Development of a Game Portal for Web-based Motion Games

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Upphovsrätt

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Abstract

The objective of this thesis project focuses on designing and implementing a game portal for web-based motion games whilst achieving high usability. Many systems lack the creativity to design web-usability with all the technical requirements and this study addresses this problem by implementing a front-end system that uses agile methodology with competitive analysis and consumes the back-end system with RESTful architecture by using AngularJS web application framework. Users were involved in the implementation process repetitively and the usability test was done with think aloud protocol and System Usability Scale which involves a questionnaire on paper. It was concluded that a clear and interactive navigation bar made it very useful for users to hover through the website. Having the notifications fixed on the upper right side of the navigation bar made them easily perceived by the users and including all user-related functions under username helped the user reach them easily. It was also concluded that modal view prevented page reloading by gathering users, attention at one point. Adding visual feedback functions such as highlighting the hovered or clicked link were appreciated by the users.
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1 Introduction

1.1 Motivation

Websites have become popular since the last two decades. It is their usability and ease of access that makes them in demand. They carry the related multimedia content on a collection of web pages and are identified with a domain name accessed via their IP (internet protocol) or a LAN (local area network) with an URL (uniform resource locator) to identify the site. Websites are composed of building blocks which are called web pages. Web pages are formed with data mixed with formatting instructions of HTML (hypertext markup language) and are accessed and transferred with HTTP (hypertext transfer protocol). Hovering through the web pages (linking/links) gives user the site structure, design and information on how to navigate (such as starting with a home page). In some websites, registration and subscription might be needed to be able to view the content. Since the inception of websites, there have been many variations, new types and functions introduced. Such as a personal website, government website or a website for a company. Also, nowadays websites can be accessed from browsers and different kinds of devices as well. The advantages of going online that developers and users take into consideration as the web-based application is, browser applications need only little or no disk space, automatically upgrade with new characteristics and easily combine with other web procedures such as searching and email [31]. One of the most popular kind of websites is for entertainment purpose which includes online-gaming.

An online game is a video game which you can access and play through using the internet or another network. Online games became rapidly available through internet since the last two decades which led to an expansion of such websites. Increasing connection speed also brought new developments with introducing new genres, such as social games. A game server is the host of an online game. Simple text-based environments, complex graphics and virtual worlds are form of design in an online game. Use of online games is motivated with fundamental ways of fun, relaxing, learning, competition and achievements which primarily create and lead to their design.

Building a new website requires detailed structuring. The website needs to catch people’s attention as soon as they look at it whilst containing all the information aimed to be shared with the users to help them achieve their designated use. Testing the usability is a very
important aspect in building a website since frequent Internet users are already accustomed to using a website, they do not pay attention to a site which is not usable.

It is critical to design a website that fulfills the user requirements. Usability is the main criterion for a successful design that satisfies user needs. The design principles for web usability include; navigation (easy-to-use), response time (minimal download time), credibility (frequent updating, relevance to users) and content (high quality). [26]

1.2 Aim

Web usability aims to create a clear, concise and simple design for websites. This brings out an environment open to all kinds of users without any age or gender limit and it ensures the content is presented with ease on different kinds of browsers. Also, the navigation and response time to the user is an important aspect of usability which indicates how efficient the design is. For an efficient navigation and response time, it is necessary to design a front-end system that completely entangles and integrates with the already existing back-end system with RESTful architecture which is developed by Emil and Kristofer[15]. Nevertheless, many user interfaces lack the creativity in designing the web usability that includes the technical requirements. Hence, this thesis focuses on forming a design in web usability to address the current problems.

1.3 Research questions

This thesis’ main focus is to answer the following question:

How to design and implement a game portal for web-based motion games to achieve high usability?

With usability, the study focuses on effectiveness, efficiency and satisfaction.

1.4 Delimitations

Implementation of the front-end system that consumes the back-end system with RESTful architecture will be designed by using AngularJS web application framework. The communication between the client and server will be achieved by standard HTTP requests. There will be online payment feature on Game Portal website in order to buy provided items and this process will be handled by Stripe online payment platform. Also, 10 users will attempt to usability test of Game Portal website. In addition, the back-end system of this Game Portal has not been developed during this study since it has been developed by Emil and Kristofer in another study [15]. The game portal includes a list of web-based motion games, such as the Bug Game, which are being developed by another study group.
2 Background

2.1 Web Development Technologies

This section will describe the terminology and technology used regarding the protocols and architecture related to the web development and design.

