries before selection one, some users preferred watching documentaries of a certain category and that it is sometimes intimidating and confusing to choose a single documentary from the long list of the archive. Other insights were that some users search online about a topic before watching a related documentary and users typically have to watch more than one documentary to get the big picture or the overall theme of the topic. Some users had difficulty keeping
track of the people being interviewed, some wished to know the current situation about a topic covered in a documentary recorded a few years ago.

Two use cases and accompanying personas were created based on the above responses. Use case 1 is for John, a 28 years old young Silicon Valley executive who likes to keep up with current affairs but has lately been out of touch because of his busy schedule and frequent business travel. He has seen Frontline documentaries on TV before and wants to catch up with the current affairs, but can only access the content online in his free time away from home, as he has to spend his free time with family when at home. He would like to have something that gives him a quick overview about a topic but also conveys how the topic has changed over a period of time.

Use case 2 is for Jane, a 21 years old college senior who has to submit a report on any current affair topic for her political science class assignment. Jane doesn’t enjoy reading newspapers or keeping up with current affairs and her friends recommend watching Frontline documentaries on the ‘War on Terror’ and write a report on that as Frontline has a comprehensive list of documentaries on that topic. She begins watching the documentaries but quickly realizes that keeping track of the people, places and events in her head is difficult and she has to pause the documentary frequently, note down points and then resume. She would like to have something that provides additional information in such scenarios, so that she can refer to them later and does not have to build a mental model of the people, places and events.
Based on the responses from the initial interview and the use case scenario and personas, high fidelity mockups (see Figure 1) of the proposed system were created. The prototype was shown to the initial interviewees and was brainstormed with Experimental Television Lab members, who are well conversed with the field of interactive television. The members were given a walkthrough of the concept, the interfaces and interactions with it in the form of a storyboard. The members then discussed possible flaws, difficulties they faced in understanding the prototype and suggested features that may be included to make the application more usable.

One of the suggestions was to include a play/pause control on the secondary screen so that the user can pause the documentary while looking into additional content.
like news articles and to automatically pause the TV playback if the user begins to watch video on the tablet, so that there is no interference between simultaneous audio playback and division of attention.

The initial design showed one additional piece of information on the secondary screen at a time and it would go away when the subject of the documentary changed. One concern was that the user might be in the middle of consuming additional information and it would defeat the purpose if the additional information goes away while the user is consuming it and would cause user frustration. A suggestion was to add ability for users to move back and forth between the previous screens with additional information. This coupled with the play/pause feature would give sufficient control to the user, to proceed at a pace comfortable to them.

Since the archive has over 100 documentaries organized in more than 20 categories, a suggestion was to implement the prototype completely for a single category and provide additional information for a single documentary first instead of aiming to implement it for the complete archive, which might not be possible given the limited timeframe. This was necessary so that user studies can be conducted later on with complete implementation for a subset of the archive and the experience can be extrapolated for all the categories and the documentaries that fall in it. All of the suggestions were incorporated in the implementation of the prototype.
IMPLEMENTED PROTOTYPE

A. Home Screen of Categories

The home screen (see Figure 2) shows the categories in which the documentaries are divided, as on Frontline’s website. The category of ‘War on Terror’ is implemented for the prototype, selecting the category leads to B.1.

B.1 Timeline View of Events

Figure 2. Home Screen showing categories

Figure 3. Timeline of events in a category
The Timeline view (see Figure 3) gives an overview for the entire category of ‘War on Terror’, this is the default view. The timeline shows the chronologically organized events which are significant as blue selectable circles and the timeline can be scrolled horizontally with the finger swipe gesture. The bar at the top gives an overview of the years and the each blue thread on it represents an event. The years at the top bar can be tapped to quickly jump to that year in the timeline. This helps in providing an overview first, users can then zoom/filter to an event and then see the details about an event or a documentary on demand. Tapping on an event leads to section B.2.

