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ELECTRICAL ENGINEERING -
DEVICES AND SYSTEMS,
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FOR THE FUTURE**

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Mobile TV: User-centered service development for an educational TV programme

Abstract

This paper presents television production parameters, user requirements and user interface design guidelines for mobile television (TV) applications. Method and results of the following steps are presented: (1) Analysis of film and TV content production parameters that need to be considered for adaptation, e.g. type of film shot, perspective, type and speed of camera movements, sound. (2) User requirements analysis for educational mobile TV applications using focus groups. (3) Development of a prototype application for educational mobile TV based on the results from the user requirements analysis. Different prototype variants were implemented with the objective to investigate the influence of different variables on the application's usability. (4) Usability test of the developed prototype variants by end users. (5) Development of general design guidelines for mobile TV applications based on the previous steps. The presented results serve the user-centered design and development of mobile TV applications. Most of the results are content independent and applicable to mobile TV applications in general.

1. Introduction

The fast development of transmission standards for audiovisual content for mobile devices in the past three years has enabled the development of mobile (TV) services. Presently two standards are competing with each other: Digital Video Broadcasting Transmission System for Handheld Terminals (DVB-H) and Digital Multimedia Broadcasting (DMB-T). Mobile TV applications have many specific design challenges. Unfortunately, no design guidelines for them exist so far. These design challenges are twofold:

- **TV content production:** For the reception of TV on mobile devices several TV content production parameters [11] need to be considered for adaptation.
- **User interface design:** Mobile TV applications have many user interface design specifics when compared to applications for personal computers. For the latter a

lot of user interface design experience has been gained over the years and is documented as guidelines, e.g. of the International Organization of Standardization [3, 4, 6]. Some of the general guidelines are applicable to mobile devices as well. Additionally, some first user interface design guidelines for mobile devices have been published [9, 15]. Also for interactive TV applications being displayed on standard TV sets some user interface design guidelines are available [2]. However, for mobile TV services the existing design guidance is not sufficient.

2. Television content production parameters

2.1 Television Production Process

The TV production process consists of four general phases: Preproduction, production, postproduction and distribution [8]. In each phase the content development is supported by technical systems (Figure 1).

	Preproduction	Production		Postproduction	Distribution
Content	Research of topics	Researching material	Producing material	Editing material	Transmission
Technology	Content Management	Browsing System	Recording, Play back	System Post-production	Broadcast signal processing

Figure 1. The four general phases of the television production process [8]

To tailor TV content to mobile devices and user expectations several content production parameters need to be considered for adaptation. The single parameters [11] can be classified by the four phases of the general TV production process. The parameters relevant for mobile TV are part of the production and postproduction phase.

2.2 Parameters in Television Production

In the television production phase the following content production parameters need to be considered for adaptation for mobile TV:

- Type of film shot (very long shot, wide shot, medium long shot, American shot, medium shot, medium close up, close up, choker close up, see Figure 2 [16])
- Motion (slow motion, fast motion)
- Perspective (top view, standard, view from below)

- Camera movements (Object's movements, tracking shots, zooming, pan/tilt/roll)
- Focal length
- Contrast
- Intensity/brightness
- Color temperature
- Saturation
- Color (color, black and white, color filter)
- Sound
- Light intensity (normal, high key, low key)
- Type of light sources (leading light, filling light, spot light, ambient light)
- Special effects in front of camera (pyrotechnics, stunts, make-up, masking)