HyperText Markup Language

HyperText Markup Language is a markup language that creates platform-independent hypertext documents \cite{7}. HTML documents are SGML documents. They consist of comprehensively specific semantics which are suitable for representing information from a wide range of domains such as hypertext news, mail, documentation and hypermedia, menus of options, documents with in-line graphics, database query results and hypertext views of information.

World Wide Web global information initiative has been using HTML since 1990. This is valid for the capabilities of HTML in general use by June 1994. HTML is an application of ISO Standard 8879:1986 Information Processing Text and Office Systems; Standard Generalized Markup Language (SGML)\cite{7}.

Cascading Style Sheets

Alongside markup languages, web designers and developers also use Cascading Style Sheets (CSS) tool to create websites \cite{34}. Web browsers take the information they need to control the visual aspect of a web page, for example the position of HTML elements, text styles, backgrounds, images and colors from CSS tool. In addition to all aspects, CSS allows to create an appealing design and an innovative Web page.

JavaScript

JavaScript is an interpreted programming language with object-oriented (OO) capabilities and loosely typed language. The core JavaScript language resembles C, C++ and Java and also supports numbers, strings and Boolean values as prior data types \cite{14}. It also has built-
on support for array, date and regular-expression objects.

Generally, JavaScript is used in web browsers. The general purpose core is enhanced with objects that allow scripts to interact with the user, control the web browser and the document content that appears on the web browser window. Client-side JavaScript is an embedded version of JavaScript and it runs scripts embedded within HTML web pages.

**Hypertext Transfer Protocol**

Encoding and transforming information between a client and a server that sends information between them over a network is a method used by HyperText Transfer Protocol (HTTP)\[13\]. HTTP has a request/response structure in which the client sends a formatted message to the server and the server replies with a formatted response message. The reply from the server has a status code which is a three-digit and it shows that the server tries to process the request. There is also a method header included in a HTTP packet request which verifies the operation of the receiver in response to the sender’s resource. GET, PUT, POST and DELETE are commonly used method headers.

**Web Server**

A Web server uses HTTP to serve the files that create Web pages to users, upon their requests, which then are forwarded by their computers’ HTTP clients.

Web servers are a part of a larger package of Internet and intranet-related programs for serving email, downloading requests for File Transfer Protocol (FTP) files and building/publishing Web pages \[33\]. The following are what should be considered when choosing a Web server;

- how efficient it works with the operating system and other servers
- its ability to handle server-side programming
- security characteristics
- publishing, search engine and site building tools that come with it.

**PyCharm**

PyCharm is an Integrated Development Environment (IDE) specifically for Python language used in computer programming. In this project, PyCharm is used for designing user interface of Game Portal Web Site and running already developed back-end system as web server of Game Portal Web Site.

**Angular JS**

Developing single-page applications encounter many challenges. AngularJS is a JavaScript open-source front-end web application framework which is used to address these challenges in the developing stage. In this project, Angular JS is used for designing front-end functions of Game Portal Web Site.

**Stripe**

Stripe is a service that allows developers to accept payments on their web applications. By using Stripe, developers can monitor payments, search past payments, create recurring charges and customers. In this project, Stripe is used for handling online payment process when users proceed to buy items from Game Portal Web Site.
2.2 Earlier Studies

This chapter will briefly describe the back-end system that designed by using RESTful architecture and a web-based motion game being developed at Linköping University.

Back-End System

Every web site need a back-end system in order to receive and response HTTP requests of clients. In this study, already developed sever site back-end system with RESTful architecture is used. This back-end system has been developed by Emil and Kristofer[15]. This system’s functionality handles payment logic such as buying games and virtual items, state description for game accounts and account related functions such as managing friends and profiles for users.

