Using personas and scenarios in designing for an IPTV solution

Fatemeh Daneshzadeh, Ali Nassergivehchy

School of Computing
Blekinge Institute of Technology
SE – 371 79 Karlskrona
Sweden
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**Contact Information:**

Authors:
Fatemeh Daneshzadeh  
Address: Hanstavägen 51, LGH 633, 16453, Kista, Sweden  
E-mail: fada08@student.bth.se

Ali Nassergivehchy  
Address: Hanstavägen 51, LGH 633, 16453, Kista, Sweden  
E-mail: alna08@student.bth.se

University advisor:  
Professor Bo Helgeson  
School of Computing

External advisor:  
Mia Blomberg  
Ericsson AB  
Address: Kistavägen 25, 16440, Kista, Sweden

School of Computing  
Blekinge Institute of Technology  
SE – 371 79 Karlskrona  
Sweden  
Internet: www.bth.se/com  
Email: info.com@bth.se  
Phone: +46 455 38 50 00  
Fax: + 46 455 38 50 57
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ABSTRACT

In this research, we focused on developing personas and scenarios in designing a PC Portal for IPTV solution. We employed personas to consider users and their context of use when designing for the system.

Different studies have been conducted on the subject of using personas and scenarios in design projects. Some of them show that using personas have a positive effect in the outcome of the design in particular contexts. Other studies, however, suggest that designers have difficulties when using personas in their design process. The underlying cause of these problems might refer to shortcomings in construction of suitable personas, or how to use them throughout the design process.

We performed a literature review on personas and scenarios, their advantages, and, how to develop them. Then, we developed personas and scenarios for IPTV problem domain and to base our personas on user study results, we used questionnaire survey and interviews to acquire knowledge about the users. We proposed a design solution and developed a prototype based on elaborated personas and scenarios to evaluate our findings.

We argued different challenges that we faced while using personas and scenarios. We illustrated how graphical user interfaces can be developed to satisfy multiple personas by providing the users with different representations of the same information. We also argued why the area of personalized television needs more attention from CHI community and why people are becoming more interested in personalized TV viewing experiences.

Elaborated personas and scenarios helped us focus more on users and their context. This could not be easily achieved without rendering the raw data from user studies into personas and scenarios.

**Keywords:** Personas, Scenarios, IPTV
### ABBREVIATIONS

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<th>Description</th>
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<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
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<tr>
<td>HCI</td>
<td>Human Computer Interaction</td>
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<tr>
<td>IAP</td>
<td>IPTV Application Platform</td>
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<tr>
<td>IMS</td>
<td>IP Multimedia Subsystem</td>
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<td>IPTV</td>
<td>Internet Protocol Television</td>
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<td>RQ</td>
<td>Research Question</td>
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<tr>
<td>SVG</td>
<td>Scalable Vector Graphics</td>
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<td>VOD</td>
<td>Video On Demand</td>
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CHAPTER 1: 

INTRODUCTION

Nowadays, more and more countries decide to make the transition from analog to digital TV broadcast. Meanwhile, extensive growth in internet usage encourages the content providers to lean toward new technologies in this area. Internet Protocol Television (IPTV) is one of the solutions that address this demand. It refers to technologies surrounding delivery of digital video services through an Internet Protocol (IP) network. Internet is an example of an IP network while it is also possible to deliver IPTV services through a dedicated network called IP Multimedia Subsystem (IMS). We do not intend to study the technical aspects of IPTV, but rather explore the user related aspect of it. This area is known as Interactive Television and IPTV can be one of its instances. What makes IPTV interactive is its capability for bidirectional communication so that users can personalize their content viewing habits by choosing the content they want to watch at any time they prefer (O’Driscoll, 2008).

Incorporating the use of IP networks makes it possible to connect to IPTV through different media such as smart phones, personal computers, and of course, TV sets through set-top box (demonstrated in figure 1.1).

![Figure 1.1 A typical view of an IPTV network](image)

Statistics published by Multimedia Research Group show that interest in IPTV services continues to grow and IPTV is getting more popular amongst the consumers (figure 1.2). IPTV enables users to vote for a movie, reply to requests from advertisers, and even contribute or add their own content. Personalization enables the users to customize the content, for example, create a new channel by collecting their favorite programs from different channels.
However, users of different media have different expectations and requirements as well as different styles of interacting with the product. As a result, Ericsson IPTV Research and Development department is highly interested in realizing what users need and expect from each medium and consequently use this information during the design and usability evaluation of the product. Our focus in this thesis project would be on personal computer as the interaction medium. This medium brings new requirements to IPTV for instance users should be able to perform other tasks such as checking emails while they are using IPTV through their PC. The interaction devices also change in PC from a rather limited remote control to mouse and keyboard.

We refer to this system as portal since it allows access to different IPTV applications. This term is also used within Ericsson to refer to the software that brings all the different technologies together to provide the users with a united IPTV experience.

1.1 Overview

During this thesis project, we try to find out what users need and expect from IPTV PC Portal and consequently use this information during the design process. To achieve such endeavor, we conduct survey and interviews as user study methods. We participate in brainstorming sessions with Ericsson stakeholders to discover their perspective. We conduct a survey in form of questionnaire with potential users and interview them to investigate their needs, wants and expectations and build different visions on how to design a creative solution that promotes interactivity. By considering the raw data from user studies, we develop a better understanding of the context of use.

Afterwards, we create personas as models representing groups of users and scenarios as ways of interacting with the system by those personas in order to focus on user-specific requirements in our design.

We use low fidelity and high fidelity prototyping techniques to test our designs with real users. We finally, use heuristic evaluation and thinking aloud protocol as usability evaluation methods to gather feedback from users and evaluators to argue the usefulness of personas and scenarios in design and also to discover the usability issues and improve the usability of our design in an iterative manner.
CHAPTER 2:

PROBLEM DEFINITION

This thesis project is within the area of Interaction Design. We particularly focus on developing personas and scenarios in designing a PC Portal for IPTV solution. We construct personas based on real potential users and their needs and personality. We then employ these personas to consider the users and their context of use when designing for the system. To base our personas on user study results, we use questionnaire survey and interviews to acquire knowledge about the users. Personas and scenarios are important since they assist the designers to have the users’ needs and expectations in mind in all stages of the design process (Bagnall, 2007; Cooper and Reimann, 2003; Nielsen, L. 2002; Usability Net, 2006).

Persona is a model of a group of users that have the similar goals and behaviors. It explores ranges of different behaviors and helps designers to design for the specific individuals and users with specific needs (Bagnall, 2007). Personas can help designers to decide about the features, relevant functionalities, interactions, and visual design. Personas are used to model the groups of users with similar wants, needs, and expectations (Nieters, et al., 2007). Using personas makes it possible for designers to consider users in each stage of the design process by having their wants and expectations in mind (Cooper and Reimann, 2003). Using persona in software design can help understand potential users better and improve the quality of product as well as reduce the time span in each design cycle (Nielsen, L. 2007).

To find out how personas accomplish a task, designers present a scenario as a sequence of sub-tasks which lead to completion of the task (Nielsen, L. 2002; Cooper, 2004). Scenarios represent stories for personas about their characteristics and the process of their activities in performing tasks in the intended system (Cooper, 2004). In other words, each scenario explains the flow of tasks when one of personas is working with the intended system. Scenarios depict how users accomplish their tasks in a specific context. They are usage examples that can be input to the design. Scenarios can be referred to as use cases that are based on users and tasks (Bevan, 2003; Nielsen, L. 2008).

Different studies have been conducted on the subject of using personas and scenarios in design projects. Some of them show that using personas have a positive effect in the outcome of the design in particular contexts (Kawasar and Nakajima, 2007; Maier and Thalmann, 2010). Other studies, however, suggest that designers have difficulties when using personas in their design process (Blomquist and Arvola, 2002). The underlying cause of these problems might refer to shortcomings in construction of suitable personas, or how to use it throughout the design process. Blomquist and Arvola (2002) mention that team members other than interaction designers such as developers may encounter different problems while using personas to imagine the user. Apart from different discussions about using personas and scenarios, effectiveness of applying these techniques in the area of multimedia specifically IPTV solution is yet to be argued.
According to our investigations, some studies (Lee, et al., 2008) address the area of interactive TV and particularly the way people watch TV. But using personas and scenarios in designing IPTV services especially Video On Demand (VOD) has not been addressed. Since the usefulness of personas and scenarios has not yet been put to test and discussed in the area of IPTV solution and VOD applications in particular, this is the gap that we address during this thesis project. To achieve such endeavor, we first identify the context of use, specify the requirements, and, develop personas and scenarios. Then, we develop an interactive prototype based on the elaborated personas and scenarios to argue whether the use of these techniques can help improve the design of prototype for IPTV PC Portal.

2.1 Aims and objectives

The main aim of this thesis project is to construct personas and scenarios for IPTV PC Portal and argue whether personas and scenarios can improve the design of IPTV PC Portal.

We fulfill this aim by reaching the following objectives:
- Choose suitable contexts and people that can be the base for development of personas and scenarios
- Develop personas and scenarios for IPTV PC Portal based on the identified contexts
- Develop an interactive prototype using elaborated personas and scenarios
- Evaluate the usability of the designed prototype
- Argue whether implementing personas and scenarios can actually help improve the usability of the designed prototype for IPTV PC Portal

2.2 Research questions

This thesis project intends to answer the following research questions (RQs):

RQ1. What is the context of use for IPTV PC Portal that can be base for development of personas and scenarios?
RQ2. How can we construct appropriate personas and scenarios in the context of IPTV PC Portal?
RQ3. How can we develop the prototype based on elaborated personas and scenarios?
RQ4. Are the constructed personas and scenarios helpful to improve the design of IPTV PC Portal prototype?

In the next two chapters, we conduct a literature review on the relevant subjects and motivate the research methods of our choice and argue why and how they assist us in finding answers to our research questions and consequently achieving our objectives and goals.
CHAPTER 3: BACKGROUND

This chapter is an in-depth study of different aspects of interactive TV as well as a literature review on different design tools we use during this research. We argue why they are important and can assist us to better answer our research questions.

3.1 IPTV and interactivity

The traditional way people have experienced video is from sofa in front of the TV set. However, new technologies make it possible to experience video while sitting behind the desk or in the train. Video itself does not change but different ways of interacting with the content emerge which ultimately changes the way people interact with the content.

The concept of interactive TV has been around since late 1990s but it is still perceived as an artificial experience (Hjelm, 2008). The ultimate outcome of interactivity would be that users can change the storyline and what happens next by interacting with the content (Ursu, et al., 2008). This would not be possible without engaging the participants. In computer games, user can directly affect what happens on screen. Similar techniques can be used to enhance interactive TV by directly engaging the users but linear TV seems to dominate the IPTV industry for a long time (Hjelm, 2008).

Interaction enhances the way users experience video. This improvement shows that content and interactivity can enhance each other if they are connected rather than disconnected. For example, if we consider changing the channels interactivity, it is totally disconnected from the content while changing the camera angle in a football match is a form of interactivity that is connected and related to the content.

However, the concept of interactive TV is different with the web. The main difference is that web consists of several hyperlinks that interconnect several pages while there is no correct way of traversing the links. Interactive TV, on the other hand, offers stories which still follow a sequence although this sequence can be non-linear as well.

Hjelm tries to clarify the confusion about interactivity of IPTV by describing four levels of interactivity in IPTV at present and future (Hjelm, 2008):

First level is when users interact with the meta-data related to different content for different purposes. Examples of this level of interaction include getting information about a particular VOD entry or browsing Electronic Program Guide (EPG) to know more about the programs being broadcasted.

Second level is when users interact with external information which is not related to the content such as teletext. Users can access information such as news but according to Hjelm this interactivity is somehow limited to pointing and clicking or ultimately adapting the
content to user preferences. One example is Bloomberg which enables users to choose different chart or stock prices.

Next level of interactivity is when users affect a program by actions such as voting. This level of interaction also includes interacting with other users through television set (or other IPTV connected devices) for instance with chatting. According to Hjelm, studies have shown than around 50 percent of users of digital TV services tend to engage in interactive programs.

The forth level of interactivity is when the storyline changes based on the user interaction. This level of interaction is close to games and can be explicit such as choosing how a program should continue or even implicit where feedback from previous users of the program changes the future of that program.

A question that comes to mind can be the difference between IPTV and personal video recorder (PVR) since IPTV offers time shifting features meaning that users can choose to watch a program after it is broadcasted. The main advantage of IPTV in this case is that unlike in PVRs, users’ choices can be stored in the system for later use. This brings up different possibility for interaction such as considering user’s choices in future offerings or advertising.

Regarding many different services and ways of content delivery, the most important factor is convenience of accessing the content regardless of medium. According to Hjelm, users do not care whether the movie they rent is delivered by post in form of a DVD or through a cable. Netflix is an example of movie delivery through post. This fact proves that relying on network accessibility of IPTV alone does not make it the solution of choice for the users while possibilities for interactivity can play a decisive role in the success of IPTV.

First designer of interactive TV, however, assumed that users setup the system exactly according to their needs and then watch the content but different problems arise from this assumption. Firstly, expecting users to configure the system affects the usability and ease of use negatively. Furthermore, users may not know what they exactly need. In fact, experiments have shown that enabling users to choose exactly what is being presented to them eliminates any possibility for surprises and therefore makes it boring to users. This refers to personalization in IPTV meaning that while users like to be individuals, they also need to belong to groups. Although the slogan behind IPTV is to make TV experience personal and interactive, it is also quite necessary to detect which group a user belongs to and ultimately use this knowledge to offer what user needs.

3.2 Personalized TV viewing experience

At first thought, it might come to mind that people are not interested to use their computers to watch television. However, a study performed by Barkhuus (2009) discovers that TV is increasingly viewed through computers. In this study, she interviews tech-savvy college students as a population with growing interest in using computers for television viewing. It is worth mentioning that this does not mean that computers are going to replace television. Barkhuus (2009) finds out that while TVs still provide rich social experiences, people increasingly use computers to personalize their TV viewing experience for instance to catch up with series their friends are watching or watch an episode they have missed.
We need to mention that this study has been done in United States in which people have access to most popular television programs through internet. However, for copyright reasons, the same websites do not allow people from other countries to access their content. This is an additional reason for usefulness of IPTV in countries other than US since digital rights management is fully taken into account in IPTV systems.

Another thought that might come to one’s mind is that the same design material provided for TV context can be used for PC as well. It turns out that a slight change in means of interaction can lead to a disaster in user experience if the same design is used. The existing design for Ericsson IPTV TV Portal is based on TV and remote control in living room context. Although usability studies have shown the high usability of this design, this design cannot be directly ported to PC and still be successful. Even though this is technologically possible and has been done in previous projects, it is clear to decision makers that it does not provide the expected quality to be offered to end users and as a result of that, they have defined this project.

3.3 Context of use

Usability of a design solution is not only affected by its features but also by the behaviors of its users and the environment in which the users interact with the system. The concept of context points to all the surrounding factors that can affect the usability of a product excluding the features implemented within the product. To understand the context of use, we collect information about users, tasks, equipments, and the environments in which the product would be used. This information is going to answer the following questions (Blomquist and Arvola, 2002; ISO 9126, 2001):

− Who are the target users of the product?
− What are the tasks that intended users are going to perform?
− In what environment setting and using which equipments will the software be used?

The answers to these questions can be used as a guide when developing personas and scenarios. This information can also be an essential input for capturing the requirements as well as selecting the aspects of the software which needs evaluation (Blomquist and Arvola, 2002; ISO 9126, 2001).

Identifying the context of use assists the designers to elicit the undocumented knowledge from different stakeholders within the project. It also helps designers to come to an agreement with the rest of the team on essential issues regarding target users, their tasks, and their environment. The other advantage of context identification is that these issues are clarified from the early stages of the development process.

As it is apparent from the description of context of use, documenting the context is a challenging task. However, there are some suggestions and frameworks on how to document the context of use.

3.4 Personas and scenarios

As mentioned before, during this project, we develop personas and scenarios in designing the PC Portal for IPTV solution. Personas and scenarios are important since they assist the designers to have the users’ needs and expectations in mind in all stages of the design process (Bagnall, 2007; Cooper and Reimann, 2003; Nielsen, L. 2002; Usability Net, 2006).
3.4.1 Personas

Persona is a model that describes the user and her needs and goals. It is a fictional description about a group of users that have the same goals and behaviors. It explores ranges of different behaviors and helps us design for the specific individuals and users with specific needs. The concept of persona is simple but sophistication is in the correct way of constructing and using it. Models are useful to demonstrate complex structures and relationships. Use of models eliminates the need for direct analysis of raw data which means a better understanding of the big picture. Designing for users makes it necessary to have a good grasp of users’ relationships with each other, with their environment, and, with the artifact being designed. Personas represent patterns of behavior which can be potentially used to have a design that matches users’ goals, behaviors and mental models.