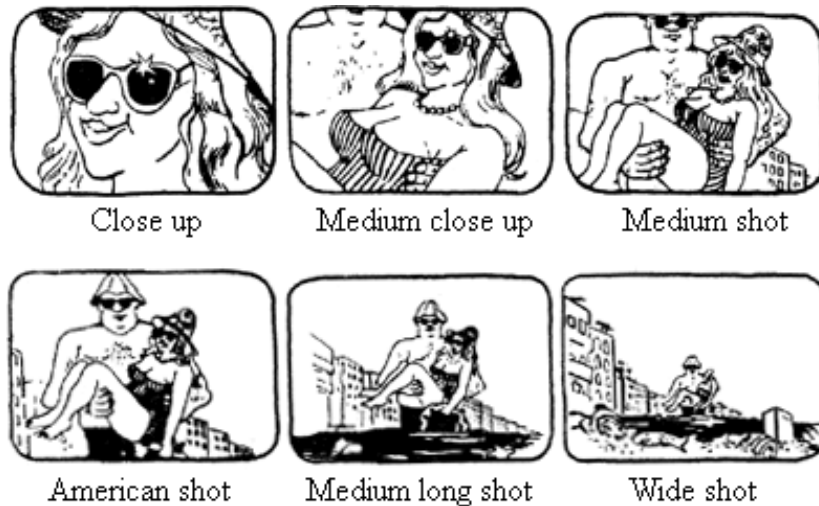


Figure 2. Important film shot types [16]

2.3 Parameters in Television Postproduction

In the television postproduction phase the following content production parameters need to be considered for adaptation for mobile TV:

- Sound elements (comment, original sound, atmosphere, sound effects)
- Rhythm of cuts (fast, slow)
- Types of cuts (hard cut, intermediate cut, montage)
- Text elements (spoken by invisible speaker, spoken by visible speaker, text faded in by font-generator, graphics, animations)
- Special effects during recording (double/multiple exposing, stop-motion method, go-motion method)
- Special effects (digital compositing, computer animation)

- Frame-rate (e.g. 5, 10, 15 frames per second)

3. User requirements analysis

3.1 Objective and method

Aim of the user requirements analysis was the identification and specification of user requirements for educational mobile TV applications. The method of focus groups has been selected for this objective. A focus group "...usually consists of a discussion involving small groups, led by a moderator. The aim is to gain information about user opinions, attitudes and preferences." [7]. Two focus groups have been carried out each with homogeneous participants. One focus group consisted of seven teenagers and young adults with an average age of 19 years. The other focus group included six adults with an average age of 45 years. None of the participants had ever seen a mobile TV application. In the focus groups two scenarios have been used to support the participants' brainstorming and to help them relate to real world situations. Scenarios are stories consisting "...of a setting, or situation state, one or more actors with personal motivations, knowledge, and capabilities, and various tools and objects that the actors encounter and manipulate. The scenarios describe a sequence of actions and events that lead to an outcome." [13]. Both scenarios described two concrete use cases in form of short stories. The following questions served to structure the focus groups:

- Which additional information and functions are interesting with regard to educational content?
- How could these content items and functions be categorised?
- What is the priority of the single content items and functions within each of these categories?
- How should the content and functions be designed and how could they be used?

The focus group sessions were subdivided into four phases. The first phase was a warm-up phase to find an easy start in the session. The participants should reflect upon their personal reception and behaviour of television, internet and use of mobile devices. In the second phase, called "Input", the participants got a short introduction on the German educational TV program LexiTV in general. However, due to their unfamiliarity with mobile TV we found it necessary to give them some rough idea. In

phase three the scenarios in form of short stories were presented to the participants to reduce biasing the participations in their expression. We wanted to allow for more freedom in creating new ideas. In phase four they were asked to put themselves in the position of the person described in the scenarios. This was followed by a brainstorming in which they developed ideas of possible content and functions for mobile educational TV applications. These ideas were written down and put on a pinboard. Then the single content items and functions were categorised on the pinboard in a group discussion. At last the participants individually put priorities on those content items and functions that they find the most important.

3.2 Results

3.2.1 Results for Teenagers and Young Adults

In summary, teenagers and young adults seem much more motivated to use mobile TV in general compared to older adults. In the focus group they were enthusiastic about and interested in using mobile TV rather actively than passively. Teenagers and young adults have mainly an entertainment-based motivation to use educational mobile TV (Figure 3).