**B.2 Timeline View – Event and Documentary Selection**

![Figure 4. Selection of an event and a documentary](image)

An event circle can be selected by tapping on it, which opens a section at the bottom of the screen (see Figure 4). The section provides a description of the event in the left and the list of documentaries on the right which are related to the event. The documentary thumbnail can be tapped to know more about the documentary with the option to watch it or view the favorite additional information cards. When the user presses the watch button, the documentary begins playing on the television and the screen in section D opens. Tapping on the button on the top left corner takes to the List View described in section C.1.
C.1 List View

A list of all the documentary is presented in the list view (see Figure 5), the user can narrow down documentaries by the tags at the top. The documentary thumbnails can be tapped to reveal additional information as in section B.2.

D. Documentary Playback

When a documentary is selected, a command is sent to the TV to play the selected documentary and to synchronize (see Figure 6). As the documentary progresses additional related information starts appearing on the iPad. Users can move
between these additional information cards with the swipe gesture. A few of the views are shown:

Figure 7. Interactive map of regions mentioned in the documentary

Figure 8. Intersecting documentary that provides another perspective to the current scenario in the documentary
Figure 9. Biography of the interviewees in the documentary

Figure 10. An article which updates about current developments in the story
USER STUDY OF THE PROTOTYPE

The implemented prototype was presented to 10 members of the Experimental Television Lab for evaluation. First, a walkthrough of the application was conducted, in which a detailed description of features and functionality was provided and then a few members were asked to use the application on their own. This was followed by open discussion about the features and usability of the application and the members were requested to complete a post completion survey (see Appendix 1), which was a Likert Scale survey in which users were asked to rate certain aspects of the application. The application was also demoed at the GVU Demo day and the Wesley Media Center opening, which was attended by leading professionals in the fields of digital media, interaction design, HCI and related industries and their feedback was taken.

Some of the suggestions are presented here. A couple of users expressed their desire to bookmark additional content, so that it can be seen later. The rationale was they did not wanted to consume additional information like articles at the time of watching the documentary as it would break their concentration on the documentary itself and it can be distracting to look at additional information at times, but saving it as a bookmark to view later would be helpful as it can viewed at the user’s discretion and can be in a standalone mode that does not replaying the documentary again. Another suggestion was to show text description for the events in the timeline view when they are tapped, to describe it for viewers who are relatively new to a topic.

Some look and feel changes were also suggested, the application had a paper like texture for the background, which in the user’s opinion did not go well with the theme of the application and was deemed unnecessary. The bottom panel which comes up when an event is selected in the timeline view had a decorative pattern at its top and had a translucent gray background, the users felt that this did not add any aesthetic or semantic value. Other aspects like the color of selectable(blue) and selected(orange) content was evaluated and was considered to convey well the distinction between the states.

The users wished that in the timeline view, there was a way to jump between the years as the horizontal swipe for scrolling to reach a year which is far away seemed
tedious. The suggestion was to include an overview bar at the top with all the years listed, which can be tapped to jump to a year and the bar would highlight the current year as the timeline is scrolled to give an navigational cue.

Figure 11. Cluster view, dropped in the current iteration

An alternate view to provide an overview for a category along with the timeline view called the cluster view (see Figure 11), which represented all the entities in a category as nodes and their relationship with other entities as connecting lines with a representative symbol, was proposed in the initial designs and high fidelity mockups. The view had a slider at the bottom, which could be dragged to see how the entities and their relationships evolved over a period of time. When this feature was implemented in the prototype, users felt that it did not add any additional value to the timeline view and was considered unnecessary. It was suggested that this view be dropped altogether from the next iteration.