Although personas are user models but they are not real people. We gather behavioral data from many real users though different user study methods including interviews to construct personas. Therefore, we can claim that personas represent real users and therefore can be used as a reference throughout the design process. Understanding personas helps us focus on users’ goals in specific contexts (Cooper and Reimann, 2003). Using personas makes it possible to indirectly involve the users in each part of the design by having their wants and expectations with us when designing the system (Cooper, 2004).

The key to success would be to design for right individuals that closely represent the target audience. It is also important to prioritize the use cases based on what is most important to these individuals while also minimizing the conflicts with needs of other users. Persona can serve as a powerful tool to focus on what key users want and also categorize different types of users and their needs in order to prioritize the use cases based on their needs.

Adding as much functionality as possible does not make a product more demanding for a larger audience. On the contrary, it only adds to navigational overhead and cognitive load for every user of the product (Cooper and Reimann, 2003). Furthermore, a feature that satisfies one type of user might dissatisfy another type of user. Therefore, designing for specific individuals and their specific needs and goals contributes to the success of a product by reducing the cognitive load for all possible users.

Personas were introduced to interaction design community in 1999, and Cooper and Reimann (2003) attempted to clarify the misunderstandings around personas by addressing the benefits that can be gained from them. They mention the following strengths for personas:

- Goals of personas and the tasks they perform determine the boundaries of product features.
- Personas can be used as a means of communication between different stakeholders of the projects including designers, managers and even developers. They can also help keep the focus on users during the development process.
- Because of their narrative nature, personas provide a more common understanding of users’ behaviors and their needs compared to diagrammatic models.
- Personas can help measure the effectiveness of the design. Cooper believes that different design choices can be evaluated against personas similarly as they can be tested with real users. But he also mentions that this testing does not replace the need for testing with real users. Instead, it acts as a quick fact check for designers when they face alternatives.
When creating the personas, we try to divide the use into different sets of behaviors. In developing personas, we integrate the goals, workflow, skills, and environment to construct useful and believable personas.

Cooper and Reimann (2003) provide designers with a standardized process to develop personas. This process consists of 7 steps as follow:

− Evaluation of persona hypothesis
− Mapping of observed and interviewed individuals to behavioral variables
− Identification of important behavioral variables
− Formation of characteristics and goals for personas
− Checking for completeness
− Development of narratives
− Indicating persona types

Here, the important point is the distinction between behavioral variables and demographic variables like age or technical skills. Although they can also affect behavior, but the main focus in creating personas should be on behavioral variables because they impact the design more significantly.

At this stage, developed personas should feel like real people which represent possible candidates for target audience of the design since only one distinct interface can be designed per persona. Designers should prioritize their personas and identify the persona which will be used as the target audience of the design. This persona is called primary persona. The goal of the design would be to completely satisfy the needs of primary persona while trying not to dissatisfy other personas. In some cases, adding few capabilities to the designed interface which fully satisfies the primary persona can also satisfy some other personas. These personas are called secondary personas.

Other researchers have also contributed to guidelines for developing useful personas. Nielsen in "Ten Steps to Personas" describes steps of creating personas as follow (Nielsen, L. 2007):

− Finding users: Find out who the users are and what they want from the system.
− Building hypothesis: Understand differences between users by identifying different groups of users. The goal of this step is to capture the ways users interact with the system.
− Verifications: Achieve data for the personas by finding out the needs and wants of the users and gathering information about their work situations.
− Finding patterns: Understand if the current user groups are covering all different types of users or if we need to extend the number of user groups by considering more users’ data.
− Constructing the personas: Define the personal specifications of each persona including body (name, age, and picture) and background (job and occupation).
− Defining the situations: Define the needs, wants, expectations, and goals of the persona.
− Validation and buy-in: Interact with other participants to get their comments on personas.
− Dissemination of knowledge: Share the personas not only in the design team but also in the rest of the organization.
− Creating the scenarios: Describe what would happen when the personas use the system for different purposes.
− On-going development: Validate and update the personas each time you achieve new data about the users.
The advantages of a well-composed persona include (Cooper and Reimann, 2003; Nielsen, L. 2007):

- We can characterize the target group for our design concept and categorize the users’ wants, needs, ideas and expectation in a particular context.
- Enabling the members of the design team to have a common understanding of potential users and their needs.
- Designing for personas assure the team that they are designing for many potential users.
- Helping the design team to focus on designing what the users will actually use instead of what they ask for.
- Prioritizing the tasks based on the personas.
- Solve disagreement issues amongst members of the team by referring to personas.
- Constantly evaluating the design against the personas.

Using persona in software companies helps to understand potential users better and improve the quality of their products as well as reduce the time span in each design cycle (Nielsen, L. 2007). While personas originate from the data gathered during the user study, they may have some gaps which can be filled by data provided by stakeholders and by research on available literature.

The critical point of using personas is that we may think that having personas is enough and we do not need to contact the real users until the end of the design anymore. But as it is also mentioned by Blomquist and Arvola (2002), in such way the design process might fail and the result may not be acceptable. Another drawback of using persona is that different parties within the development team might still not be able to have personas in mind in all of their decision makings.

3.4.2 Scenarios

The process of developing personas makes it possible to get a clear picture of user goals and to identify the target audience. However, the process of translating the achieved knowledge to consistent design solutions that meets persona’s goals is still missing. Scenarios fill the gap between conduction of user studies and production of design solutions. Scenarios use personas as main characters and tell stories that can be used to extract the design solutions (Cooper and Reimann, 2003).

Narratives are powerful tool to communicate ideas. Since they help engage their audience and trigger their imagination, they can be used to visualize and therefore evaluate the design ideas. Interaction design is the design of behaviors over time so narratives together with the power of minimal visualization tools such as whiteboards can be used to perfectly depict and communicate the interaction concept without expensive efforts like implementing the interaction concept. Going through more details however, demands for sophisticated visual tools while scenarios are useful tools to identify the requirements without dependence on technologies.

We use scenarios to identify the flow and sequence of accomplishing the required tasks to achieve particular goals and to complete the activities.

“A scenario is a written story that describes the future use of a system or a web site from a specific, and often fictitious, user’s point-of-view. The scenario is created around a character, a setting and a goal.” (Nielsen, L. 2002)
The advantage of scenarios is that we can explore possible ways to perform different tasks and can make them more efficient. We may also suggest some new tasks that can support the goals more effectively (Brehob, et al., 2009).

3.4.2.1 Developing scenarios

Although, narratives are easier to understand for users, it is not optimal to produce them directly. As engineers, we need a systematic way to approach scenarios. Our studies in the area of interaction design shows that there are multiple overlapping terms referring to the same core concept. Scenario is not an exception. What brings a value to a design project is to take advantage of various techniques used to acquire the same knowledge in various formats and under different terminology. To develop scenarios, we found two concepts that overlap with scenario very helpful: task hierarchies and workflow analysis. In next section, we go through more details about them and motivate why they are helpful in documenting and optimizing the scenarios.

Task hierarchies

By developing task hierarchies, we decompose the tasks and document the components of the complex tasks by breaking them down into different subtasks. Task hierarchies are used to identify and illustrate the tasks and subtasks of an activity (Abe and Ellington, 2004).

The main goal in creating task hierarchies is to break down the complex tasks into their smallest components and having a task execution model which helps picture our goals and operations and plan according to users’ needs and their activities. Task hierarchies can provide us with different levels of involvement of each task in a process and assist us to decide on different levels of performing each particular task (Abe and Ellington, 2004; Hackos and Redish, 1998).

Workflow analysis

We perform workflow analysis to find out how the users accomplish a particular task or process. Workflow analysis is also known as "business process analysis" and makes it possible for us to identify the process of performing the tasks by the users and obtain information about users’ behaviors in context (University of Maryland, 2001b).

During workflow analysis of each particular task, we try to answer the following questions:

- What are the involved steps in the task?
- What information should be used for each of the tasks?
- What may cause an error or affect the completion of the task?
- What kind of skills is required for accomplishing each task?
- How can we improve the task performance?

We determine a set of goals for the target users and a set of tasks which support these goals. Then we find ways to perform the tasks and make them more efficient or we suggest some new tasks that can support the goals more effectively (Usability First, n.d.).

Hierarchical Task Analysis assumes that users are responsible to achieve their goals using available functionality and misses the cognitive processes of users while it is essential to have an understanding of users’ cognition to improve the design for tasks especially resource intensive ones. In addition, Hierarchical Task Analysis also misses the elements required to
analyze workflows. These reasons, demonstrate the necessity of employing other structures to exploit all different aspects of user activities. As a result, we employ hierarchical task analysis together with workflow analysis to have a more effective task analysis (Abe and Ellington, 2004).

3.5 Prototyping

Prototyping is an inevitable part of software development process in order to share design ideas, test the user interface and finally achieve customer satisfaction. Prototyping has a vital role in improving the interaction design model. Prototypes are used as a representation of the product in design process and as a means of testing and developing alternative design ideas (Lim and Stolterman, 2008). Prototyping is a basis for evaluation of alternative design choices, early in the product development cycle (Rudd, et al., 1996).

Interactivity explains the behavior of prototype. It examines if the prototype provides the user with appropriate feedback when user enter some inputs, if the user can go to another pages or forms easily, and if the user is able to perform a task by using efficient tools such as clicking on links, buttons, or drop-down menus (Farnum, 2002).

Human-Computer Interaction happens as the dialog between human beings and computer programs. It means that the computer program accepts the input from human and responds to that input. We always refer to the particularities of user interface as look and feel. The concept "look" mentions the visual design of the product while the concept "feel" mentions the level of interactivity of that product (Svanaes, 2000).

Amongst different available IPTV services such as Live TV and Video on Demand (VOD), we particularly focus on Video on Demand and try to find out the design issues to improve the interactivity of this service.

Video on Demand

VOD services allow users to explore, rent and watch the videos available in an IPTV system. Specifically when it comes to movies, it enables users to browse different categories of available movies to get more information on each movie, watch previews associated with that movie, and possibly rent that movie. Users can play the rented movie as much as they want until the rental period expires. VOD offers a different way of experiencing movies compared to what people are used to. User can choose to watch a movie and interrupt the playback at any given time. IPTV in particular, makes it possible to have access to VOD services through different media including TV set, personal computers, and even mobile phones.

As mentioned, VOD makes it possible for users to rent and watch the movies whenever they want in an interactive way. Possibilities for interactivity in VOD include:

- Enabling users to access the meta-data associated with each video
- Enabling users to perform other tasks in addition to playback such as fast forwarding, rewinding, pausing and resuming the video to enhance the interactivity
- Making it possible for users to interactively search amongst the videos to capture their interests based on different meta-data associated with videos

In a typical IPTV system, a VOD offering is loaded from the server every time a user wants to watch the content. Using PC however, it is possible to download the content only once
meaning that users can also buy the content or rent it for longer periods using their PC. The first case requires continuous access to high speed internet connection while the second case eliminates that need. In fact, users can also access rented VOD offerings when they are offline. To tackle the copyright issues, a possible strategy for content rights management would be to provide the users with a key for downloaded content that is valid until rental duration expires.

3.6 Usability evaluation

Usability evaluation is the last step in an iterative process of design. After performing the usability evaluation, we can verify if the design fulfills the requirements or not. If yes, then we can claim that the product is designed based on users’ wants, needs and expectations. The most important issue while testing the usability of a product is to be able to improve the quality of the product by measuring different aspects of usability. International Standard, ISO 9241-11, defines usability as:

"Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use."

In addition, Folmer and Bosch (2004) state that usability is often assessed using the following criteria:

- Ease of learning
- Retention of learning over time
- Speed of task completion
- Error rate
- Subjective user satisfaction

Although these terms may seem to be other aspects of usability, but in fact they all fall into three major aspects of usability: efficiency, effectiveness and satisfaction.

Effectiveness: Effectiveness is the accuracy and completeness with which users accomplish intended tasks in an interface. Indicators of effectiveness are usually the quality of task outcome and error rates (Frokjær, et al., 2000).

Efficiency: Efficiency is the speed and convenience to operate a product. An interface may facilitate to operate a task in one step or it may require many steps. The steps can be hidden from the user point of view or the user may be responsible to keep track of all the details through different steps. In other words, the main factor of efficiency is the speed of accomplishment of a task with minimum number of errors occurred (Kuniavsky, 2003).

Another definition of efficiency is when users have learned the design, how quickly they can perform tasks (Nielsen, J., 2003). Efficiency is also defined as the relationship between the accuracy of achieving goals by users and optimized use of resources to achieve these goals (Frokjær, et al., 2000). Therefore, it is not efficient to use unnecessary resources to help users achieve their goals. Also, it is not efficient when minimum use of resources lead to inaccurate achievement of goals. In other words, a product is efficient if it uses minimum required resources to accomplish each task.

According to Frokjær, et al. (2000), we can measure efficiency using the following indicators:

- Task completion time which is the primary indicator of efficiency.
- Learning time: In this approach, learnability is considered as a part of efficiency.
Satisfaction: Satisfaction refers to the comfort, acceptability, and positive attitude of the users towards use of the system (Frøkjær, et al., 2000).

An important issue in usability is correlation between different aspects of usability. A possible correlation can be the correlation between learnability and efficiency. But some researchers believe that "In a usability test, it is important to measure all three aspects of usability: satisfaction, efficiency and effectiveness rather than simply assuming that they are correlated" (Winter, et al., 2007). This statement suggests that we cannot take usability as a unique concept but we should consider all different aspects of it.

There are several methods for usability evaluation. Each of the available methods is useful in the right time and the right situation. There is no overall distinction among the available methods but the important issue is to choose the appropriate method at the right time of developing a product.

This chapter was an in-depth study of different aspects of interactive TV as well as a literature review on different design tools we use during this research. We argued why they are important and how they can assist us to better answer our research questions. In the next chapter, we motivate the methods of our choice in this research and why and how they assist us in achieving our objectives.
CHAPTER 4: METHODOLOGY

This research aims at investigating the usefulness of adopting personas and scenarios to a specific problem and context explained earlier. The outcome of this study includes elaborated personas and scenarios based on user studies, low-fidelity and hi-fidelity prototypes designed based on elaborated personas and scenarios, and, argument about adopting personas and scenarios in this specific problem. To answer the research questions raised in the above steps, we employ survey and interview, as two research methods commonly used for user studies, together with literature review (Creswell, 2002).

When choosing the object for our studies, we consider the target group as a sample of target audience with similar age distribution, experience and motivation.

We conduct survey and interviews to further our knowledge about the problem and its context. These research methods assist us to know the target audience of IPTV PC Portal as well as to come up with a set of tasks demanded by them which both would be used as basis for elaboration of personas and scenarios. In other words, we use survey and interviews to gather data from users regarding their needs and expectations from the product to construct the personas and scenarios.

We design and develop low-fidelity and hi-fidelity prototypes using personas and scenarios. Then we evaluate the usability of the designed prototypes by using heuristic evaluation method to test the effectiveness of applying personas and scenarios in designing for IPTV PC Portal. Heuristic evaluation is especially useful in this context since it allows us to gather comments and usability problems from experts with help of heuristics and therefore makes the results of evaluation more meaningful compared to statistical results.

In this chapter, we motivate the methods of our choice and why and how they assist us in finding answers to our research questions and consequently achieving our objectives.

4.1 Methods of user study

We use three methods to achieve a better understanding of the users and the system they intend to use. We use brainstorming method to get a grasp of what different stakeholders of the project picture in their mind and what is technically feasible in the project. We use survey to gather quantitative data about the target audience of IPTV PC portal including demographics and their interest in different application of IPTV. This data provides us with answers to our first research question. We also use interviews to gather qualitative data about potentials users. We then use all these data to further develop our personas and scenarios to provide answers to the rest of our research questions.
4.1.1 Brainstorming

For brainstorming, we adapt to context meeting technique presented by Thomas and Bevan (1996) to identify and document the contextual factors. For context meeting, we first prepare a list of all the stakeholders who are connected to the project, those who are interested in the outcome of the project, and those who are aware of the development process. It is also a plus to consider end users while preparing the list. The project manager should also strongly participate. Then we hold a meeting with the stakeholders and ask them different questions about users, tasks, equipments, and environments. Finally, we document the results in the format known as context report introduced by Kirakowski and Cierlik (1999).

Brainstorming has different advantages including:
- Easy to understand
- Not expensive
- If it is controlled properly, it can be a quick way of generating ideas and solutions
- Encourages creative thinking
- Provides a good opportunity for widespread involvement and participation

It also has some disadvantages including:
- May take too much time if not properly controlled
- May raise expectations by considering some ideas that will never be implemented

4.1.2 Survey

Survey is performed to achieve quantitative data about the users regarding their preferences. Survey is an important research method in Human Computer Interaction and is defined in this area as follows: “Survey is a technique for gathering information from a large number of users” (Brehob, et al., 2009).