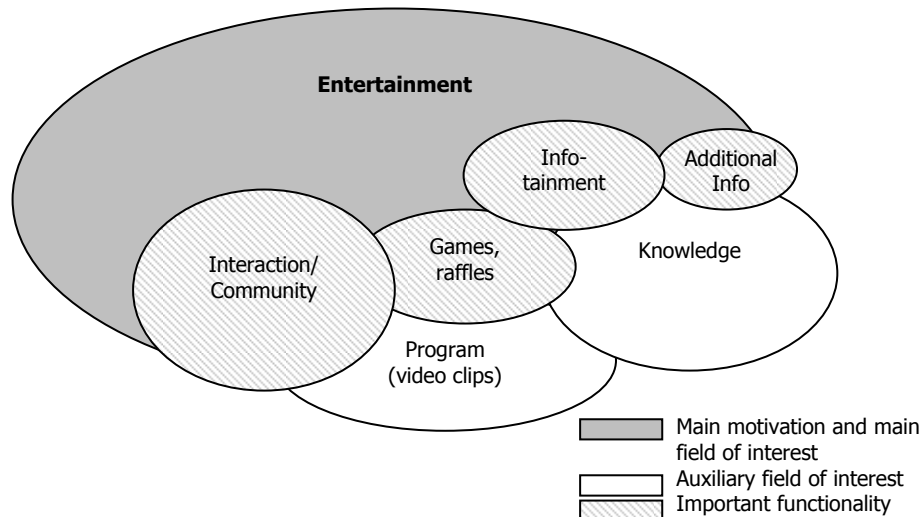


Figure 3. Main motivation and main field of interest for educational mobile TV of teenagers and young adults.

The following user requirements were identified (selection):

- Individual choice of videos to the topic of TV program
- Communication with other users, e.g. chat
- Interactive functions related to the TV program, e.g. votings
- Games related to TV program

- Watching a TV program
- Additional information to topic of TV program
- Combination of information and entertainment offers
- Background information to this TV program in general
- Statement of specific title of TV program

3.2.2 Results for Older Adults

In summary, most of the older adults preferred to use traditional TV, print magazines and the internet compared to mobile TV. In the focus group they were more interested in a passive rather than active use of mobile TV. Older adults have mainly a service-based motivation to use educational mobile TV (Figure 4).

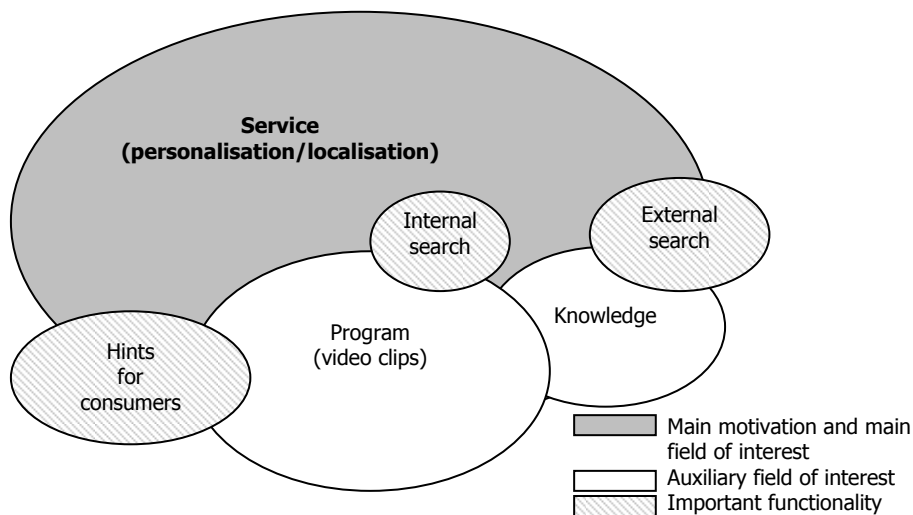


Figure 4. Main motivation and main field of interest for educational mobile TV of older adults.

The following user requirements were identified (selection):

- Watching a TV program
- Personalized services, e.g. recommendations on TV programs or additional information related to a regularly watched TV program
- Location-based services related to TV program
- Practical hints related a TV program rather than theoretical information, e.g. „How to do a good barbecue?“
- Application internal and external search options
- Consumer hints related to TV program
- Links to websites with additional information

4. Prototyp application for educational mobile television

4.1 Objective and Method

Main objective of the prototype development was the investigation of the influence of different media presentations, media previews and media types on the prototype's usability. The following variables were defined:

- Independent variables: (1) Text length, (2) Preview to media selection, (3) Offered media types.
- Dependent variables: The usability of the mobile TV application.
- Disruptive variable: Their influence must be controlled, e.g. the environment where the usability test takes place.
- Constants: textual content, font family, font size, color design

Text length was chosen as independent variable because the focus group participants required additional textual information related to the TV program. Since in a mobile TV application the text is related to the TV program the preview to the offered media, e.g. video clips, and the variety of media types to be offered was investigated. The prototype was developed for the educational TV program "LexiTV" of the German regional public broadcaster Mitteldeutscher Rundfunk (MDR).