The results from the post completion survey are presented in the next page. A concern was the interference/distraction from the main content that the use secondary screen device may add, however the results showed that the users did not find it very interfering. Other results seemed to affirm the use of the companion application. A division in Motorola Mobility that researches companion applications for television has expressed interest in conducting user evaluations with the prototype.
Results from the post completion survey:

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Avg. (Scale 1: Least, 5: Extreme)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness of the timeline view in providing an overview</td>
<td>4.2</td>
</tr>
<tr>
<td>Effectiveness of the timeline view in helping you choose a single documentary from the archive</td>
<td>4.1</td>
</tr>
<tr>
<td>Relevance of additional synced content</td>
<td>4.2</td>
</tr>
<tr>
<td>Level of interference of the synced information</td>
<td>2</td>
</tr>
<tr>
<td>Was the app an enhancement to the existing website</td>
<td>4.2</td>
</tr>
<tr>
<td>Overall helpfulness of the application</td>
<td>4</td>
</tr>
<tr>
<td>Overall usability of the application</td>
<td>4.1</td>
</tr>
<tr>
<td>Overall Experience</td>
<td>4.1</td>
</tr>
</tbody>
</table>
SYSTEM ARCHITECTURE

Web Server
The server hosts the database that contains tables that keep track of the current time-point (documentary id, playtime) of the documentary on the television, maintain a pool of instructions sent by the iPad (like play, pause) and store metadata for the synced content. It also hosts the HTML, CSS and JavaScript files. The server returns the current time-point and metadata to the iPad in response to an AJAX request and passes on instructions like play/pause from the iPad to the TV.

Video Player on a Television/Desktop Browser
The player is a web application that utilizes HTML, JavaScript and CSS. The HTML file contains the embedded flash player that displays the video streamed from the GT media server. The styling of the page like the background, images, color scheme is defined in the CSS file. JavaScript periodically checks the current time-point of the video and sends an AJAX request to the server to save it into the database. The player also polls for instructions from the iPad via the server to play/pause the video.

Companion App on the iPad
The companion app is a web application that also utilizes HTML, JavaScript and CSS. Being a web app, it can run on any tablet with a modern browser that supports HTML5. The building blocks of the application like the timeline, filtered list, interviewee bio, intersecting documentaries, graphics, articles, interactive maps are specified in separate HTML files, which are loaded when needed. The styling of the application like the background, images, typeface, color scheme is defined in the CSS file. In the playback mode, JavaScript periodically polls the server by an AJAX request and the server responds with the current time-point of the documentary on the television. If the time-point corresponds to metadata that maps to synced content, they are shown on the iPad. The application also streams video from the media server and can send instructions to play/pause the video on the TV.
REFERENCES


APPENDIX 1: LIKERT SCALE USER SURVEY

Interactive Documentary Explorer

Please rate the effectiveness of the timeline view in providing an overview for the category *

1 2 3 4 5
Least Effective ○ ○ ○ ○ ○ Extremely Effective

Please rate the effectiveness of the timeline view in helping you choose a single documentary from the vast archive *

1 2 3 4 5
Least Effective ○ ○ ○ ○ ○ Extremely Effective

Please rate the relevance of the additional synced information that appears when the documentary is playing *

1 2 3 4 5
Least Relevant ○ ○ ○ ○ ○ Extremely Relevant

Please rate the level of interference of the synced information *

did the synced information distract you while watching the documentary

1 2 3 4 5
Least Interfering ○ ○ ○ ○ ○ Extremely Interfering

Do you think that the application was an enhancement to the existing website *
existing: http://www.pbs.org/wgbh/pages/frontline/view/

1 2 3 4 5
Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree
Please rate the overall design and aesthetics of the application *

1 2 3 4 5
Poor □ □ □ □ □ Extremely Well

Please rate the overall helpfulness of the application *
The application provided relevant information at appropriate times

1 2 3 4 5
Least Helpful □ □ □ □ □ Extremely Helpful

Please rate the overall usability of the application *
easy to learn and use, satisfactory, simple, consistent

1 2 3 4 5
Least Usable □ □ □ □ □ Extremely Usable

How was your overall experience

1 2 3 4 5
Extremely Frustrating □ □ □ □ □ Extremely Pleasant

Any comments?

Submit