Survey is an important technique which provides feedback from users. These feedbacks have strong impact on interface design and development as well as understanding the requirements. Surveys can provide information about users’ ideas and preferences about the design of the product in different stages of developing the interface (University of Maryland, 2001a).

In this thesis project, we conduct a survey in form of questionnaire to investigate the users’ expectations and preferences. To get a better picture of demographics of our potential target audience, we do not limit the participants to a special group of users. In preparing the questionnaire, we need to consider different issues to prevent from having biased questions. For this purpose we need to consider the question type, possible answers for multiple-choice questions, wording of questions, order of questions, and response format (Trochim, 2000).

Survey has different advantages including:
- Surveys are somehow inexpensive
- Surveys helps us understand different characteristics of a large population of users

The limitation of surveys is that they need motivated respondents to accept to participate and complete the survey.

Many principles should be considered in designing the questions for a survey. A list of issues needs to be considered in the process of improving survey questions are as follow:
In each category of questions, different types of questions need to be considered: rating questions and multiple choice questions as well as open-ended questions. Subject-wise, three different categories of questions can be named for this survey:

- Identify the individual specification of potential users (general demographic questions)
- Identify the tasks user expect to be able to perform though the product
- Ways users expect to perform different tasks

In rating questions, the responses are shown as star ratings in order to motivate and engage the users. We avoided percentage or textual agree/disagree responses to minimize the confusion. This strategy was also effective to prevent respondents from being discouraged when they see a bunch of text that looks like an exam. We wanted to highlight that we are looking for their personal opinion and that there is no incorrect answer to these questions and we are not trying to examine them.

In order to ask the respondent’s age, we designed the question in a way that is least privacy offensive. This question should be asked in way that respondent feels comfortable to answer it. In these types of questions, forcing the respondents to put themselves in categories might make them feel offended and they may not provide us with the accurate response.

The distribution of the questions should not be in an order that induces a specific “correct answer” to respondents. Therefore, we sorted the question in a neutral way but later on we changed the order in a way that we intended to analyze the responses.

### 4.1.3 Interview

For constructing personas, we need qualitative data about the users regarding their particular needs and wants, and their ideas and expectations of IPTV PC Portal. To achieve this data, we use interview as an efficient method for this purpose (Cooper and Reimann, 2003) and then we combine the data from survey and interviews to construct our personas. We interview different types of users to understand their particular needs and wants.

The interview method that we use is "semi-structured interview" in which we do not follow a completely predefined agenda. It is a flexible method which allows us to bring up new questions during the interview as conversation goes on. Semi-structured interview is a qualitative method which is used frequently to find out how different people think about a specific domain (Rubin and Rubin, 2005; Zaphiris and Kurniawan, 2007)

By using this method of interview, our objective is to gather information concerning the user's expectations of the system and their experience as much as possible. Semi-structured interview starts with some specific questions and then continue with open-ended questions to achieve broader views of each user. Therefore, we start with some general questions and continue the interview with each user based on what the user says.

### 4.2 Prototyping methods

This section is a literature review on different prototyping techniques that can be used through different steps of the design and development process. We explain why each technique is appropriate for our goals. We then introduce SVG briefly while discuss the challenges of using SVG and JavaScript to implement the hi-fidelity prototype in next chapter.
Prototyping methods widely used in software industry are classified into two main categories; throwaway prototyping, and evolutionary prototyping. We briefly describe each of these methods and their applications.

### 4.2.1 Throwaway prototyping

Throwaway or rapid prototyping is when a prototype is created only with the intention of being discarded rather than being developed into the final product. After initial requirement gathering, a simple model of the system is built in order to get feedback from users to refine or improve the requirements. Usability testing is another purpose of this prototyping method.

The most important reason to choose this method of prototyping is the speed of development. If users have a picture of their initial requirements quickly, they will be able to refine and improve their requirement early in the software development life cycle. Another advantage of throwaway prototyping is that users can test the user interface. This enables usability experts to get comprehensive feedback from users and help them grasp the way system works (Overmyer, n.d.).

“…revolutionary rapid prototyping is a more effective manner in which to deal with user requirements-related issues, and therefore a greater enhancement to software productivity overall. Requirements can be identified, simulated, and tested far more quickly and cheaply when issues of evolvability, maintainability, and software structure are ignored (Overmyer, n.d.).”

Rapid software prototyping is a known practice in the software development process and is sometimes referred to as Rapid Application Development (RAD). RAD is a software development methodology involving iterative development and construction of prototypes. It is a combination of various techniques such as data driven information engineering and prototyping, aiming to speed up software development process (Whitten, et al., 2004).

RAD is mainly used to prototype the application in order to determine and refine target audience requirements and design the final product. We first need to build preliminary data model and business process model, and then take advantage of rapid prototyping in order to analyze the system and enable users to verify the requirement specification. Iterative development is followed by improving the models and the prototype in several development cycles (Whitten, et al., 2004).

### 4.2.2 Evolutionary prototyping

Evolutionary Prototyping is quite different from Throwaway Prototyping. The main reason for evolutionary prototyping is to develop a robust and well-structured prototype capable of evolving to the final product. In this method, the prototype is constantly refined and rebuilt. This method allows developers to add features to or make changes in the prototype.

“…evolutionary prototyping acknowledges that we do not understand all the requirements and builds only those that are well understood (Davis, 1992).”

The advantage of evolutionary prototyping over Throwaway Prototyping is that the prototype is a functional system although it does not deliver all the required functionality. In this method of prototyping, we insist on the fact that the product is never completely done:

“For a system to be useful, it must evolve through use in its intended operational environment. A product is never "done;" it is always maturing as the usage environment changes (Herndon, 1997).”
4.2.3 Prototyping techniques

Prototypes fall into two major categories in respect to fidelity: Low fidelity prototypes and high fidelity prototypes. Low fidelity prototypes are built quickly and often provide no functionality. They present the look and feel of the user interface and do not contain details about the functionality of the product. On the other hand, high fidelity prototypes are interactive and users can interact with the user interface. They are working models made to demonstrate and evaluate user interface. High fidelity prototypes closely resemble to final product. They represent the core functionality of user interface and provide users with a true appearance of graphical user interface (Walker, et al., 2002).

“The low-versus high-fidelity debate lies in the fidelity of prototype required to illustrate a concept, model design alternatives, or test an application. The debate rages to whether prototypes need to be complete, realistic, or reusable to be effective (Rudd, et al., 1996).”

Deciding on fidelity of prototype depends on requirements and limitations of the project, testing and evaluation constraints, and intended target group. Table 4.1 summarizes different properties of low fidelity and high fidelity prototypes.

<table>
<thead>
<tr>
<th>Table 4.1 Different properties of low fidelity and high fidelity prototypes</th>
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<tbody>
<tr>
<td><strong>Low Fidelity Prototypes</strong></td>
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<tr>
<td>Functionality</td>
</tr>
<tr>
<td>Built Quickly</td>
</tr>
<tr>
<td>Usability Testing</td>
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<tr>
<td>Close to Final Product</td>
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<tr>
<td>Simple</td>
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<tr>
<td>Easy to Modify</td>
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<tr>
<td>Cheap</td>
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<tr>
<td>Most Used Medium</td>
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In the next subsections, we argue the differences and application of low fidelity and high fidelity prototypes and their automation issues in detail.

4.2.3.1 Low-fidelity prototyping

Low-fidelity prototypes can be paper-based prototypes like mockups, or cardboards. They are dissimilar to the final product from different aspects such as interaction methods, level of details and visual appearance (Rudd, et al., 1996). It means that unlike high fidelity prototypes, you cannot expect low fidelity prototypes to look like the actual user interface. Low fidelity prototypes are not usually subject to automation due to their nature and difference in material. They tend to be cheap, simple and easy to modify.

The material used in low fidelity prototypes are usually different from the material used in the final product. We can take storyboarding as an example for difference in material. This prototyping technique is often used in conjunction with scenarios. A storyboard contains a series of sketches representing how and in what order users accomplish a task using the product (Preece, et al., 2002). The material in storyboarding is often paper but the product can be a hardware item, a software application, or even a movie.
**Sketching and paper mockups**

In case of software prototyping, we usually use two types of medium: paper, and computer. Medium of prototype is the artifact in use to prepare the representation of the product. Using computer as medium is not always an advantage. There are comprehensive research papers discussing the affordability of different artifacts. Dahl et al. (2006) discuss the affordability of paper and compare it with the affordability of other media such as stationary computers, mobile computers, mobile devices and fixed devices. The study shows that none of these media afford what paper can afford.

Each prototyping medium has its own advantages and disadvantages. Paper prototypes allow quick changes to share different interaction design ideas while ignoring some realism. Also, participation in design on paper is more accessible to beginners or different stakeholders such as managers, because most people are able to sketch (Walker, et al., 2002).

Medium can also be studied from the point of view of usability testing. Walker et al. (2002) discuss the different natures of paper and computer media. She argues that different media support usability testing from different aspects. We can test different segments of interaction using each medium. For instance, paper cannot respond to mouse or keyboard.

Having paper-based sketches could really help us to improve our design ideas in different steps. It also helped us to make the sketches closer to the wants and expectations of the users in a short time. But the only problem with the paper-based sketches was that the users had some problems in considering that they are not using the real system. They insisted on small details rather than focusing on general concepts, while according to Rettig (1994) design details are not supposed to be considered in paper-based sketches.

**Testing**

The time designers need to spend on making a low-fidelity prototype is much less than the time needed for development of a high-fidelity prototype. For this reason it is highly recommended to test the low-fidelity prototype before we actually commit to code, otherwise, it would be almost too late to apply the changes in the code (Rettig, 1994). In low-fidelity prototype, designers discuss, design, sketch and then test the prototype with real users and a real task. The evaluation of design is based on how quickly and efficiently users can use the interface without help from the designers. After each test, designers can refine their design based on the feedback they received. Within a short time, they can see exactly how their design is perceived by typical users just like those who will use the product later on. This demonstrates the value of two important rules of interaction design: “Know your user”, “You are not your user” (Rettig, 1994).

Testing for iterative improvements is referred to as “formative evaluation”, meaning that you evaluate the design while it is still in its formative stages. In contrast, the term summary evaluation is used for a situation in which you evaluate the design once the product is complete which implicitly means that there is not enough time to make substantial changes.

**4.2.3.2 Hi-fidelity prototyping**

High fidelity prototypes make it possible for the users to approximate the representation of the user interface. These prototypes are quite close to the final user interface of the product and are usually built with the same techniques and material as product (Walker, et al., 2002). Having the same interaction methods and appearance of the final product can help developers
test and evaluate their product in order to predict its success or implement possible improvements.

A high fidelity prototype contains lots of details and some functionality, but the users must remember that it will not function completely because the main intention of a prototype is to depict the interaction model. It needs some graphical design improvements and application development to achieve a milestone in the final product release (Farnum, 2002).

We already argued major advantages of prototyping and the reasons why we should include it in the process of software development. But including a high fidelity prototype in development process has some advantages and disadvantages. Table 4.2 summarizes some of these advantages and disadvantages.

<table>
<thead>
<tr>
<th>Table 4.2 Advantages and disadvantages of high fidelity prototyping</th>
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<tbody>
<tr>
<td><strong>Advantages</strong></td>
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<tr>
<td>Reducing the time and cost</td>
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<tr>
<td>Increasing the user involvement</td>
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<tr>
<td><strong>Disadvantages</strong></td>
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<tr>
<td>User confusion between prototype and final software</td>
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<tr>
<td>Developer attachment to prototype</td>
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Advantages while using high-fidelity prototypes include:

- Reducing the time and cost: Prototyping helps us understand the real needs and requirements of the users, and as a result, can reduce the time and cost of software development significantly (Overmyer, n.d.).

- Increasing the user involvement in software development process: Prototyping allows users to interact with the software, and consequently leads to a more complete feedback from the users. This feedback in turn, can prevent future misunderstandings (Crinnion, 1991).

There are also some disadvantages when using high-fidelity prototypes including:

- User confusion between prototype and final software: Prototyping might lead to a misunderstanding for the user about the software finally delivered. They may also expect the same performance and functionality of the final product, which is not the intent of the designers (Overmyer, n.d.).

- Developer attachment to prototype: Developers may also become attached to a prototype that they spent a lot of time and effort on and try to convert it into the final product while it does not have the necessary architectural requirements (Urban, n.d.).

### 4.3 Usability evaluation methods and techniques

There are three types of usability evaluation methods:

**Testing methods:** In testing methods, illustrative users work on representative tasks using the prototype and the designers use the results to change the user interface design in a way that supports the users’ needs and expectations.

**Inspection methods:** In inspection methods, usability experts and sometimes developers or other professionals examine the usability of the system form aspects of user interface.

**Inquiry methods:** In inquiry methods, the evaluators find information about users' needs, likes, dislikes, and understanding of the system by talking to them or by observing them when they are using the system in real work - not for the purpose of usability evaluation.
For the purpose of usability evaluation in this project, we use one testing method and one inspection method. We use heuristic evaluation as an inspection method and thinking aloud as a testing method to evaluate the usability of IPTV PC Client.

Usability evaluation techniques are usually grouped into two areas (Zaphiris and Ang, 2008):
- Expert-based techniques
- User-based techniques
So, prototype needs to be evaluated from usability point of view in two different steps:
- Verify with experts
- Validate with users and customers

**Verify with Experts:** This activity consists of the verification of the prototype by the usability experts. Experts are concerned with verifying if users’ wants and needs, in terms of functionality, are included in the prototype. This verification would be based on usability principles. In this project, we use heuristic evaluation approach (Nielsen, J., 1994) as an inspection method. The usability heuristics will be based on Jakob Nielsen’s heuristics. This method guides the usability expert in a process that can verify UIs’ quality of use. After performing the heuristic evaluation, we will improve the prototype based on the results by repeating the implementation and integration activities.

**Validate with users and customers:** After the verification with the expert, we need to validate the prototype with users and customers. If the prototypes do not fulfill users’ needs and expectations, changes and improvements can be made. This process will be repeated until the prototype fulfills the users’ preferences and needs. In this project, we use thinking aloud method (Nielsen, J., 1994) as a testing method. This activity divides in two parts, the first one is when users interact with the system to perform the tasks of their own interest; the second one, is when the experts require the users to perform some specific tasks.

<table>
<thead>
<tr>
<th>Evaluation method</th>
<th>Type</th>
<th>Applicable stages</th>
<th>Can be conducted remotely?</th>
<th>Can obtain quantitative data?</th>
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</thead>
<tbody>
<tr>
<td>Heuristic</td>
<td>Inspection</td>
<td>Design, Code, Test, Deployment</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Thinking aloud</td>
<td>Testing</td>
<td>Design, Code, Test, Deployment</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

In the following sections we study the heuristic evaluation (as an inspection method) and thinking aloud (as a testing method) more deeply. Then we explain the process of performing each of the evaluation methods.

### 4.3.1 Heuristic evaluation

Heuristic Evaluation as a usability evaluation inspection method is an expert review technique where experts inspect the user interface to judge compliance with predefined usability principles or ‘heuristics’. It is the most widely used inspection method. This method is a technique for gathering usability issues of a system based on a set of general heuristics. A heuristic is a guideline or general principle that can be used as a rule of thumb during the design process or as a tool for evaluating an existing design or system. The main idea behind this technique is that we gather potential usability issues of a system through independent evaluators. Nielsen's experience indicates that around 5 evaluators usually results in about 75% of the overall usability problems being discovered.
Heuristic evaluation is a discount usability inspection method. It needs a small set of evaluators to judge the user interface for compliance with usability design principles. It requires at least three evaluators to conduct a usability test based on specified heuristics. Experiments have showed that three evaluators are able to detect 60% of the usability problems in a specific interface. With increased number of evaluators better results are obtained. However, more than five evaluators tend to find the same errors and five evaluators are expected to detect 75% of the whole usability problems. Therefore, using five evaluators might be a reasonable choice. The skill level of evaluators themselves determines the quality of the test conducted. Table 4.4 shows the characteristics of the heuristic evaluation method:

<table>
<thead>
<tr>
<th>Personnel needed for the evaluation</th>
<th>Usability issues covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usability experts</td>
<td>4 Effective</td>
</tr>
<tr>
<td>Software developers</td>
<td>0 Efficiency</td>
</tr>
<tr>
<td>Users</td>
<td>0 Satisfaction</td>
</tr>
</tbody>
</table>

Heuristic evaluation is a quick and cheap usability evaluation method. It is the process for usability experts viewing an interface and making value judgments. To assist the evaluators in finding the usability problems, we provide them with a list of different heuristics that can be used to make suggestions while evaluating the usability of the system. Nielsen (1994) provides the following 10 heuristics of usability:

1. **Visibility of system status**: Users should be provided with appropriate feedback (including graphical signs) of the current status of the system.