Bug Game

The Bug game is a motion controlled game run in the web-browser where the user is supposed to squash insects to keep them from reaching a tree by using him/her arms. The game uses a camera to capture the user’s motions as input. A payment system will be used where the user can pay money to receive virtual items and buy new games and chapters of the games.
3 Theory

In this part the basis of the work that this thesis will build up on, concepts and methods will be described comprehensively.

3.1 What is Usability?

ISO 9241-11 defines usability as:

The 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 [32].

The ANSI 2001 and ISO 9241 Metrics recommends that usability metrics should include the following[19][29]:

• Effectiveness: The accuracy and completeness in which users achieve specific goals.
• Efficiency: The resources used in relation to the accuracy and completeness in which users achieve goals.
• Satisfaction: The comfort and acceptability of use.

Usability is simply how easy it is to use an object. The object can be anything from a website, software application to a machine, tool, process or a book. Eventually, anything that people interact with should be usable. In terms of websites and software applications, usability can be defined as the ease of how an average person can use the system to complete the designated goals.

3.2 Why is Usability Important?

Nowadays many companies use the Internet in growing their businesses. The market is very competitive and limited so designing a good website that increases the companies’ profits as well as promoting their services or products has become a priority issue. A web site’s characteristics and nature depend on which system it uses, what field it is in, what is the aim of use and so many other features which makes it harder to clearly explain what a successful
web site is. All this features are connected to the target users. In e-commerce, user is the most important factor for increasing a company’s profits [23]. In this study, since the user is able to buy games and virtual items, the shopping section of the Game Portal can be treated as an e-commerce website.

Users are the primary focus in designing websites. It is important to have as much as possible information about users since it means to understand how they make their preferences. This can be defined as in a choice of alternatives, depending on the user’s opinion that one thing is better than the other. Choices reflect a user’s attitude or a feeling towards the interface and functionality design of a website as well as his/her final decision on that website. Therefore a usable website should provide positivity in its the online stores and gather users’ attention which will increase the amount of time users spend hovering through the website and revisit rates, thus, encouraging online purchases [11, 25]. Failing to produce a usable website will result in online business failures since users stop using unusable websites according to Becker and Mottay [6].

3.3 Design Principles for Usable Web Site

Web site usability was mainly developed with design principles that included five key elements: consistency of interface, response time, mapping and metaphors, interaction styles, multimedia and audiovisual [26]. These principles are later improved to include more aspects to meet the best criteria in design with; navigation, response time, credibility and content. Usability concept mainly focuses on user experience, customer satisfaction and customer’s perception of the product [31].

The following statements emphasize the significance of the principles in order to create a prosperous Web site,

- download delay (speed of access and display rate within the Web site)
- navigation (organization, arrangement, layout and sequencing)
- content (amount and variety of product information)
- interactivity (customization and interactivity)
- responsiveness (feedback options and FAQs)

This brings together the basics for Web programmers who aim to design front-end and back-end development for a usable Web Site. Navigation carries great importance since it is the key element for users to gather the information easier and also it makes it easier for users to find the information they are seeking. Navigation and content are always linked, therefore a good structure, organized layout, readability and the use of graphics are pinpoint rules for a successful design. Another important aspect is responsiveness which suggests that design and development of the Web site should be responding to user’s behaviour with minimum delay time. The environment of the design and how it carries the content play an important role here. Usability does not only cover user interface in web applications but also discusses the information (content) and the functions performed by that application [31].

Other aspects of usability are composed of learnability, memorability, efficiency, satisfaction and errors [12]. Learnability explains how easy it is to accomplish a task when a new user visits the website for the first time. Memorability is when a user visits the website again after a period of time and use the website. Efficiency is how fast it is for users to complete
tasks on the site after they get familiar with its use. Satisfaction shows whether the users enjoy the design of the site meanwhile errors show the number of errors users make when they use the website, the degree of errors and if it would be easy to recover from them.

3.4 How to Evaluate Usability

The need for usability evaluation is essential for web applications since they have become the base for all business and information interactions [18].

Usability evaluation ensures the newly released software products are efficient, effective to achieve goals, easy to use and reach maximum user satisfaction [17]. Think Aloud (TA), Heuristic Evaluation (HE) and Cognitive Walkthrough (CW) are general methods for usability.