4.2 Independent Variables

4.2.1 Text Length

Text length was implemented in three different variants (Figure 5).

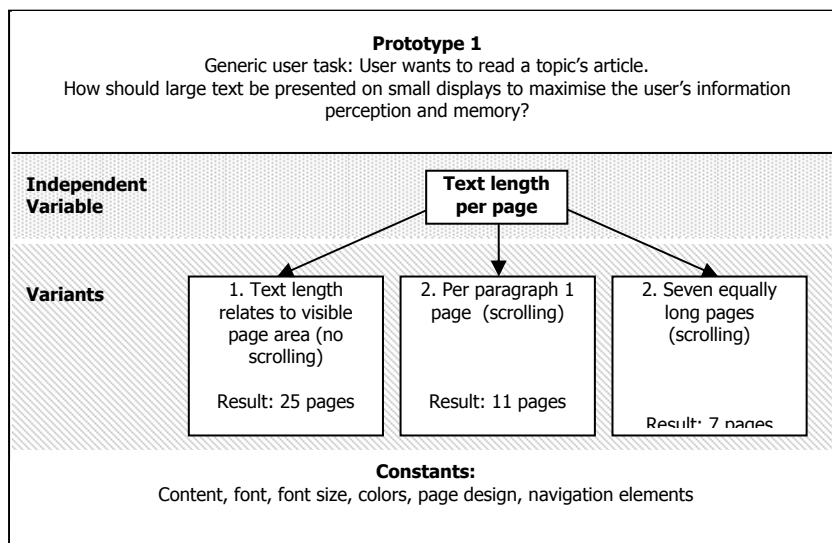


Figure 5. Variants of independent variable "text length".

Variant 1 avoids scrolling by only displaying as much text as can be presented on each page (Figure 6, 13). Variant 2 the text is divided into several paragraphs that

each is presented on one page. Depending on the length of the paragraph scrolling is necessary (Figure 7, 13). Variant 3 presents an equal amount of text on each page without separating the text in different paragraph. Scrolling is necessary on each page.

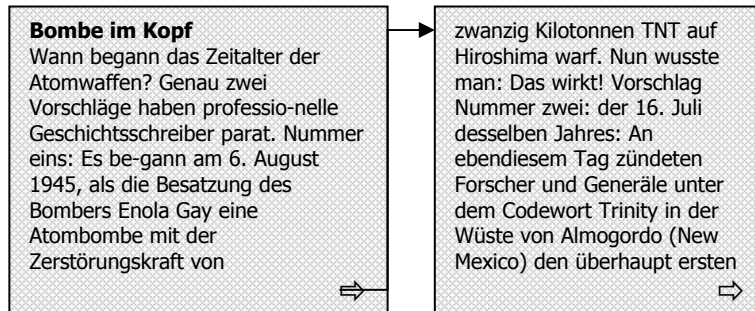


Figure 6. Text length variant 1: Relates to visible page area (no scrolling).