2. **Match between system and the real world**: The terms and concepts used in the system should be known and well understood by the intended users of the system. Information should be organized in a logical way as audience is used to in the real world.

3. **User control and freedom**: Users should experience an acceptable level of freedom and control when they interact with the system.

4. **Consistency and standards**: Controls such as scrollbar, buttons, etc. as well as icons and terminologies should be consistent throughout the interface. Industry and platform standards should also be taken into account as appropriate.

5. **Error prevention**: Wherever possible, errors should be prevented from happening. For example, a numeric range as input can be shown as a drag-and-drop bar instead of a text box. When deleting an important field, a confirmation dialog can be shown to make sure user is not mistakenly deleting something.

6. **Recognition rather than recall**: The memory load of users should be decreased by presenting familiar icons and options whenever possible. Do not force the users to try to remember information from one interface to another. For example, mouse-over tooltips can be used to describe the functionality of an unfamiliar icon.

7. **Flexibility and efficiency of use**: Beginners and expert users use the system differently but it should easy to use for all of them. Accelerators such as keyboard shortcuts should be provided to enable advanced users to complete frequent tasks faster.

8. **Aesthetic and minimalist design**: Displaying unimportant interface elements or information may distract users from paying attention to what is important. Minimalist approach greatly improves the usability of the design.
9. **Help users recognize, diagnose, and recover from errors:** Error messages should also propose possible solutions to users on how to recover from the error.

10. **Help and documentation:** Although best designs do not require help and documentation, having access to these types of information may be useful for some users. In this case, this information should be searchable and easy to follow. Other forms of help such as videos are good ideas in case complicated tasks are requirements in a system.

Verification of these principles in the prototype is called heuristic evaluation, performed by usability experts. Usability experts as the evaluators will inspect the user interface to judge compliance based on predefined heuristics for the intended tasks. Then, they will by checking the questions at each stage examine if the characteristics of the heuristics are fulfilled or not. After finding the usability problems, they will list the founded problems and rate them according to the severity ratings.

On the other hand, as Nielsen himself suggests, new heuristics can also be added for specific purposes. This will improve evaluator’s perspective and provide better results. However, this new added heuristics should be picked carefully; they should not interfere with the existing ones and stay inside the basic usability principles. For adding new heuristics, interviews or questionnaires can be used for the specific product in focus. This may improve the reliability of the method further, since it includes the participation of actual users as well.

Heuristic Evaluation is usually conducted in a series of four steps (Galitz, 2007):

- **Preparation:** Select evaluators and prepare sheets for recording the results.
- **Determining the approach:** Set typical user tasks or let the evaluators to set up their own tasks or conduct an comprehensive inspection of entire interface
- **Conducting the evaluation:** evaluators inspect the user interface individually to identify the issues of heuristics as usability problems and record the problems
- **Aggregating and analyzing the results:** group the similar issues or problems and determine the possible fixes

Advantages of heuristic evaluation include (Scholtz, n.d.; Galitz, 2007):

- Easy to perform
- Relatively lower cost
- Less time consuming
- Involving developers and testers in user-centered design process
- No need to have access to users

There are also some disadvantages to heuristic evaluation (Scholtz, n.d.; Galitz, 2007):

- Doesn’t not provide solution to usability problems but rather pinpointing them
- Inspection methods can discover half of what is discovered during laboratory testing
- Evaluators should have some knowledge of interface design
- Evaluators may lack an adequate understanding of the users and the tasks
- Difficult to identify missing interface elements or features
- Difficult to summarize the findings from different evaluators since problems are usually reported and prioritized differently
4.3.2 Thinking aloud protocol

Thinking aloud is a testing technique in which users are asked to speak their thoughts as they perform a task. The main benefit gained from this technique is that designers can find the mistakes users make and also the underlining factors behind these mistakes in order to improve the design to avoid those problems in future (Nielsen, J. 1993).

During the usability test, users are asked to express their thoughts, feelings, and opinions while interacting with the system. This is done in order to capture a wide range of cognitive activities. There are two alternatives in thinking aloud protocol (Nielsen, J. 1993):

- Critical response: Users are asked to reflect their thoughts only when it comes to specific parts of different tasks.
- Periodic report: In case the tasks are too complex and expressing thoughts distracts the users from actually performing the tasks, users are asked to express their opinions in predetermined time intervals. This interval depends on the complexity of a task.

Although the main aim of thinking aloud protocol is to have a better understanding of users’ mental model but the terminology and expressions they use to express themselves can be helpful both to incorporate into the design and to use in documentations. In Table 4.5 shows the characteristics of the thinking aloud evaluation method:

<table>
<thead>
<tr>
<th>Personnel needed for the evaluation</th>
<th>Usability issues covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usability experts</td>
<td>1 Effectiveness</td>
</tr>
<tr>
<td>Software developers</td>
<td>0 Efficiency</td>
</tr>
<tr>
<td>Users</td>
<td>4 Satisfaction</td>
</tr>
</tbody>
</table>

In thinking aloud method, test leader takes note when users express their thoughts while using the product. It helps us find out how they view the product and this information leads to a better understanding of users’ misconceptions. Advantages of thinking include:

- Less expensive
- Results are close to what is experienced by users
- Results are rapid and high-quality from qualitative user feedback point of view
- If there would be any difficulty regarding a subject, the observer can clarify the situation.

As a disadvantage of thinking aloud method, we can mention that the environment is not natural to the user.

Choosing the test group: Ideally, more users are needed to achieve more focused results. The test group must be a sample of the target audience with the same distribution of age, experience and motivation. But the main point is to choose users who are interested in the area and therefore their feedback is more useful. Best choices are users who need the service offered by the product in the near future or have used similar services offered by competing products recently (Kuniavsky, 2003).

In this chapter, we motivated the methods of our choice and why and how they can assist us in finding answers to our research questions and consequently achieving our objectives. In the next chapter, we present the results and findings of this thesis project.
CHAPTER 5: RESULTS

In this chapter, we present the results and findings of this thesis project. It includes user study results, identified context of use, personas, scenarios, prototyping results, and usability evaluation results.

5.1 User study results

In this section, we go through the details of user study results in 3 parts: brainstorming results, survey results and interview results. The raw data gather through survey and interviews are then organized into personas and scenarios to be useful as powerful design tools. We discovered that these data are not useful enough if directly used during the design process.

5.1.1 Brainstorming results

We had several brainstorming sessions with various stakeholders of the project in different stages of our thesis work in order to achieve a better understanding of their requirements and viewpoints. It is therefore, difficult to gather the results of brainstorming in a separate section as it affects the many of other sections. Brainstorming helped us achieve a better understanding of IPTV. In this section, we present our findings in our initial brainstorming sessions with project stakeholders as an effort to understand and limit the context.

In our efforts to understand and limit the context, we asked the interaction designer of TV Portal team about the target audience of PC Portal. The response was that any person can be considered as the audience of this product. Although we later discovered that this is not true for PC Portal, we should take into consideration the real challenges designers face in TV industry. While it is the de facto standard to choose and limit the target audience of the design, this means failure in TV related products. It is not acceptable to simply limit the design of a modern TV system to a small group of people. However, when it comes to PC, we can claim that old people for instance, are not much interested in this product. Someone can claim that it is due to weaknesses in the design, but we believe that unless we redefine the usage of PC as a personal TV, old people won’t be interested in using it to watch TV. Our assumption here is that PC is still a personal computer used as it is used in the current time while it would be possible to change the definition of a PC in future.

Their emphasis was on interaction design and usability of the product and when we asked them about the environment in which people will use PC Portal they referred to Ericsson’s slogan in this regard: anytime, anywhere, any device.

However, during this project, we focused on personal computers as the device to design for. The possibility to connect a PC to TV was excluded from the designs since stakeholders believed that it would not be easy to interact with the product any more. In an IPTV solution, if a user wants to use a TV set to access the system, there is a better way to do it than to connect through PC: connecting through the Set-Top Box. IPTV should not be mistaken for various internet TV solutions that are only accessible through PC.
5.1.2 Survey results

Conducting this survey was an important step in our user studies. We employed survey in order to gather the statistical data we required to know more about the demographics. This survey also helped us get a better picture of users’ needs and expectations. We also gathered useful qualitative data during the interviews we conducted. Survey results together with qualitative data gathered through interviews will be used as an important input for making the personas.

In order to be able to draw reasonable conclusions from the survey, we needed more participants in our survey. Therefore, our analysis is based on responses gathered from 45 users that participated in this survey. We tried to choose respondents from different demographics with difference in experience and background. The statistical data and our findings extracted from survey results are discussed in this section while our survey questionnaire can be found in appendix A.

In the first 3 questions, our aim was to investigate the age and gender of the users interested in IPTV PC Portal. But in order to avoid the confusion, we referred to the concept as watching TV channels or movies online. Here is the statistics:

![Figure 5.1 How much users like to watch TV or movies online](image)

While we do not intend to draw general conclusions from statistics gathered from responses, they can help us have a more realistic primary persona specifically when we are considering age and gender.

Two questions were asked to find out more about the environment of using PC to watch TV or movies online. One of the questions was about how much users like to watch TV when using computer. Here is the detailed result:
The answers to this question show that many of the respondents are interested to watch TV or movies when they are using their computer. It is an important issue that should be considered when designing the system. We need to consider the fact that users are also busy with their usual tasks when they are using their computer. Therefore, the design should be flexible in a way that assists the users to follow their own task such as checking their email or browsing the web at the same time.

Besides technical requirements such as minimized resource consumption, the client application can be designed as a transparent control panel that allows the users to open other applications easily as they are still working with the PC portal. Users should also be able to minimize different IPTV applications such as live TV or Video on Demand in order to go back to their usual tasks without getting disconnected from their current IPTV application being played in the background.

The other question was about how users watch a high quality video online. The results are as follow:

- **55%** → I can watch a high quality video smoothly.
- **22%** → I sometimes experience short delays while watching a high quality video.
- **7%** → Delays are long and I need to wait before I can watch a high quality video.
- **16%** → I don’t know.

The answers to this question show that most of the users are able to watch a high quality video smoothly or with short delays. It means that most of the users have access to reliable internet connections and can use this system so we can count on them as the potential users of this system.

A set of questions were asked about the movies section. The purpose of two questions were to see if the users are more interested to buy the movies or to rent them from an online movie store. Also one question was regarding the most wanted information about a movie when representing them in the online movie store.
One question was about how much users like to buy movies. Here is the result:

![Figure 5.3 How much users like to buy movies](image)

The result shows that respondents were not much interested in buying the movies. It is needed to analyze the answers to the next question and then decide which one is more desirable for users; buying the movies, renting them or both.

The other question was about how much users like to rent movies. The result is as follow:

![Figure 5.4 How much users like to rent movies](image)

The result shows that the majority of respondents were interested in renting the movies. However, in interviews some users mentioned that best for them would be to download the movies and keep them as long as they want. It seems that this factor is in connection with financial and legal issues of Video on Demand which is not within the scope of this study. In summary, we can draw the following conclusion from the results of this question and previous question: users are more interested in renting that buying the movies.

In this part, we had one more question and it was about the first thing users want to know about a movie. Here is the result:
This question was a multiple choice question while respondents were also allowed to choose more than one choice. The answers to this question show that the most wanted information from a movie by the users are title, genre, and year. After that director, actors, and plot stands in the next levels. 5% of users also chose ‘other’ and mentioned awards and critics. This finding shows that it is necessary to provide the users with a link to relevant web page dedicated to the movie (such as IMDB) that contains more detailed information for professional viewers. Especially, in case of PC portal this is feasible and relevant.

The result for this question could have been different, if we had asked the question in a different way such as an open-ended question. We came to this conclusion because some responses we received were totally different in data type and in ways they can be gathered. However, the current question implicitly provides a list of all the possible answers which can set a limit for respondent to provide the best response.

One question was asked about TV channels and how many TV channels users like to have. Here is the statistics:

The analysis of responses to this question shows that a large group of users want to have up to 20 channels and also a large group of users want to have more than 40 channels. We can use this finding to design a channel list that supports more channels since it would not be appropriate to show few channels when most users have more. But we also need to consider that some responses to this question are not valid since we did not mention the subscription type or the amount they needed to pay for each channel. This might have misled the respondents to think of what they desire to have without even paying for it.
One question with five sub questions regarding different features in the system was asked to find out and compare the necessity of each feature to have in PC portal. Here are the results:

![Figure 5.7 Necessity of different features in the system](image)

When comparing the achieved results from these sub questions, it can be concluded that the most desirable feature among the users is “Listening to radio from internet”. Maybe it is because they do not need to watch anything so they can perform other tasks with their computer at the same time. After that, the most wanted features are "Renting and watching movies online" and "Watching TV channels online". Using the results achieved from this question, we can decide on main use cases to design for. But we should also consider that key stakeholders have a say in the order of features to be included in a product.

In the last sub question, users were asked to explain if there is any other feature that they like to have in such system. The most interesting answer to this question was the following: "When watching a movie online, I like to chat with the other people who are watching the same movie."

This shows the potential benefit industry can gain from asking real users what they want. Instead of engineers spending hours performing feasibility studies on what features to add, why not ask users what is missing. In this way, industry can focus on developing what is really expected and not what they think is good for users.

In the final category of the questions, users were asked about having some suggested extra features in the system.

The first question in this part was about the importance of following TV series for the users. Here is the result:

![Figure 5.8 How important is it for users to follow TV series](image)
The answers to this question show that it is not highly important for most of the users to follow TV series. So, it may not be of a high priority to have a feature that supports this want and provides the users with different episodes of TV series. However, the large percentage for the answers in levels four and five gives us a hint for future development.

The second question in this part was about the importance of watching live sporting events for the users. The statistics are as follow:

![Figure 5.9 How important is it for users to watch live sporting events](image)

The answers to this question show that most of the users are interested or highly interested to watch live sporting events. So, having a section for live sporting events is a feature that can be considered in the system.

The last question in this part was about the importance of following the news for the users. Here is the result:

![Figure 5.10 How important is it for users to follow the news](image)

The answers to this question show that most of the users are interested to follow the news and care about that. So, having a news section is a feature that can be considered in the system.

### 5.1.3 Interview results

For interviewee selection, we tried to choose users of different ages with difference in experience and motivation. In other words, we selected different users with different background and demographics.
We first provided the interviewees with comprehensive explanation of IPTV services. Then we started the interviews by asking a set of predefined questions. The general questions that we asked during the interviews are as follow:

1. What do you expect from your current TV services that you do not already have?
2. What do you want from IPTV?
3. What do you think about using IPTV on your PC?

We then asked different questions from each particular user depending on how conversation went on during the interview.

We interviewed 7 different users including university students, old people, professionals, men, and, women. Then, we combined the data from survey result together with the data from interviews to group the similar characteristics into different user groups and then turned them into our personas.

To collect and capture the data, we took notes of all the issues mentioned by respondents during the interviews. After collecting the data, we tried to summarize and analyze them to extract the useful data that can help us in developing our personas.

**Analyzing interview results**

In order to analyze the qualitative data gathered through interviews, we used coding technique (Bogdan and Biklin, 1998) to categorize textual data into relevant categories. Coding technique enabled us to organize large amount of textual data and discover involving patterns that we used later on to formulate goals of our personas.

To perform the coding, we first read all the transcribed interviews and then generated a number of categories as we read the responses. In this step, we labeled the data without attention to the overlap between categories. We also created schematic diagrams to depict the relationship between different categories. Finally, we used focused coding to eliminate repeated categories or combine them in order to achieve a mutually exclusive set of coding categories. The advantage of using this technique was that developed categories facilitated the process of formulating persona goals later on when we developed our personas.

The documented results are available in appendix B and we bring one sample here to show how we documented the highlights of each interview.

### Table 5.1 A documented interview result

<table>
<thead>
<tr>
<th>Name: Pedro</th>
<th>Gender: Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: 32</td>
<td>Job: Ph.D. Student at SICS</td>
</tr>
</tbody>
</table>
- Uses some available services for VOD
- Uses some internet TV services to watch some channels from his country.
- Thinks that it would be so good to combine all services in one system.
- Likes short advertise but not long ones.
- Sometimes wants to relax and watch whatever is on TV. (Not to choose all the time.)
- Sometimes wants to relax and watch a newly released movie on his PC. (Since the live TV doesn’t show the newly released movie)
- He is busy and is interested in watching some of his favorite movies at his free times.
- He likes to rent some movies and watch them in his free times but he usually doesn’t have any special thing in his mind and likes to search and find one of the high rated movies from different genres to watch.
5.2 Identified context of use

It is not realistic to point to a single method and claim that it can be used alone to identify the context of use. We realized that all the methods of user study helped us to achieve a better picture of the context. We have started to investigate about the context of use by our brainstorming sessions with stakeholders. Further details can be found in section 5.1.1.