TA method is combined mainly with a lab-based user testing (there is also thinking out aloud at user’s workplace testing instead of labs) [17]. In lab-bases user testing, test users work with products meanwhile thinking out aloud simultaneously, their behaviours verbal protocols are recorded in laboratory environment. According to Andreas, thinking aloud may be the single most valuable usability engineering method [16]. It involves having an end user continuously thinking out loud while using the system. By verbalizing their thoughts, the test users enable us to understand how they view the system, which makes it easier to identify the end users’ major misconceptions. By showing how users interpret each individual interface item, TA facilitates a direct understanding of which parts of the dialogue cause the most problems.

HE is an usability inspection method [17]. Heuristics are usability principles which evaluate usability problems in a user interface design by examining and evaluating interface and its suitability with the usability principles.

CW is theory-based, evaluates every step crucial to execute a task and searches for problems in usability that might occur when there is an interference with learning by exploration [17].

These methods carry their own advantages and disadvantages. For example, TA has exquisite qualitative data however the laboratory environment may have an effect on the tester’s response. HE is cheap, fast and easy-to-use meanwhile very detailed and prioritizes low-importance problems in usability. CW employs a technique that finds mismatches between users’ and designers’ concept process in a task. On the other hand, CW requires comprehensive knowledge of cognitive psychology and technicality to perform better.

According to Wonil and Gavriel TA method includes 9 users to detect 80% of usability problems, meanwhile HE will only need 8 evaluators to perform the same task. CW method requires 11 evaluators due to prediction from linear regression to detect 80% of usability problems [17].

Based on the predictions using the observed data with a variety of experimental conditions, a general rule for optimal sample size (such as, test users for TA and evaluators for HE and CW) would be $10 \pm 2$ instead of $4 \pm 1$. That is, TA, HE and CW methods require nine test users, eight evaluators and 11 evaluators, respectively, to reach 80% overall discovery rate, rather than 3 ~ 5 evaluators [17].

Furthermore, mixed methods could be considered, such as HE And TA. Although HE is tend to be used in early stages of the development process and TA is utilized later, combining
these two methods decreases the number of evaluators and test users than using only one
method individually. The combined method accomplishes a better performance by using
both methods’ complementary characteristics.

3.5 Metrics for Usability Testing

Obtaining a complete understanding of user’s needs and improving the product to provide
a better user experience are widely chosen reasons for measuring usability [8]. There are
two performance metrics in a design process. These metrics measure the increases in perfor-
mance over time and success in correctly identifying signals from the system. The following
subsections explain these metrics in detail.

Learnability

Learnability is a fundamental performance metric especially when it is important that users
progress through using the system over time [3]. Tests are done where users are given to
try out sessions with the system to functionalize learnability. It is essential to measure the
increase over time where the user successfully manages to accomplish the system to gather
accurate measurements.

Task Success

Task success is a widely used performance metric. It measures the efficiency in a user’s ca-
pability to perform a given task [3]. The task success metric is measured with binary success
which is either succeeding or failing a task. A user can not partially accomplish a task. Also
Nigel states that, user satisfaction can be measured by the rate of which users accomplished
to achieve their goals [8].

3.6 Measure Usability

Testing with end users is a requisite for a fundamental usability method [16]. This method
gives information about how people use the system directly and their problems with specific
interfaces. Several methods are involved in testing with users which are commonly thinking
aloud, field observation and questionnaires.

Observation

Observation is a simple field study [16]. It involves visiting users in their work places. A
usability test is constructed carefully with a scenario where a person performs a list of tasks
while someone is using the website for the first time. Another person observes and listens
user’s actions, takes notes and records the timing of the tasks. Noise and disturbance can
lead to false results so ideally the observer should be virtually invisible to make sure the user
is in a normal working environment. Sometimes video can be used to ensure the observation
process is without any intrusion. This method allows the developer to test whether the site is
usable and to immediately see whether the users are able to perform the tasks or if there are
any difficulties in doing so [12, 16].

Single Usability Metric

There are ways to easily describe usability of a system by combining metrics into a single
point, such as, when comparing competing products or reporting on corporate dashboards.
SUM is a standardized average of measures of effectiveness, efficiency, satisfaction and also
has 3 metrics which are test level satisfaction, completion rate and task time [27]. SUM
3.6. Measure Usability

generates one continuous variable for usability evaluations that can be used in hypothesis
testing, regression analysis and usability reporting [28].