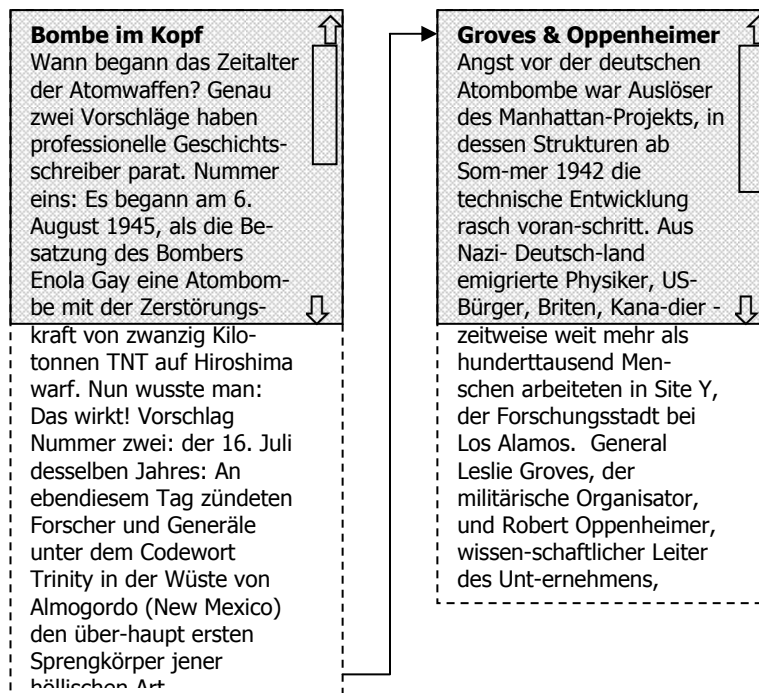


Figure 7. Text length variant 2: Text splitting by paragraphs (scrolling).

4.2.2 Preview to Media Selection

Preview to media selection was implemented in three different variants (Figure 8).

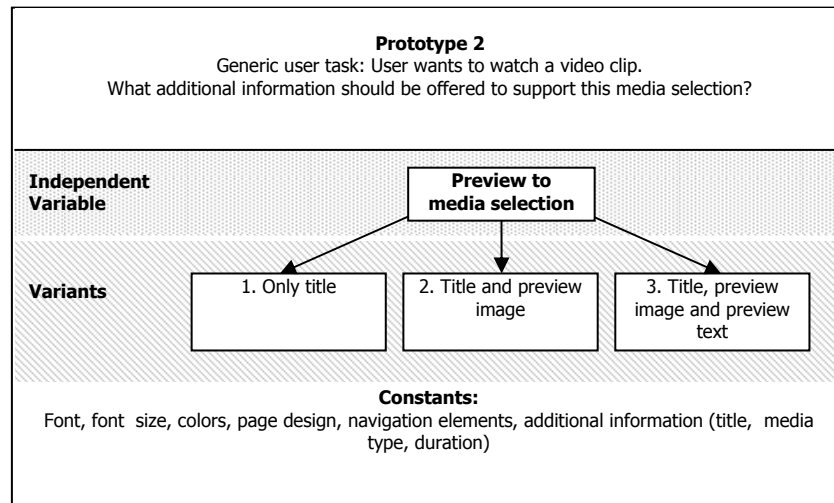


Figure 8. Variants of independent variable “preview to media selection”.

In variant 1 an icon for the available video, its title and its duration is presented. Variant 2 additionally presents a preview still image. Variant 3 is variant 2 extended by an introduction text about the video (Figure 9).

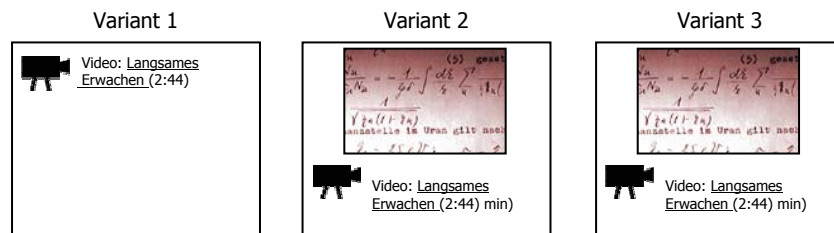


Figure 9. Variants of preview to media selection.

4.2.3 Offered Media Types

The offered media types were implemented in three different variants (Figure 10).

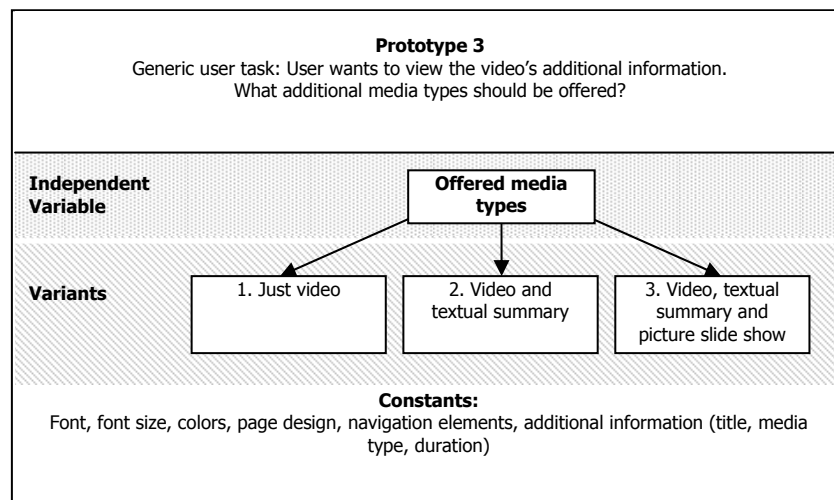


Figure 10. Variants for independent variable “offered media types”.