We realized that the greatest challenge in identifying the context is the way to document the findings. For this reason, we adapted to context meeting technique presented by Thomas and Bevan (1996). However, as mentioned in section 5.2.1, we found this technique too deterministic and inflexible at least in the way the findings are documented in form of tables called context report. Therefore, we decided not to go through the tables in this report. It is worth mentioning that we found personas as a suitable format that reflects the findings regarding the context in a better way. The summarized version of context report can be found in appendix C in form of bullet lists.

We need to find rough answers to the following questions in order to develop a better understanding of the context. First, we need to know who the target users are in order to make the IPTV PC Client meet their needs and wants. Second, we need to understand where and in which conditions they will use the IPTV PC Client. Then finally, we need to understand how they will use the IPTV PC Client.

There are certain constraints implied by IPTV requirements that limit its context of use. High-speed access to IP networks either an IMS network or internet is a requirement for IPTV. Therefore, people of countries with limited access to these technologies cannot be the target audience of IPTV solution, although access to these technologies is perhaps just a matter of time in these countries.

When it comes to demographics such as age, we realized that older people still prefer to use traditional ways of accessing content such as normal TV or cinema.

When it comes to different devices, there is a general idea that technology makes it possible for people to access the same services through different devices, and therefore the device does not matter anymore. However, we strongly believe that specifications of the device such as screen size and aspect ratio as well as its means of interaction such as keyboard, mouse, or touch screen fundamentally affect the design for the same service.

Interaction design for the same service in a limited mobile phone with arrow keys is different with design for a 10 inch touch screen device. At the same, the same UI designed for PC will not satisfy users of a 42 inch TV set. Therefore, it is crucially important to emphasize that the context of use for our designs in this project is personal computers.

There is a general belief that it is possible to design a system regardless of the target medium. Web has made this relatively possible. Users can browse the same website using their PC, their iPhone or their iPad. While this is technically possible, we believe that total ignorance of the target medium leads to ignorance of the context of use, and consequently a bad design. Take Yahoo mail as an example; while its design is suitable for personal computers with mouse and keyboard, it does not properly function in an iPad simply because of different scrolling and text input mechanisms in iPad.
In addition, users expect to experience a design that integrates well with the unique functionality of the medium rather than to see the exact same thing everywhere. This fact also holds for experiencing TV; it is not proper to expose the users to the design done for the Set-Top Box when they use their PC to access their system. Based on our experience, it is also inappropriate to provide the users with the design done for PC when they are using their smart phones. Every device has its own unique features for interaction and perhaps a different context of use that should be taken into account when designing for that specific device. For instance, users of smart phones are more distracted than PC users because of their context of use so a design for smart phones should require less concentration by for instance having fewer possible choices in each page and less details.

In conclusion, we believe that making our designs specific to PC was a positive step to limit and specify the context of use and users won't achieve the best user experience if they use this design for other media such as smart phones. Even though all these designs can share personas and user goals, the way users interact with them will be different.

5.3 Constructed personas and scenarios

In this section, we go through the details of personas and scenarios that we have constructed based on the raw data from user study results.

5.3.1 Developed personas

Our personas are representing groups of users with similar wants, needs, and expectations. We constructed personas based on the interviews we conducted together with survey results. As mentioned in previous chapter, after development of personas, we must identify the primary persona. The fundamental principle behind personas is that we can have one user interface per persona. Therefore, primary persona represents the target users for designing the user interface. The resulting user interface shall highly satisfy the primary persona.

At the same time, there are other personas that can be partially satisfied with the user interface designed for primary persona. These personas are called secondary personas. Small modifications and additions to the same user interface make it possible to satisfy primary and secondary personas.

In a more concrete term, this implies that we have multiple representations of the same information and therefore multiple interfaces in the same product. This can be costly if there is a bold contrast between personas in all aspects. However, we did not find considerable differences in our personas in many aspects. The main aspect in which personas had considerable different expectations was representation of content and its related metadata.

Here are the personas we developed based on the results of user studies:
Our primary persona is Alice:

**Table 5.2 Primary persona**

<table>
<thead>
<tr>
<th>Alice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: 24</td>
</tr>
<tr>
<td>Job: Student</td>
</tr>
<tr>
<td>Slogan: &quot;I like to watch my favorite movies and TV programs, anytime, anywhere&quot;</td>
</tr>
</tbody>
</table>

Alice is a full time master student and spends most of her time in university. She uses her computer most of the time to work on her assignments, search for information, and to communicate with her friends and family. Easy to use technology is very important for her. Her knowledge and interest in new technologies is average.

She likes to be able watch to her favorite movies or TV programs at her break times using her computer or while she is not doing a serious work with her computer. She also likes traveling a lot and is interested to watch her favorite movies or live TV channels when she is away from home especially when she is traveling on the train.

She gets to know about movies by watching their trailers on TV or in different websites on the internet and also from the posters that she sometimes sees around the city. She likes to be able to search for different movies and get more information about them before she chooses to rent one. She is particularly interested to watch top-rated drama movies.

Sometimes, she wants to relax and watch whatever is on TV so she does not want to choose all the time. She seldom looks for her favorite programs in the TV guide. In case she does not find anything, she likes to be able to search for them.

**Goals**

- Rent a movie and watch it online in her free times.
- Search for drama movies and see which one is top rated.
- Sort her search results based on different criteria especially rating.
- Select movies or TV programs to get more information on them.
- Watch broadcasting TV channels live from PC.
- Look in TV guide for currently broadcasting TV programs from different channels and then choose a channel to watch.
- Search in TV guide for her favorite TV programs.

Our secondary personas are: Fredrik and Lars.
Fredrik

Age: 35
Job: Computer technician
Slogan: 
"I am passionate about movies and TV programs"

Fredrik is a computer technician who likes to enjoy his free times by watching movies and his favorite TV programs. He is knowledgeable in technology and is interested in new cool gadgets. He always looks for new experiences.

He watches TV and movies a lot. Watching movies and TV programs is the most important entertainment in his daily life. He always plans to watch at least one movie per week. He usually talks a lot to his friends about newly released movies and the TV series that interests him most. Every morning, he spends some time to read the movies page in the daily newspaper.

He uses his computer a lot and also spends some time in front of his computer to watch movies that he has downloaded before or the ones that are available online through services such as Voddler. He looks for different movies online to watch their trailers. He also likes to know more about the movies from his favorite directors.

When it comes to renting the movies, he likes to have many options available in front of him. He wants to be able to search and get more information about different movies and then choose the one he is interested in. The most important criteria for him include director, year of release, cast, and imdb rating. Sometimes he likes to keep his favorite movies on his computer.

He enjoys watching his favorite TV programs and wishes it would be possible to choose any program from the TV guide to watch. He sometimes uses the TV guide to get more information about the TV programs that are currently playing.

He sometimes schedules next episodes of his favorite TV series to be recorded and watches them later. He wants to be able to find the recordings he looks for easily to play them instantly.

<table>
<thead>
<tr>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Rent a movie and watch it online or download it to watch it later.</td>
</tr>
<tr>
<td>- Having as many options as possible to choose from.</td>
</tr>
<tr>
<td>- Search in movies by different criteria such as director, year of</td>
</tr>
<tr>
<td>release, cast, and, imdb rating.</td>
</tr>
<tr>
<td>- Access to more information about the movies that he is interested in.</td>
</tr>
<tr>
<td>- Be able to watch the trailer of different movies in high quality.</td>
</tr>
<tr>
<td>- Watch broadcasting TV channels live from PC and get more information</td>
</tr>
<tr>
<td>about broadcasting TV programs.</td>
</tr>
<tr>
<td>- Schedule episodes of TV series to be recorded and watch them later.</td>
</tr>
<tr>
<td>- Search in TV guide for his favorite TV series.</td>
</tr>
<tr>
<td>- Access to his recordings and manage them as well as searching in</td>
</tr>
<tr>
<td>them.</td>
</tr>
</tbody>
</table>
Table 5.4 Secondary persona 2

**Lars**

Age: 61  
Job: Teacher  
Slogan:  
"I am not so interested in using the computer for a long time."

Lars is a teacher who is going to be retired in a few years. He is not so interested in using the computers except for checking and sending emails or checking out some news and the weather. He wants every system to be very easy to use and does not like the complicated ways of performing particular tasks.

He is passionate about gardening and prefers to spend his time on that rather than spending hours in front of TV or watching long movies.

When he wants to watch a previously broadcasted TV program containing some important news or recommended by friends, he uses SVT (Swedish national TV) website and searches for the program in it. He prefers to use services like SVT for his purposes rather than using new advanced technologies because he easily gets confused when he tries to use an unfamiliar system.

In case of using TV on his PC, he wants to relax and watch whatever is on TV and does not want to choose between the programs but only switch between different channels. He sometimes wants to get more information about the currently broadcasting program.

<table>
<thead>
<tr>
<th>Goals</th>
</tr>
</thead>
</table>
| - Watch broadcasting TV channels live.  
| - Search in automatically pre-recorded TV programs and play them.  
| - Have access to more easy to use functionality of the system such as live TV.  
| - Watch currently broadcasting TV programs and change channels so easily. |

5.3.2 Developed scenarios

For developing the scenarios, we first created necessary task hierarchies. We also developed workflows to achieve a better understanding of user’s cognitive processes. Finally, we developed the scenarios for some specific tasks and investigated how users accomplish these tasks to achieve their goals.

Here is a list of the main tasks we identified for IPTV PC Portal:
- Login towards the system (IAP)  
- View/order Video on Demand (VOD)  
- Search in the list of movies, TV programs, or, recordings  
- Watch a broadcasting TV channel  
- Choose a TV program to be recorded  
- Manage recordings  
- View Electronic Program Guide (EPG)
We analyzed the tasks in the system using the results we gathered during identification of the context of use as well as the characteristics and goals of our personas.

**Task hierarchies**
Here, we present one of the diagrams of hierarchical task analysis. The rest is available in appendix D. The following diagram illustrates the hierarchy for viewing, selecting, and, ordering movies. The aim for this task is to choose a Video on Demand item and rent it as quickly and easily as possible.

![Hierarchy for viewing, selecting, and, ordering movies](image)

**Scenarios and workflows**
In order to take into account the cognitive processes of users while they complete different tasks, we assume personas as users that perform particular tasks and use this assumption as a basis to develop scenarios. We conduct the workflow analysis based on our task hierarchies and investigate the sequence of the required tasks and subtasks to complete an activity (Hackos and Redish, 1998).

We define one scenario for each persona that we have developed. Our scenarios represent stories for personas about their characters and the process of their activities in performing different tasks in the intended system. In addition to the narrative user story for each scenario, we also represent the workflow diagram for that scenario. Workflows explain the flow of the tasks personas perform to achieve a goal.

**Scenario 1:**
User: Alice – Primary persona  
Use context: Traveling on the train  
Task diagnostic: Renting a movie

Alice is a student and has finished her exams recently. She had one week break before starting her new semester and decided to go to a short trip to Gothenburg by train to visit her family. Now, she is in the train and has her laptop with her. She has the internet connection on board and really likes to watch a movie online during her travel time. She logs into her IPTV account and goes to the movies page. She faces a large number of movies and tries to get more information about some of them that seem interesting to her. But after seeing the low ratings for them, she decides to search for high rated movies. She starts searching for a good movie by entering a keyword in the search area. She just starts by typing the name of her favorite actor and drama as her favorite genre and then gets the results. She sorts the results...
based on rating and chooses the highest rated movie amongst them. She makes sure that she wants to see this movie so she presses the rent button. After renting the movie, she starts watching it immediately.

**Scenario 2:**

User: Fredrik – Secondary persona  
Use context: Pressed for time  
Task diagnostic: Schedule a program to be recorded

It’s Sunday evening and Fredrik is in front of his computer while chatting with his friend on Skype. He notices that one of his favorite TV shows was shown last night and will be broadcasted again on Monday morning. But he must be at his work at that time. He decides to record the program and then watch it when he comes back home in the evening. So, he logs into his IPTV account and opens the TV section. Then, he chooses to view the program guide. He moves to tomorrow’s programs (Monday) and finds his favorite TV show in the program guide. He chooses the program and schedules it to be recorded. He checks the list of scheduled recordings and makes sure that his favorite program is there. Tomorrow when he comes back to home, he just needs to login to the system, go to the recordings page and choose the recorded TV program to be played.

During the development of scenarios, we analyzed how users accomplish tasks in the system and tried to find easiest and quickest ways to perform the tasks and make them more efficient. In some parts, we suggested some new tasks that can support the goals more effectively.

### 5.4 Prototyping

During our user studies, we realized that there are various ways people decide to watch a movie. Some people look for the latest movies and get information from newspapers. Some people rely on friends and choose movies based on their recommendations. Some people look for movies from a specific director or actor. Some people look for movies in a specific genre. Some people decide to watch a movie based on professional reviews they read about it. But it is also important to keep in mind the constraints and limitations of IPTV systems.

Although it is possible in theory, does a real IPTV system contain all the movies ever made? Can you expect that your friends have access to the same IPTV system as you do so that they can recommend you movies through the system? Considering all the different alternatives to IPTV solution this is not likely to happen either in IPTV or other similar services in the future. IPTV systems make it possible for telecom operators to insert movies into the system by providing related metadata. This procedure – called “provisioning” – takes time since it is not possible to simply import an available database of movies. Therefore, IPTV systems currently deployed do not contain many movies.

Considering the metadata available for each movie, the goal is to make it possible for the users to easily navigate through the movies and find what they are looking for. For this purpose, appropriate sorting and searching functionality should be incorporated in the design.

As mentioned before, since the numbers of available movies in a real IPTV system is not expected to be very high, navigation of available content has a higher priority than searching for the content. Users cannot expect to find anything they look for but rather they should decide to choose between what is available in the system.
During this project, we perform both throwaway prototyping and evolutionary prototyping. In fact, our first prototypes are most inline with the definition of throwaway prototyping while the latter prototype (VOD application) is more inline with evolutionary prototyping trend.

5.4.1 Low-fidelity prototype

In the first phase of this project, we found out that it is not possible to make the interviewees focus on a specific use case within IPTV solution since the distinction between different use cases were not clear for them at it is for experts in the area. On the other hand, covering all use cases for the prototyping is also beyond the scope of this thesis project. Therefore, our focus from now on would be on Video On Demand service and its interaction design.

For low-fidelity prototyping, we designed various sketches and tested them with users in order to improve the designs, align them with users’ needs and wants, and, discover usability issues as soon as possible and with the lowest cost. Then, we provided the developers with different design alternatives that were developed based on the achieved results in sketch testing. These documents were also used by developers as a reference for attributes of different SVG elements as well as a guide on how to develop the design ideas. As a guide on interaction design and the way user interface should react to users’ actions, we provided the developers detailed explanations.

In this section, we present the results of low-fidelity prototyping. It includes the basic sketches and the results of the testing that we conducted on those sketches.

5.4.1.1 Sketching and paper mockups

In the design phase, we initially sketched our designs on paper (as low-fidelity prototyping) and tested them with users. Here, we present the initial sketches together with explanations on systems reaction as mentioned earlier:

Logged in / logged out behavior:

Before login, features that require credentials in order to connect to server are disabled and can be shown blurry. After a successful login, all features are enabled.

In case no user has ever entered credentials in this installation of client, after clicking "LOGIN", user should create profile. After clicking "Create Profile", user needs to choose a username and a password to enter credentials only once. By enabling "save password", user doesn’t even need to enter password each time.

In case of having multiple users, login page includes multiple profiles. Then users can login by clicking on their usernames. Users can change their password or credentials by clicking on
edit icon. After choosing a user profile, system asks for password if user did not choose to save it. By enabling "save password", user doesn’t even need to enter password each time. Following figure presents the basic sketches for the whole login process:

![Figure 5.13 Basic sketches – Login process](image)

The following figure shows an overview of the login/logout behavior:

![Figure 5.14 Basic sketches – Overview of the Login / Logout behavior](image)

**VOD Application:**

In case too many movies are offered in VOD service, it becomes more difficult for users to navigate through the list of available movies, keep track of what they have seen before, and, choose a movie to watch from all available offerings. So, to simplify these tasks, we propose the following features:

- Users can mark candidate movies as favorite while they navigate through the list
- Users can perform sorting and grouping in the list
- Users can search for movies and perform the above tasks in the result list

"All Movies" section includes movies that were watched before, movies that are currently rented and their rental period is not expired, and, movies marked as favorite. We group the movies by different genres and if each genre is clicked by the user, the list will jumps to the beginning of that group.
After clicking "More Info" or Double-clicking a poster, the last page becomes blurry and the popup page appears.

My Movies section contains information about movies marked as favorite, movies watched before, and, movies currently rented. In addition, Movies search results has the exact same view but only shows matching items. Following figure is an overview of VOD application:
5.4.1.2 Testing

After designing and sketching the low-fidelity prototype, we tested the prototype with real users and some predefined real tasks. We chose a small set of real users close to the target audience of such system, including 5 users, and asked them to try to perform two predefined tasks using the sketches: "Rent a movie" and "Search for a movie".