Effectiveness is composed of completion rates and errors, efficiency is calculated with
time on tasks and satisfaction is measured with standardized questionnaires (collected on
task-by-task basis or a test at the end of the session). The overall system emphasizes usability
as the quality of use in a context. On the other hand, usability of use can be measured as the
outcome of interaction in a context instead: until all the intended goals of use of the overall
system are achieved (effectiveness); resources like time, money or mental effort that have to
be consumed to achieve the intended goals (efficiency); and the measure which the user finds
the system acceptable (satisfaction) [19] [29] [10]. The interaction is influenced by physical
and organisational environments, users, tasks, equipment (such as hardware, software and
materials) which makes up the overall system. According to Nigel and Miles, reliable mea-
sures of general usability can only be succeeded by determining the effectiveness, efficiency
and satisfaction with which representative users fulfill designated tasks in representative
environments [10].

Completion Rate

Completion rate can be used to calculate effectiveness [24]. It is also the fundamental usability
metric and can be calculated by assigning a binary value of ‘1’ if the test taker completes a
task and ‘0’ if the test taker does not complete a task.

Completion rate is very easy to understand and due to its simplicity, it is very popular.
Furthermore, it can be calculated at any stage of the development. Thus, effectiveness can be
presented as a percentage by using the following equation [3.1]

\[
Effectiveness = \frac{\text{Number of tasks completed successfully}}{\text{Total number of tasks undertaken}} \times 100\% \quad (3.1)
\]

Time Based Efficiency

Efficiency can be measured in terms of task time [24]. That represents the time (seconds/minutes) the user takes to successfully finish a task. Calculating the time is as simple
as subtracting the start time from the end time. Therefore, efficiency can be calculated using
the following equation [3.2]

\[
\text{Time Based Efficiency (goals/min)} = \frac{\sum_{i=1}^{R} \sum_{j=1}^{N} \frac{n_{ij}}{t_{ij}}}{NR} \quad (3.2)
\]

Where:
\( N \) = The total number of tasks
\( R \) = The number of users
\( n_{ij} \) = The result of a task \( i \) by user \( j \); if the user successfully completes the task, then \( N_{ij} = 1 \),
if not, then \( N_{ij} = 0 \)
\( t_{ij} \) = The time spent by user \( j \) to complete a task \( i \). If the task is not successfully completed,
then time is measured till the moment the user quits the task

Test Level Satisfaction

Measuring test level satisfaction is done by giving a questionnaire to the test participant at
the end of the test session [24]. The aim is to measure the test taker’s impression of the overall
ease of use of the system. For test level satisfaction, System Usability Scale can be used since
it claims to derive a reliable and low-cost standardized measure of the overall usability \[20\].

System Usability Scale has a ten-item simple scale which gives a general view of subjective evaluations of usability \[20\]. SUS can quickly and easily gather user’s subjective rating of a product’s usability and that is the reason it was developed \[5\]. It is commonly used after a participant uses the system being tested and before any discussion or interrogation takes place. Participants are asked to record their immediate response each time. Also, Kirakowski states that reliability of SUS is 0.85 over 1 \[21\].

The result that SUS generates is a single number representing a complex measure of the overall usability of the system (scores for individual items do not mean anything on their own). The SUS score is calculated by first, adding the score contributions from each item. The score contribution is scale position minus 1 for items 1, 3, 5, 7 and 9. For items 2, 4, 6, 8 and 10 it is 5 minus the scale position. Multiplying the sum of the scores by 2.5 will generate the overall value of SUS \[20\].

### 3.7 User-based Design Process

Since 1970s, consideration of users while developing a computer system have gained importance. The user holds the central place in a user-based design process since the Web site is designed for the user himself and his input guides the process from beginning to end. The user’s viewpoint is reflected rather than the designer’s viewpoint whenever possible \[2\].