In variant 1 only a video is offered. Variant 2 offers two media types to choose from (video and text), both about the same topic. Variant 3 offers three media types (video, text and still image with text), all about the same topic (Figure 11).

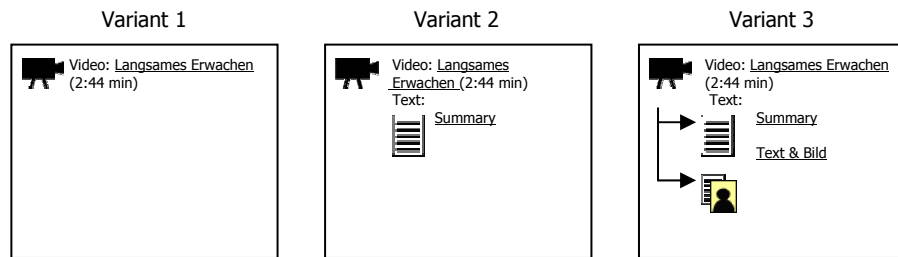


Figure 11. Variants for offered media types.

4.3 Menu Structure

The hierarchical menu structure of the prototype application is based on the results of the conducted focus groups. It is shown in Figure 12.

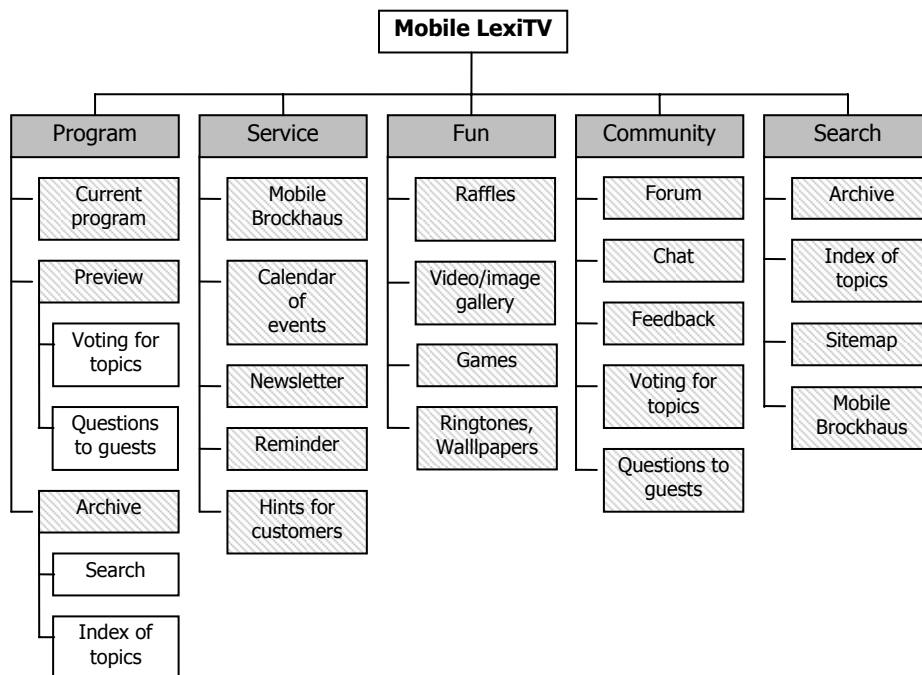


Figure 12. Menu structure of the developed prototype.

4.4 Prototype Design

The prototype was designed for a Personal Digital Assistant (PDA) (Figures 13 and 14). It was implemented on a PDA using Macromedia Flash MX, HTML and Cascading Style Sheets (CSS).



Figure 13. Screenshot of start page (left) and of selection page of TV program subcategory (right).