During the test time, we had the sketches in our hands and after any request by them to the system such as clicking on an application in the homepage, we presented them the sketch of that special application. We repeated this for all the steps while navigating to different features of the design.

During the testing sessions, we evaluated the designs based on how quickly and efficiently users could use the interface without help from us. Normal users had a good understanding of paper prototypes and could easily navigate to different features. We documented any comment or feedback from them. Here we present a list of issues extracted from the comments made by users:

- Users have problem when they want to get back to the homepage and they need to come back all the way they passed to access a particular application. Most of the users liked to be able to access menu items from all pages.
- Users want to be able to access the homepage easily.
- When browsing the Movies page, users want to see as many movies as possible at a glance.
- When browsing different categories, users want them to be based on different genres, not rating or year. Instead they prefer to have sorting for different genres by rating or year.
- Users want to have the scrolling ability because of many different reasons:
  1. When using PC users used to use scroll and always try to do it
  2. It lets them know where in the list they are at each moment
  3. They can jump to any point in list at any time
- Users need to have access to "All" movies in addition to movies of each category (Genre). It is especially useful if someone wants to find a movie and don’t know which category it belongs to. For example, if Alice is looking for the movie "The Jungle" and she does not know which category it belongs to:
  1. She chooses All category
  2. She sorts by title and goes down to find the movie
  3. Or alternatively she just types it in the search bar to search for that
- On the contrary to paging, browsing between different items is very fast without any delay.
- Most of the users want to have a simple search but be able to search in different preferences such as director, actor, and etc.
- Users want to sort the movies based on their preferences such as title or year so easily.
- Most of the users are satisfied with getting some info on each movie that they click on it or drag the mouse on it.
- Repeating the trailer and rent buttons in different places were confusing for the users.
- Users prefer less steps to reach an objective (prevent changing the page).

Testing the sketches and paper designs helped us to measure the performance of the typical users on prepared tasks. After performing the tests, we, as designers, refined our designs based on the feedback that we had received from the users. Table 5.5 shows the changes of the designs that we applied based on testing results:
Table 5.5 Changes based on testing results

| ✔ Access the main menu from all pages (No need to get back to the main page to change between different applications) |
| ✔ Having home page access from all pages. |
| ✔ Having categories based on different genres. |
| ✔ Having different sort options at top of the page for all different categories |
| ✔ Adding scrollbar instead of arrows. |
| ✔ Having the trailer and rent options only in one place |
| ✔ Having search option as a search bar at top of the page and searching in all the meta data |
| ✔ Getting complete info on each movie by clicking on it instead of double click. |
| ✔ Reduce the steps to reach an objective (As much as possible prevent changing the page) such as searching |

5.4.2 Hi-fidelity prototype

In this project, SVG and JavaScript are used as the technologies to develop the high-fidelity prototype. In this section, we shortly discuss these technologies and our findings on how to optimize their use by applying fundamental software engineering concepts.

5.4.2.1 Scalable Vector Graphics (SVG)

SVG is an XML-based specification developed by World Wide Web Consortium (W3C) which describes two-dimensional vector graphics with capabilities for interactivity and animation. Since SVG appearance and behavior is described in text files, they are human readable and very compact compared to raster images.

SVG offers a suitable framework to create rich, interactive, and extensible visual interfaces. Vector graphics provide quality, extensibility and scalability that cannot be obtained from raster images. An investment in SVG however, requires a realistic appraisal of its limitations as well. Part of limitations of SVG is because of the vast range of the SVG specifications and that most browsers do not fully implement the specification. The other limitation is regarding speed. Although download speed is considered as the main advantage of vector graphics compared to raster graphics, SVG can be an intensive consumer of CPU usage while rendering, particularly if many elements are embedded in one page or several have continuing repeated animations (Watt, 2001). Meanwhile, it is worth mentioning that SVG animations do not change the file size significantly as in raster graphics.

Some speed issues arise partly because SVG browsers are still being developed and optimized. For instance, significant speed improvements occur in newer versions of popular SVG browsers. Therefore, considering the performance improvements so far, further improvements can be expected. In addition to that, viewers also need to consider optimizations in different settings.
In conclusion, speed is heavily dependent on the complexity of SVG graphics and therefore role of designers and developers to increase the performance of SVG applications should not be underestimated. In other words, poor development skills inevitably lead to bad performing SVG applications.

5.4.2.2 JavaScript

JavaScript is used to manipulate the Document Object Model (DOM) of SVG documents. Although JavaScript is perhaps the most widely used language for this purpose, it is also possible to implement DOM interface in any other language. This manipulation enables us to develop sophisticated interaction with the SVG scene graph.

In this thesis project, we use JavaScript to manipulate the object tree of SVG documents. Since SVG has an XML structure, JavaScript can be used to dynamically control graphical attributes. This control consists of addition and removal of SVG elements as well as setting and getting different attributes for each element. JavaScript can be used to implement interaction with SVG graphics. Interaction occurs when graphical objects respond to events.

5.4.2.3 Modifiability and reusability

Modifiability and reusability are important qualities in software architecture. Telecom operators, as primary customers of IPTV systems have a high tendency to have their own redesign of the look and feel. On the other hand, development and applying changes to normal SVG pages are quite hard and time consuming.

By participation in the stand-up meetings of the project which is done on a daily basis according to scrum guidelines, we found out that even small changes in the look and feel will take so much time and is not easy. To overcome this pitfall, we proposed the following solution by referring to our previous experience in software development:

Implementation of a component library containing various SVG-JavaScript based components that can be reused in any part of the UI in a flexible way so that they can be modified and skinned according to requirements from different customers.

Although JavaScript is a scripting language, it is possible to gain benefits from object oriented paradigm within JavaScript. In this project, we introduced the concept of reusable JavaScript-SVG components and took advantage of object oriented paradigm. Figure 5.18 is an example of a set of components we designed for Video on Demand application:

![Figure 5.18 Reusable JavaScript-SVG components and their interconnection](image)
The best way to manage the complex SVG-based User Interfaces is to keep track of more complex graphical structures than simple graphical elements such as rectangles. We also found out that creating and maintaining graphics dynamically is more beneficial when we approach interactive data-driven applications. In order to be able to reuse the same component over and over again, all the event handlers in the system must be component sensitive so that we can have several instances of one component on the same page. We do not intend to get into further technical details since it would be out of the scope of this report although achievements in this regard can lead to interesting research results for software architecture of SVG applications.

By implementing the idea of component library, we observed a considerable speed up in the development of the high-fidelity prototype. The components implemented for the prototype include menus, lists, scrollbars, dialogs, buttons, tabs, panes, etc.

Figure 5.19 shows the properties and methods of a reusable component in the system as an example. This component, Sortbar, is mainly developed for UI and functional capabilities of sorting. The functionality of this component is effective when it is connected to an instance of the List component.

Figure 5.19 Class diagram for Sortbar component

The following figures demonstrate main components developed for the high-fidelity prototype. Since these components are especially designed to be reused, it is also possible to reuse them in other areas that the same functionality and/or look and feel are needed. All screenshots of the final version of the high fidelity prototype are available in appendix E.
5.5 Usability evaluation results

In the following sections we present all the results of the usability evaluation phase together with the improvements that we did based on the results.

5.5.1 Heuristic evaluation

We chose a small set of experts to examine the system. To facilitate the evaluation, we provided them with a list of heuristics. We also asked them to rate the problems they find based on the following severity rating metrics:
Table 5.6 Severity rating metrics

1. A cosmetic problem only → need not be fixed unless extra time is available
2. A minor usability problem → fixing should be given a low priority.
3. A major usability problem → important to fix and should be given a high priority.
4. A usability catastrophe → imperative to fix before the product can be released.

This heuristic evaluation was performed using 3 independent usability experts who are professionals in the field of interaction design. We asked them to evaluate the usability of the system in one major task: "Renting a movie in VOD application"

It should be considered that heuristics are meant to assist the evaluators in finding problems, not to restrict them to find those that only relate to heuristics. For this reason, we also asked them to come up with more questions which are included in the results.

Appendix F is presenting the list of heuristics that we provided the evaluators with and also the problems they found. The severity ratings presented in these results are the average ratings set by the evaluators. One of the heuristics is represented here:

<table>
<thead>
<tr>
<th>Task: Renting a movie in VOD application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Visibility of system status</td>
</tr>
<tr>
<td>› Does the user know if his/her request is sent?</td>
</tr>
<tr>
<td>→ Button effects (Especially for mouse down and up + mouse over and out) 2</td>
</tr>
<tr>
<td>› Does the user know where in the system he/she is?</td>
</tr>
<tr>
<td>→ Breadcrumb 1</td>
</tr>
<tr>
<td>› Is there a risk for the user to enter different requests at a same time?</td>
</tr>
<tr>
<td>→ Wait indicator + Blurry background 3</td>
</tr>
<tr>
<td>› Can the user easily understand that the goal of the intended task is achieved?</td>
</tr>
<tr>
<td>→ Rent button changes to play button, price changes to expiry date, and playing the movie starts directly after completion of renting 3</td>
</tr>
</tbody>
</table>

During the heuristic evaluation, we also gathered additional comments from evaluators besides all the comments we had received on the checklists and questions. Here, we present a list of those results:

Table 5.8 List of heuristic evaluation results

- Reverse sorting
- Different design for rented category
- Different views in different parts: Most wanted view for sorting and search results → List view
- Sort-by arrows
- Stop the playing movie when exiting the page.
5.5.2 Thinking aloud protocol

When choosing the test group, we tried to have a sample close to the target audience in age distribution as well as in experience distribution. What was common between all of them was their interest in the area. They were either interested to use the service in near future or had used similar services recently. We provided the test users with the running application and asked them to perform a set of predetermined tasks while they try to express their thoughts and feelings as they go on. Here we present an overview of how we conducted thinking aloud method in practice, in order to gain realistic results which are helpful for us as the observers:

We, as observers, needed to make sure of the following issues:

− User realizes that the interface is under study, not they.
− User should comment on his/her actions, thoughts and intentions all the time.
− Explain to the users at the beginning that you may give only a small help to the users and they should try to find their own way.
− In any given help to the user, you should be very careful about its effects on performing the tasks by the user.

For recording the results we could take notes or use video recording equipments. In this project we took notes of all the comments explained by the users during the testing time.

Here we present a list of all the results that we gained during performing thinking aloud usability evaluation method:

− Users wanted to be able to sort the movies by their renting price as well as the current sort-by options
− Users were interested to have a separate page for search results. Also it was not clear to users why we search in one category.
− Users wanted to be able to sort the search results
− Users were highly interested to have different views at the same time and possibility to change them. One more thing that they mentioned was remembering their selected view next time that they open the application.
− They liked the mechanism that avoids separate page for advanced search, what users said that they don't like. In a few minutes they understood the logic and interpret it.
− Users don't like to have menu in full-screen player because when they suddenly move the mouse to top it will appear in the middle of playing movie.
− Users expect to see a fresh page when clicking on the options in main menu. Instead for keeping the current situation and not refreshing the page using minimize.
− Rental duration wasn’t clear for the users when they wanted to rent a movie.
− They wanted to have big posters for their rented movies.
− There existed different issues that the users mentioned about the player:
  • Having speed indicator
  • Volume controller: Users prefer rectangle form rather than drag and drop. Because then they can manage and control the volume more easily since they exactly know the current level of volume.
  • Pause/Play in higher speeds
• Play should always work (Users don’t like the message: Please choose something!)
• Direct playing after renting the movie
• Having timeline
• Remember last set volume

− Advanced users tried keyboard many different times and they wanted to have at least keyboard support for menu
− Some confusion on having different lines of options at top of the page. But they could easily get the meaning. And understood that "ok I choose the category and then sort the contents of that category based on what I want".

5.5.3 Improvements
In this section we deeply describe the improvements based on testing results:

☑ Different views for different users: One of the important findings in this project was that you cannot find a single view that satisfies all purposes and all users. Users who are highly interested in the service and use it frequently, expect to have a view which show all the detailed information related to the VOD entry without being required to navigate to a separate page. Some users are more interested in seeing as many posters as possible. When it comes to sorting, most users are interested in list view in which they can easily compare the information of movies with each other.

In order to cover as many user groups as possible, we had to enable the users to actively choose between a set of pre-designed UIs. In order to address this challenge, we developed a component named ViewSelector in which allows the user to actively switch between different pre-designed views. These views are designed to address different wants and expectations mentioned by tested users and heuristic evaluators. An important feature of this component is the storage and retrieval of last selected view. This possibility reduces the distraction being caused by constant need for switching a suitable view by the users. Here is the class diagram of the component:

![Class diagram of the ViewSelector component](image)

And here is a screen shot of the VOD application demonstrating the reusable ViewSelector component:
An easy to use player: Another area of improvement in the prototype was the player component. When it comes to SVG video element, the browser support is vastly different and somehow incomplete. But based on the available features in the engine, we could implement the following improvements after we gathered them from users and evaluators:

- **Speed Indicator**: Fast forwarding and rewinding are two functionalities that have existed for years in video players. Some users with less interest in brand new technologies asked for these functionalities. In order to enable the users to clearly distinguish between a normal playing video and a fast forwarding or rewinding video, we implemented a speed indicator that shows the current speed. We also implemented the possibility for users to fast forward or rewind in different speeds as they wish.

- **Volume controller**: We provided users with two different designs for volume controller. One was a scrollable volume controller and the other was a 5 level controller with increment and decrement buttons. The overall feedback we received from users was slightly better for the second alternative. It can be interpreted that it gives users a discrete feeling of the volume level and that they can see what the value exactly is. The can also increase it step by step without begin unsure of the previous value. Multiple was of changing the volume could also be a factor.

- **Pause and play the video in different speeds**: This was not considered by initial developers of the player component. The main purpose of fast forwarding and rewinding to is to play the video from a certain point. For this reason, users expect to see the video playing in normal speed after they press the play button. This was another improvement we implemented in the player component.
- **Action for play button when no video is selected**: What was initially implemented by developers was a message box asking the users to choose a video first. This looked disturbing to users and they expected the player to start playing a video. We designed and implemented the player component in a smarter way so that it automatically choose a video and play it.

- **Actions after renting a movie**: Most users did not expect to see an empty player after they rent a movie. Therefore, we directly play the movie content after the movie is rented and therefore decreasing the navigational complexity in a way.

- **Player still playing when switching to another application**: This was also one of the comments we received from users. The expected the video to be stopped or paused when they switch to another application so that they can play other videos in those applications.

The following figure is a screen shot of the movie details demonstrating the player including all the added features to that:

![Figure 5.24 A screen shot of the movie details page showing the player](image)

- **An interactive search**: We provided the users with two alternative designs for searching. First alternative was a live filtering search in which users could filter the available data by just typing inside a search box. The second alternative was a text-based search with a search button that leads to a separate results page. After the testing and evaluations, we gathered a list of pros and cons of each approach that can be considered when deciding on how to implement the search functionality:

Live filtering search:
- **Pros**: reducing the navigational complexity
- Cons: search domain is the current category while most users are interested in the all the matching results not only those within current category

Separate page for search results:
- Pros: search domain can be all the categories or a specific category so it is easier to fulfill users wants
- Cons: increases navigational complexity since users need to close the results page every time

What is common between the two approaches is that the search should go through all relevant fields of metadata associated with each VOD entry. We found out that advanced search on different fields is confusing for users and should be avoided. The replacement approach can be the prioritization of search results for instance showing a VOD with matching title higher than one with matching cast or plot.

Implementing the second approach is also faster in web technologies such as SVG. Another improvement we applied to search functionality was the possibility to sort the search results based on attributes such as title, rating, etc.

The following figure is a screen shot of the search results page, listing all the movies that contain the searched keyword in any metadata:

![Search results page](image)

**Figure 5.25 Search results page**

- Movie Rental: The improvements we applied to movie rentals based on evaluation results include:

  - **Rentals page:** in initial versions of the prototype users could only find the rented movies by checking all the movies one by one. What was demanded by users was a separate representation of the movies that are rented. What needs to be considered is that the
number of movies in rentals page is not usually more than one or two. Therefore, we designed this page with very large poster and specific information about the rental such as the time left for the rental to expire and the beginning date of rental. We should mention that the content of the rentals page dynamically changes over time meaning that rented movies that expire will not be shown. Some users where curious about all the movies they have rented from the beginning which is also referred to as purchase history. Although purchase history is not an important element in interaction design for renting movies, it can be added as a history tab to Movie Store or as a separate page in settings.

- **Rental duration and expiry date:** During the renting process, users should be informed about the rental duration so that they know what exactly they are paying for. In addition, the expiry date should be shown whenever users encounter a rented movie in the GUI. These improvements where added to the prototype after evaluation.