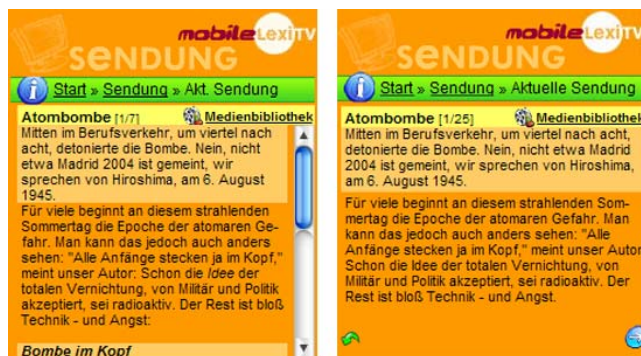


Figure 14. Prototype implementation of text length variant 1 and 2.

5 Usability Test

5.1 Objective and Method

Overall objective was the evaluation of the prototype's usability [4]. Specific objectives were the identification of the most usable variant for each of the three independent variables (text length, preview to media selection and offered media types). This was accomplished by within-subjects comparative usability tests [1, 12, 14]. Each variant was tested by nine participants. For the usability tests the methods of user observation, thinking-aloud, qualitative interview and video/audio analysis were applied [12, 1]. The usability tests were carried out in the participant's home environment. The test session consisted of three phases. In the first phase the participants made statements about their attitude and motivation towards mobile devices and TV program related websites and other TV related media offerings. In the second phase the participants freely explored the prototype and got familiar with the navigation using the PDA pen. After the short free exploration the participants were asked to perform specific tasks. They performed the same task with each of

the three variants for each of the three independent variables. Following the thinking-aloud protocol the participants were asked and encouraged to "...continuously verbalize their ideas, beliefs, expectations, doubts, discoveries etc. during their use of the system under test." [7]. In the third phase of the test session the users were interviewed on critical incidents while task performance as well as on their experience and opinion after using the prototype. They were asked to rank the different variants. The results of the usability tests form the basis of the developed design guidelines for mobile TV applications.

5.2 Results

5.2.1 Text Length

In the test the participants performed the following task: "Please find the article to the TV program. Read the text "Die zweite Phase" and write down a short summary afterwards without looking at the text again."

- Most participants best remembered the text after using variant 2. In average three of six key words were remembered with variant 2.
- However, three of nine participants preferred variant 1 that avoids any scrolling.

5.2.2 Preview of Media Selection

In the test the participants performed the following task:

„You would like to watch the videos to that article. Please describe what content you expect in the video after looking at the giving information."

- The concept of the media library was easily found and well understood, both by six of the nine participants.
- Eight of nine participants favoured variant 3. Variant 2 irritated the participants because the still image did not inform them about the very well about the video content.
- Scrolling in longer lists in the media library was not a problem for any of the participants

5.2.3 Offered Media Types

In the test the participants performed the following task:

"You now would like to inform yourself about the atom bomb. Please go to the media library and explain what is offered there on this topic."

- The folder concept of the media library was well understood by eight of nine

participants (Figure 15).

- All participants preferred to have different media types offered to them on the same topic.

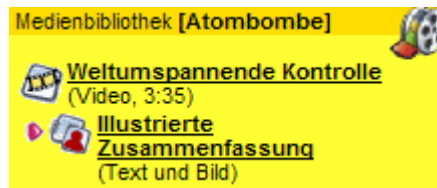


Figure 15. Folder concept of the media library.

6. Design Guidelines

- Avoid scrolling in texts, unless the text is strongly structured with different subtopics on each page.
- Structure long texts in chapter or paragraphs to support memorizability.
- For long texts offer an overview page that lists the chapter headlines and links to the chapters.
- Offer a navigation option to get back to the text overview page from each subpage.
- Offer preview of videos with a short textual description.
- To each video offer a text on the same topic as alternative media type.
- Include still images with text only when they support the message of the associated text.

7. Conclusion

The chosen method of TV content production parameters analysis, user requirements analysis, prototype development and usability testing has proven suitable for the development of design guidelines for mobile TV applications. The presented results serve the user-centered design and development of mobile TV applications [5, 10]. The identified TV production parameters are content independent and relevant for the production of mobile TV content in general. The extracted user interface design guidelines are also content independent. The analysed user requirements, however, are specific to educational mobile TV applications.

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