- **Playing the movie directly after renting:** as explained before, this improvement was implemented in order to reduce the navigational complexity so that users do not need to explicitly press the play button after they rent a movie.

The following figure is a screen shot of the rentals page, demonstrating a different view for showing the rented movies. This view is listing all the movies rented by the user with unexpired rental time:

![Rented Movies page](image)

**Figure 5.26 Rented Movies page**

- **Menu keyboard support:** In case of computer-based IPTV solution, mouse is by far the most important interaction device being used by the majority of users. In addition, scrolling wheel plays an important role when browsing pages. For some users especially advance computer users, keyboard is also important. The main challenge here would be to mix both of them. Difficulties arise when users try to use both of them at the same time or one after another. Also switching the keyboard focus from one UI element to another has its own
challenges. Maybe these are reasons why W3C has not specified clear standards for keyboard support in web technologies. For instance, no one can use Facebook or YouTube properly with only a keyboard.

As an instance to demonstrate the possibility of implementing keyboard support for SVG pages, we implemented the keyboard support for the main menu. This part was the main part users had tried to use the keyboard during testing. Arrow keys were assigned to navigate between different menu items. Enter and space keys were also assigned to act as selection. Furthermore, Home button was also assigned to return users to the home page from different applications. In addition to keys associated with the main menu and home page, escape key was also assigned to switch the application to windowed mode from full screen mode anywhere in the application. F11 was used to toggle between full screen and windowed mode as a standard being followed in most applications deployed in Microsoft Windows.

Table 5.9 presents some other small changes based on usability evaluation results:

<table>
<thead>
<tr>
<th>Table 5.9 Improvements based on usability evaluation results</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑ Not having menu in full-screen player</td>
</tr>
<tr>
<td>☑ Adding sort-by price as well as the other options in Sort-by.</td>
</tr>
<tr>
<td>☑ Adding mouse down-up effects for buttons.</td>
</tr>
<tr>
<td>☑ Adding the possibility to reverse the sorting and present it by sorting arrows.</td>
</tr>
</tbody>
</table>

5.5.4 Future improvements

In this section, we list the improvements we mainly extracted from evaluations but were not feasible to implement. The underlying reason in most case was technical difficulties such as problems in the SVG engine that needed to be fixed by engine developers or problem requiring heavy C++ and system programming.

☑ Transparent background: As an initial proposal for the look and feel of the main page, we proposed the transparent background meaning that the main menu could be shown as a transparent control panel on the desktop. This feature required some engine-side development as well as C++ and Windows programming and the development team did not find time to implement this feature. This feature, if implemented, could drastically change the interaction design of the application since it no longer looked like a traditional windowed application. Although there are more possibilities for improving the wow factor in the application, making the application inconsistent with traditional windows application had its own risks and challenges. If not designed or implemented carefully and properly, it could have been a source for many usability related issues. One of those issues could be that each feature (VOD or local videos) was seen as a separate application that could be closed or minimized.

☑ Time line in player component: Advanced users and those with an experience in web are more interested in a time line that enables them to jump to a certain point in time. It is also very important for all users to be aware of the length of the video and the time left. Unfortunately, the target SVG engine had no support for this important feature so it could not be implemented.
Keyboard support for all pages in the application: In case of computer-based IPTV solution, mouse is by far the most important interaction device being used by the majority of users. In addition, scrolling wheel plays an important role when browsing pages. For some users especially advance computer users, keyboard is also important. The main challenge here would be to mix both of them. Difficulties arise when users try to use both of them at the same time or one after another. Also switching the keyboard focus from one UI element to another has its own challenges. Maybe these are reasons why W3C has not specified clear standards for keyboard support in web technologies. For instance, no one can use Facebook or YouTube properly with only a keyboard.

Window always on top: Based on our survey results, particularly question 7 (“How much do you like to watch TV when you are using your computer?”), we conclude that most of the users are interested to watch TV or movies when they are using their computer and are busy with their usual tasks such as checking their email or browsing the web. In order to enable users to use different applications (especially TV) while they are performing other tasks in their computer, the following behaviors are necessary:
- window always on top behavior
- windowed video full screen behavior

In an ideal design, users should have access to this mode through an interactive UI element so that they can easily toggle to normal mode and this mode.

Support for different video qualities: Although in case of fixed networks, we can assume that Quality of Service (QoS) is always in an acceptable level, but when it comes to mobile broadband, expected variations in quality can affect user experience negatively. For this reason, changing the video quality based on the current network speed can be added to the system. Ideally, automated detection of speed and handling the streaming quality could be the best solution. But in case this is not feasible, we can give this option to users to manually switch to a quality that suits them best. In this case, proper design can reduce the complexity by embedding a drop down in the player component to select different qualities. But the only question that remains is the representation of qualities to the user. According to usability principles, heavy numerical information are not user-friendly because they are not of interest nor meaningful to most of the users. Based on usability evaluation results, end-users are more interested in the simpler textual classifications such as: Low/Medium/High Quality or Standard Definition (SD)/High Definition (HD).

Switching between different applications: To make the GUI easiest to use, leaving an application should be equivalent to resetting the state of that application. For example, if a user is browsing category X and in the middle of this task switches to Local Videos application, then he or she should not face the previous content when switching back to Movie Store. This is the simplest navigation model which makes it easier for users since they do not need to remember what they were doing last time. Other complicated approaches could also be used but requires additional features to reset the state of an application like a close button on every page.

The main reason why this simple behavior could not be implemented was simply because one of the developers had spent some time in development of a situation in which the estate of each page is kept. Since this was an important technical achievement for him, the developer could not be convinced to give it up.
Editing online video entries: The ability to edit multiple entries at the same time in online videos was distracting the users and also affected the look and feel. Therefore, an alternative could be to have editing features only available for the current (selected) video to make the interaction design more clear.

Breadcrumb: In case the solution contains more features and different levels of navigation, a breadcrumb can be used to show users where they actually are. Another advantage would be that users can go back to different levels just by clicking on the title of that level in the breadcrumb.

Error messages: Error messages, e.g. in login, do not explain the underlying cause of the problem. Error messages should be used in more interactive way to enable users to troubleshoot the problem. Usually, developers are not careful enough when it comes to error messages and validation although this is an important heuristic.

In this chapter, we presented the results and findings of this research including user study results, identified context of use, personas, scenarios, prototyping results, and usability evaluation results. We also explained the improvements based on usability testing results. In the following chapter, we discuss the challenges that we faced during the conduction of this thesis project.
CHAPTER 6: DISCUSSION

In this chapter, we discuss the challenges of using personas in a practical project and requirements that make a technology useful for prototyping. We also propose research questions for future work in continuation of this research.

6.1 Challenges in using personas

As mentioned in previous chapters, personas are representing the users of the system in form of fictional characters. Personas are supposed to help the design team members to understand and consider users wants, needs and expectations during the process of design and development of the system.

Personas have been used by researchers and practitioners for quite some time. But there are still arguments about the success of using personas. People have different understandings of personas and have applied them in different ways. Using personas has also been criticized from different perspectives.

We faced some challenges when using personas during the design of PC Portal. We provided the software development team with constructed personas. But we realized that constructed personas were hard to use for them. A reason was that personas do not contain much information about the way users interact with the system. To solve this problem, we also provided them with developed scenarios. But it was not still enough since they were mostly interested in knowing how the graphical user interface exactly looks like. They rather needed some sort of visual specification and storyboards to follow. Another challenge we faced when using personas was the difficulty to explain user behavior when it came to non-existing features.

Personas may lead the designers to exclude real users from different steps of the design process and instead start using their own imagination. In this situation, there is a risk that resulting design does not satisfy the end-users.

As mentioned before, Cooper believes that a single UI can be developed per persona. He also introduces the concept of persona types including primary and secondary personas. Primary persona is the persona that we choose to design for and secondary personas are the ones that can be satisfied with minor modifications and additions to our design for primary persona. We found this concept very helpful when making the use of personas in practice. We also believe that clarifying that we can design a single UI per persona is a very important step toward making personas useful for the design. However, we need to mention that it was not possible to find a one-to-one mapping between each persona detail and each design detail in the GUI.
6.2 Suitable technologies for prototyping

Interaction between the user and a computer system happens in the User Interface (UI). If we refer to related technologies as UI description languages, the fundamental question would be if a UI description language properly supports user interaction. If the answer to this question is positive, next question would be whether that UI description language can be used for prototyping.

The most crucial requirement for proper user interaction support is Event-Driven Architecture (EDA). EDA is a software architecture pattern promoting the production and detection of event as well as reaction to them. From interaction design perspective, important events are those issued by users through different interaction devices such as mouse, keyboard and touch. Event handlers then can be used to change the state of the system based on what users did and the continuous sequence of events and actions is what we refer to as interaction.

SVG follows Event-Driven Architecture and as a result is an appropriate UI description language for the purpose of interaction design. However, SVG alone is just a specification of XML elements and attributes and the way they should behave. But, we also require an implemented SVG engine that behaves according to the specification. In fact, at the moment, all available SVG browsers are incomplete and not fully inline with the specification but even if we assume that such browser exists, does the specification cover all aspects of user interaction? The answer to this question requires a full-fledged examination of each and every detail of the specification which is not within the scope of this thesis project but according to our experience in the prototyping phase of the project, it can be concluded that SVG has the basic prerequisites to deploy user interaction although different SVG browsers have their own flaws, unimplemented features, and, miss-interpretation of the specification.

In order to answer the second question, it is needed to determine what is exactly meant by “prototype”. This word is used in many disciplines with slightly different meanings. Within the software industry and particularly within Ericsson it is referred to as working software that does not fulfill non-functional requirements such as security, scalability and reliability. In interaction design however, prototype is an artifact (including software) that is made with the purpose of evaluating the user interaction. The main difference between these definitions is that functional requirements are not implemented in an interactive prototype since it is supposed to be used only as a reference when it comes to software development. During the course of this thesis project however, we realized that there is not a common understanding of this concept between different stakeholders.

As we are expected to stick to our definition of prototype as something that is widely accepted in HCI community, the main measure for evaluation of a UI description language would be the lead time of achieving what is expected from an interaction design prototype. If the overall time for accomplishing a project is 6 month then probably interaction designers should not spend more than a month on prototyping. Is SVG capable of rapid prototyping? We believe that there is no straightforward answer to this question. SVG provides you with a blank canvas that you can basically draw rectangles, circles, polygons, lines and more complex paths on it. You could also attach different event handler to these shapes as you want. Rapid prototyping however refers to composing software systems based on reuse of components and the use of software architectural templates. The lack of such components or known architectural templates for SVG makes it hard if not impossible to prototype in (meaning an interaction design prototype). On the other hand, modifiability is a highly
important non-functional requirement in prototyping User Interfaces. For the reasons mentioned above, it is also hard to apply changes to the prototype after receiving constant feedback from users and therefore level of modifiability is not high in SVG.

Our solution to tackle these problems was to design and develop a number of reusable components as well as an architectural pattern to follow up in order to speed up the development process and reduce the lead time. After developing the components and building the structure provided by the architectural template, we could significantly reduce the development time. As a result, we could also apply the changes proposed by users through usability evaluation within the initial time plan.

In conclusion, the answer to second question is that if interaction designers start with SVG as a plain choice of technology with a total lack of reusable components and a known best-practice architectural template, then the process of prototyping takes much more time than they should actually allocate to it. In other words, in this case, rapid prototyping wouldn’t be feasible. But as we further develop a known best-practice architectural template as well as reusable SVG-JavaScript based components, it becomes more and more feasible to perform prototyping in SVG.

6.3 Future work

In this research, we based our development of personas on data gather from user study results. However, designers sometimes use their own ideas to develop personas. This is mostly due to time constraints in real projects. An interesting research for future work would be to investigate the usefulness of personas constructed based on designers’ own ideas. It is also interesting to conduct a research on how designers can evaluate and improve the personas they have constructed based on their own ideas.
CHAPTER 7:

CONCLUSION

In this thesis project, we addressed the challenges of applying personas and scenarios in designing for IPTV. We tried to find out what users need and expect from an IPTV PC Portal by participating in brainstorming sessions with Ericsson stakeholders, conducting a survey on potential users, and, interviewing different types of users. To make use of the raw data gathered through our user studies, we identified the context of use and developed suitable personas and scenarios. Moreover, we used the elaborated personas and scenarios to develop low and high fidelity prototypes in order to test our design ideas with real users. We finally argued the usefulness of using personas and scenarios in the design process.

7.1 Outcomes

The outcomes of this thesis project include:

- Selection of the context and a suitable user group as the target audience under study
- Elaborated personas and scenarios based on results of user study
- Low-fidelity prototype designed based on personas and scenarios
- High-fidelity prototype developed based on personas and scenarios

7.2 Answers to research questions

In this section, we provide short answers to our research questions:

**RQ1. What is the context of use for IPTV PC Portal that can be base for development of personas and scenarios?**

We conducted user studies including survey and interviews to achieve a better understanding of IPTV PC Portal and its context of use. Considering the fact that PC is set as the target device in this research as a fold of context, we found out that the target audience for this system is young people with high interest in using the computer. We argued that this system can promote the use of mobile broadband technology and can be used while people are traveling.

**RQ2. How can we develop suitable personas and scenarios in the context of IPTV PC Portal?**

We performed a literature review on personas and scenarios, their advantages, and, how to develop them. We believe that lack of aforementioned advantages in personas can be a good indication of their erroneous development and if formulated systematically, can be used as the criteria for evaluating personas to identify incorrectly developed personas.

We translated the raw data we gathered through our user studies into personas and scenarios to assure that they are suitable for the context of PC Portal. We also proposed use of similar techniques to facilitate the development of scenarios.
RQ3. How can we develop prototype based on elaborated personas and scenarios?

A persona represents needs and expectations of a group of users and a scenario illustrates the flow of the tasks being performed to achieve a goal desired by a persona. If we constantly refer to this information while designing the prototypes, it can be evaluated that the prototypes are adapted to these requirements. This would imply that these prototypes are developed based on elaborated personas and scenarios.

We developed both low fidelity and high fidelity prototypes based on elaborated personas and scenarios. We employed the concept of primary and secondary personas to concentrate the design on the primary persona while also satisfy the secondary personas by making necessary additions to the user interface that is designed for primary persona. We illustrated how graphical user interfaces can be developed to satisfy multiple personas by providing the users with different representations of the same information.

RQ4. Are the developed personas and scenarios helpful to improve the design of IPTV PC Portal prototype?

We evaluated the developed prototype to verify whether its usability is improved. Based on our findings, elaborated personas and scenarios could help us improve the design of the prototype for Ericsson IPTV PC Portal. As powerful design tools, they assisted us to apply our findings about the context, the users, and, the tasks in designing the system. This could not be achieved without rendering the raw data from user studies into personas and scenarios. We also addressed the challenges in using personas and scenarios in the design process.

7.3 Contribution

The contribution of this thesis project can be explained in two directions: academia, and, industry.

We contributed to academia by examining the usefulness of personas and scenarios in designing for interactive television. We argued different challenges that we faced while using personas and scenarios. We illustrated how graphical user interfaces can be developed to satisfy multiple personas by providing the users with different representations of the same information. We also argued why the area of personalized television needs more attention from CHI community and why people are becoming more interested in personalized TV viewing experiences.

We contributed to industry by providing a guideline on how to conduct user studies and how to make use of raw data from user studies by developing personas and scenarios. We demonstrated the potential benefit that can be gained from using personas and scenarios within IPTV solution area. We discussed the factors that make a technology appropriate for prototyping. We proposed and prototyped a design solution based on elaborated personas and scenarios. Our design solution is currently the design of choice for Ericsson IPTV PC Portal and the prototype is being demonstrated to different Ericsson customers around the world.
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APPENDICES

APPENDIX A – Survey Questionnaire

Future TV Survey

Dear participant,

The goal of this survey is to know more about your wants and desires about your future TV experience. There is no incorrect answer to the following questions but rather whatever you say will shape the future of TV.

Please help us design better TV services for you with your responses and your comments…

1. How much do you like to watch TV channels or movies online?

   - [ ] ★★
   - [ ] ★★★
   - [ ] ★★★★
   - [ ] ★★★★★
   - [ ] ★★★★★★
   - [ ] ★★★★★★★

2. How important is it for you to follow TV series?

   - [ ] ★★
   - [ ] ★★★
   - [ ] ★★★★
   - [ ] ★★★★★
   - [ ] ★★★★★★
   - [ ] ★★★★★★★

3. How important is it for you to watch live sporting events?

   - [ ] ★★
   - [ ] ★★★
   - [ ] ★★★★
   - [ ] ★★★★★
   - [ ] ★★★★★★
   - [ ] ★★★★★★★

4. How important is it for you to follow the news?

   - [ ] ★★
   - [ ] ★★★
   - [ ] ★★★★
   - [ ] ★★★★★
   - [ ] ★★★★★★
   - [ ] ★★★★★★★

5. How much do you like to buy movies?

   - [ ] ★★
   - [ ] ★★★
   - [ ] ★★★★
   - [ ] ★★★★★
   - [ ] ★★★★★★
   - [ ] ★★★★★★★

6. How much do you like to rent movies?

   - [ ] ★★
   - [ ] ★★★
   - [ ] ★★★★
   - [ ] ★★★★★
   - [ ] ★★★★★★
   - [ ] ★★★★★★★

7. How much do you like to watch TV when you are using your computer?

   - [ ] ★★
   - [ ] ★★★
   - [ ] ★★★★
   - [ ] ★★★★★
   - [ ] ★★★★★★
   - [ ] ★★★★★★★

8. How do you watch a high quality video online?

   - [ ] I can watch a high quality video smoothly.
   - [ ] I sometimes experience short delays while watching a high quality video.
   - [ ] Delays are long and I need to wait before I can watch a high quality video.
   - [ ] I don’t know.

9. How many TV channels do you like to have?

   - [ ] Up to 5
   - [ ] Up to 10
   - [ ] Up to 20
   - [ ] Up to 30
   - [ ] Up to 40
   - [ ] More: ……
10. What is the first thing you want to know about a movie?

☐ Director  ☐ Genre  ☐ Year  ☐ Actors
☐ Rating  ☐ Short story  ☐ Title  ☐ other: …………

11. Please rate the following features according to your interest:

a) Watching TV channels online

☐ ★  ☐ ★★  ☐ ★★★  ☐ ★★★★  ☐ ★★★★★

b) Renting and watching movies online

☐ ★  ☐ ★★  ☐ ★★★  ☐ ★★★★  ☐ ★★★★★

c) Listening to radio from internet

☐ ★  ☐ ★★  ☐ ★★★  ☐ ★★★★  ☐ ★★★★★

d) Recording TV programs from internet

☐ ★  ☐ ★★  ☐ ★★★  ☐ ★★★★  ☐ ★★★★★

e) Watching previous episodes of TV series online

☐ ★  ☐ ★★  ☐ ★★★  ☐ ★★★★  ☐ ★★★★★

f) Are there any other features you would like to have?

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

What is your gender?
☐ Female  ☐ Male

In what year were you born? ………

Your email address (if you like to be contacted regarding this research and rewards)
…………………………………………………………………………………………………

Any more comments?
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
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…………………………………………………………………………………………………

Thank you for participating in this survey.
Your responses and your comments are so valuable to us.
APPENDIX B - Interviews

<table>
<thead>
<tr>
<th>Name: Pedro</th>
<th>Gender: Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: 32</td>
<td>Job: Student</td>
</tr>
</tbody>
</table>

- Uses some internet TV services to watch some channels from his country.
- Uses some other services for VOD
- Thinks that it would be so good to combine all services in one system.
- Likes short advertise but not long ones.
- Sometimes wants to relax and watch whatever is on TV. (Not to choose all the time.)
- He is busy and is interested in watching some of his favorite TV programs at his free times.
- He likes to rent some movies and watch them in his free times but he usually doesn’t have any special thing in his mind and likes to search and find one of the high rated movies form different genres to watch.

<table>
<thead>
<tr>
<th>Name: Henrik</th>
<th>Gender: Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: 31</td>
<td>Job: Computer Technician</td>
</tr>
</tbody>
</table>

- He goes to cinema very often.
- He likes to buy DVDs of his favorite movies.
- He likes science fiction movies.
- He is willing to pay for new technologies.
- He spends so much time on his iPhone.
- He uploads his photos and shows them to friends.
- He likes to be able to search for the top rated movies.
- He likes to have many different movies in front of him to choose between them.
- He really likes the possibility to choose programs from EPG to be recorded.

<table>
<thead>
<tr>
<th>Name: Johan</th>
<th>Gender: Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: 45</td>
<td>Job: Teacher</td>
</tr>
</tbody>
</table>

- He is busy and doesn’t know why he should have a new TV service.
- He thinks SVT player is enough. Because he can even search in it.
- He doesn’t like new offers for TV like LCD, LED, HD ready, full HD, …
- He likes Spotify so much because he can search for different singers and know more about their music and access to their different albums.
- He thinks that Voddler can be a good idea to choose and watch the movies online for free.
- He thinks that he is used to use different services for his different purposes and it is not so interesting for him to have all of them in one system because then he needs to forget about his previous favorite services.
- He wants every system to be very easy to use and doesn’t like the complicated ways of performing particular tasks.
<table>
<thead>
<tr>
<th>Name: Maria</th>
<th>Gender: Female</th>
<th>Age: 28</th>
<th>Job: Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>- She uses her computer so much.</td>
<td>- She likes to have such a system on her computer.</td>
<td>- She likes to be able to record her favorite TV programs.</td>
<td>- She is interested to watch TV channels live when she is traveling on the train.</td>
</tr>
<tr>
<td>- She uses some other services for VOD</td>
<td>- She likes to view the TV guide and get more information about the currently playing TV programs.</td>
<td>- She likes to be able to search for the top rated movies.</td>
<td>- She likes to search for her favorite movies and watch them in her free times.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Anna</th>
<th>Gender: Female</th>
<th>Age: 24</th>
<th>Job: Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>- She watches TV &amp; movies a lot.</td>
<td>- She likes to have access to different parts of the TV series.</td>
<td>- She downloads movies for free.</td>
<td>- She likes to keep her favorite movies in her computer.</td>
</tr>
<tr>
<td>- She likes to be able to choose programs from EPG to be recorded.</td>
<td>- She likes to have many different movies in front of her to choose between them.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Helena</th>
<th>Gender: Female</th>
<th>Age: 37</th>
<th>Job: Nurse</th>
</tr>
</thead>
<tbody>
<tr>
<td>- She has two children and likes to entertain them with TV.</td>
<td>- She likes to rent some movies and watch them in her free times.</td>
<td>- She buys animation movies for her children and thinks if it would be possible for her to search for them in the internet is so good.</td>
<td>- Her main use of her computer is communicating with her friends through Facebook.</td>
</tr>
<tr>
<td>- She likes to be able to choose some cartoons from EPG to be recorded and then play them some time for entertaining her children.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Kurt</th>
<th>Gender: Male</th>
<th>Age: 67</th>
<th>Job: Mechanical Engineer / Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>- He has difficulties using his computer.</td>
<td>- He watches special events and mostly Swedish movies in SVT channels from their home television.</td>
<td>- He thinks he doesn’t need high speed internet connection since he just uses internet for checking emails.</td>
<td>- In case of using TV on his PC, he wants to relax and watch whatever is on TV. Doesn’t want to choose between the programs. Sometimes wants to get more info about the currently broadcasting program.</td>
</tr>
<tr>
<td>- He wants every system to be very easy to use and doesn’t like the complicated ways of performing particular tasks.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C – Identified Context of Use

Users

User Types: In included any authorized IPTV PC Portal user. But more details on different user types will be available in interview results and finally in the personas.

Skills and knowledge:
- Nearly all have some experience in accessing multimedia content through internet.
- Experience in using the product: None
- Experience in using other products with similar functions: None for majority of them and the rest are varying amounts
- Experience in using the Operating System: Majority have some experience in using the OS that is on their computers (the portal should be platform-independent)
- Linguistic ability: Majority fluent in speaking and reading English

Physical Attributes:
- Age range: 7 upwards
- Typical age: usually 15 – 65
- Gender: Likely to be 50% male, 50% female
- Physical limitations: Distance with the computer (resolved in case we integrate STB remote and keyboard with IPTV PC Portal)

Tasks

List of the identified tasks:

The main tasks that we identified in context report are:
- Login towards IAP
- Order/View Video on Demand (VOD)
- Search list of movies and EPG or recordings
- Watch a broadcasting TV channel
- Choose a TV program to be recorded
- View EPG

Task: Login towards IAP

Task goal: To login toward server as quickly and easily as possible

Task output: List of available features

Task: Order/View Video on Demand (VOD)

Task goal: To choose a movie and buy it as quickly and easily as possible for instant or future playback using IPTV account

Task output: Purchased movies are available in a list
Task dependencies:
- Enough credits in case the payment system is prepaid
- The movie should not be bought before by the same user

Task: Search list of movies and EPG or recordings

Task goal: To search among movie details and EPG entries as quickly and easily as possible

Task output: List of items matching the entered keywords

Task Flexibility: Search function should be accessible in different parts of the system

Task: Watch a broadcasting TV channel

Task goal: To tune in to a channel and watch the content instantly

Task output: Recorded programs are available in a list

Task Flexibility: Users should also be able to record a program while watching it

Task: Choose a TV program to be recorded

Task goal: To enable the users to choose a favourite program to be recorded as quickly and easily as possible

Task output: Purchased movies are available in a list

Task Flexibility: Users should also be able to record a program while watching it

Task: View EPG

Task goal: To browse EPG data as quickly and easily as possible

Task output: List of current EPG items

Task Flexibility: EPG should be accessible in different parts of the TV application

Environments

Social environment:

Social platforms:
- Families
- Friends
- Couples
- Individuals

Physical environment:
**Physical platforms:**
Working with PC:
- at home
- at work
- while travelling (on the train, etc.)
PC connected to TV using cables:
- in case of advanced users

**Technical environment:**

**Technical Platform:**
The PC Portal should be available:
- as a web-based application through internet
- as a client software on a PC
- as a client software on a Mac

**Software:**
- required to run the product:
  - SVG Engine
  - JavaScript
- likely to be encountered when using the product
  - OpenGL
APPENDIX D – Task Hierarchies

The following diagram demonstrates the task hierarchy for logging into the system to access all IPTV services.

Hierarchy for logging into the system

Next diagram illustrates the hierarchy for viewing, selecting, and ordering movies. The aim for this task is to choose a Video on Demand item and rent it as quickly and easily as possible.

Hierarchy for viewing, selecting, and ordering movies
This diagram shows the hierarchy for watching live TV and viewing the program guide. The aim in this task is to watch different broadcasting TV channels and get information regarding the broadcasting TV programs or select them to be recorded.

Hierarchy for watching live TV and viewing program guide

The following diagram represents the hierarchy for managing the recordings. The goal for this task is to play a recorded program, delete a recorded program, or cancel a scheduled recording.

Hierarchy for managing the recordings
The following diagram illustrates the hierarchy of searching in list of movies, program guide, and, recordings.

Hierarchy for search
APPENDIX E – Screenshots of the Final Prototype

Home page – Offline mode (applications that do not require login are enabled)

Home page – Login dialog (users do not need to enter username and pin code every time)
Home page – Online mode (all implemented applications are enabled)

Movie Store – Grid view with short information on the selected movie
Movie Store – Grid view with short information for every movie

Movie Store – List view (preferred by most of inquired users for sorting and searching)
Movie Store – Grid view with detailed information on the selected movie

Nick and Norah

2008
Comedy
25 min
Price: 2.55

Director: Peter Sollett
Cast: Michael Cera, Kat Dennings

A comedy about two people thrust together for one hilarious, sleepless night of adventure in a world of mix tapes, late-night living, and live, loud music.

Movie Store – Movies in a specific category
Movie page – Complete details for chosen movie including the possibility to play the trailer and rent the movie

Salt

Director: Phillip Noyce
Cast: Angelina Jolie, Liev Schreiber, Chiwetel Ejiofor

As a CIA officer, Evelyn Salt (Jolie) swore an oath to duty, honor and country. Her loyalty will be tested when a defector accuses her of being a Russian spy. Salt goes on the run, using all her skills and years of experience as a covert operative to elude capture. Salt's efforts to prove her innocence only serve to cast doubt on her motives, as the hunt to uncover the truth behind her identity continues and the question remains: Who is Salt?

Movie page – Confirmation dialog for renting a movie including price and rental duration

Rent: €35

Are you sure you want to rent this movie?

Salt

Price: €35 / 1 hr

Yes

No
Movie page – Possibility to play the movie directly after it is rented

Rented Movies page – Listing all the movies rented by the user with unexpired rental time
Search results page – listing all the movies that contain the searched keyword in any metadata

Player component – Full screen mode
Player component – Possibility to scale the application to any size (advantage of vector graphics)

Windowed Full Screen – Possibility to watch content while performing the usual tasks (Main advantage of computer-based IPTV solution)
APPENDIX F – Heuristic Evaluation Results

Task: Renting a movie in VOD application

1. Visibility of system status
   - Does the user know if his/her request is sent?
     → Button effects (Especially for mouse down and up + mouse over and out) ②
   - Does the user know where in the system he/she is?
     → Breadcrumb ①
   - Is there a risk for the user to enter different requests at a same time?
     → Wait indicator + Blurry background ③
   - Can the user easily understand that the goal of the intended task is achieved?
     → Rent button changes to play button, price changes to expiry date, and playing the movie starts directly after completion of renting ③

2. Match between system and the real world
   - Is the language of the system (including tiles, buttons …) easy to understand for the user?
     → Some error messages reflect what is important and understandable for developers not for the users. ②
     An example is:
     Error message: “You are logged in but you cannot access VOD data because OpenStream is down while IAP is still working”
   - Is it clear for the user when an object is clickable or selectable?
     → Some effects needed for tab selectors for changing the pages ②

3. User control and freedom
   - Can user exit from the application easily?
     → Missing exit button when the application is in full screen mode ②
   - Can user easily understand how he/she could reach the current place in the application?
     → Breadcrumb ①
   - If you enter the wrong data, can you change it easily?
     → Some changes are needed in edit option of data since now it is complicated for the user and the place for editing should be fixed to prevent complication. Also user should be able to edit only one option at a same time to prevent confusion. ③
   - Can user easily Undo and Redo actions?
     → Problem in changing the content of text areas ③
4. **Consistency and standards**

- Do the icons for buttons mean the same in the whole system?
  - No problem

- Is the functionality of the buttons the same in the whole system?
  - No problem

- Is it easy for the user to accomplish the same task correctly based on his/her previous learnability?
  - No problem

- Are icons labeled?
  - Having label for main menu items in the home page. (But not all of them at the same time – only the one which is in focus)

- Does each page have a title?
  - The tab selector is a good idea to use for two purpose at the same time: Page title + tab item.
  - The only needed place is search results page that needs title (It can be merged by showing the keyword that has been searched for)

5. **Error prevention**

- Does the system prevent the user from making different types of errors?
  - No problem

6. **Recognition rather than recall**

- Are all the needed data by the user available on the display at each step in a transaction sequence?
  - No problem

- Do text areas have "breathing space" around them?
  - No problem

- Does the system gray out or delete labels of currently inactive soft function keys?
  - No problem – Specially in main menu

- Are special signs or borders used to identify the meaningful groups?
  - No problem – Specially in sort bar or category selector

- Are all the actions visible enough for the user, so user doesn’t need to remember how to use the system?
  - No problem

7. **Flexibility and efficiency of use**
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do the users have the option of either using pointing device on fields or using a keyboard shortcut?</td>
<td>It is needed in the whole application specially in the main menu users should have the option of clicking directly on menu items or using keyboard.</td>
</tr>
<tr>
<td>Does the system support advanced settings for advanced users and hide them from novice users?</td>
<td>Settings doesn’t have any default option to change everything to default.</td>
</tr>
<tr>
<td>8. Aesthetic and minimalist design</td>
<td></td>
</tr>
<tr>
<td>Does each icon stand out from its background?</td>
<td>No problem</td>
</tr>
<tr>
<td>Are meaningful groups of items separated clearly?</td>
<td>No problem</td>
</tr>
<tr>
<td>9. Help users recognize, diagnose, and recover from errors</td>
<td></td>
</tr>
<tr>
<td>Do all error messages in the system use consistent grammatical style, form, terminology, and abbreviations?</td>
<td>In login the from of showing an unsuccessful login is differ from when you click on play button of the player in Online Video application without choosing any video before. Then you receive the message: “Please choose something!”</td>
</tr>
<tr>
<td>Do error messages explain the cause of the problem?</td>
<td>In login, in case of unsuccessful login you will not get a proper reason. User needs to find out if the username or password is incorrect or the connection is failed.</td>
</tr>
<tr>
<td>Are prompts brief and unambiguous?</td>
<td>No problem</td>
</tr>
<tr>
<td>Are error messages expressed in plain language (No Codes)?</td>
<td>No problem</td>
</tr>
<tr>
<td>10. Help and documentation</td>
<td></td>
</tr>
<tr>
<td>In navigations, is information easy to find for the user?</td>
<td>No problem</td>
</tr>
<tr>
<td>In presentation, is the visual layout well designed?</td>
<td>No problem</td>
</tr>
<tr>
<td>In conversations, is the information understandable, accurate, and complete for the user?</td>
<td>No problem</td>
</tr>
</tbody>
</table>