According to Nigel, human-centred activities require that project planning shall assign time and resources accordingly. This involves time for iteration, adding and incorporating user feedback and the evaluation of design solutions whether they satisfy the user requirements. Users and stakeholder groups are identified and their relationship is described with the proposed development with key goals and constraints. \[9\].

In the past, users did not have a first-hand contribution to the Web design process because at the early stages of this communication technology, users had limited, relatively peculiar experience. Consequently, they could not provide useful insights regarding the web design. Since then, the Web has grown rapidly and users have improved with the relevant frequency, intensity and extent of Web use to allow the growth of a user-based approach \[1\].

For this system to work effectively, a clear understanding of task-related information search and use behaviour of the clients should be clearly understood by the designer. Karla and Abelse suggested resources used in responding to information needs should be able to compete with the other complementary sources the clients are accustomed to use \[2\].

#### Information – gathering stage

Stage 1’s main job is to determine which criteria the user applies while deciding the level of usability of a Web site. This type of data can be gathered through questionnaires or interviews extensively.

#### Development stage

Development stage includes several important tasks. The designers need to make the criteria usable in an operation and estimate their implications since they are the basis for the entire process \[2\]. Feasibility of the criteria is ranked during the process, then the criteria are translated into Web site features where they form the preliminary version of the Web site. The
design should have a continuous feedback mechanism since it is important to get a continuous user feedback.

**Evaluation stage**

Evaluation of the Web site is a continuous stage in user-based design process. It is also a part of the implementation stage continually. It is essential to have users evaluate the Web site before it becomes operational in order to determine if the criteria for the usability is met in the design.\(^2\) Feedback is always important in every stage of the process of design. Questionnaires can be resourceful for gathering effective feedback where the user group is asked to use the Web site and answer some specific questions. Another method can be used such as think aloud protocol with a researcher to gather comments from the users. Both methodologies result with useful data for the Web site. It is an iterative process and repetition improves the evaluation of comments from users. Until the users indicate that the Web site is ready to be implemented, the stage continues. Testing is also a part of evaluating in some occasions \(^2\). Specific tasks to accomplish specific design goals may require usability testing through the process.

**Implementation stage**

Implementation takes part at some point of the user-based design process in which the website is considered complete and finished. User group’s feedback to initial versions of the website combined with the design based on the user group’s criteria together forms the implemented version of the site. Since user feedback is continuous in this process, it is never considered as completely finished \(^2\). However, at this stage design is not the main focus of the developers anymore, implementation and maintenance have the priority. The website becomes operational and available which makes it possible for frequent users to get accustomed to the site as their normal information gathering routine. It is useful for developers to formally announce the availability of the website to the primary user groups via electronic or non-electronic means to reach out all the aimed users.

### 3.8 Research Methodologies

One of the approaches of building a software is iterative development which is composed of several iterations in sequence. Each iteration is independent and consists of activities such as requirement analysis, design, programming and test. At the end of an iteration, the aim is an iteration release, which is a stable, integrated and tested partially complete system. \(^22\)

**Agile methodology**

Agile methods are a subset of iterative and evolutionary methods \(^22\). They divide tasks into small increments with the least planning and do not include long-term planning directly. Iterations are typically short time frames (time boxes) and they last from one to four weeks. A team works on each iteration including all the software development steps as planning, requirements analysis, design, coding unit testing and acceptance testing which is executed when the product is demonstrated to stakeholders. This approach decreases the overall risk and helps the project to quickly adapt alterations\(^30\).

At the end of each iteration, the aim is to produce an available release with minimum bugs nonetheless there is no guarantee for full functionality of the release. It is significantly required to have multiple iterations to release a product or new features.
Competitive Analysis

It is common that designers study already-existing examples and search for inspiration by observing all available competing designs. Designers with experience can create a summary from some specific cases to observe design principles, patterns and schemes which are repeatedly represented in the concept. Competitive analysis plays an important role in helping designers place their design in the scope of their relation to other examples.

Competitive analysis works in a way that requires the competitors to line up side-by-side and compare their similarities and differences on selected points. This method prevents any expectations from users who are used to other sites and covers everything from designing the interface to selected features. Some sites might have inconsistencies which shows that they have innovative solutions, or there is more than one approach in that particular industry. Competitive analysis aims for a result that helps define the general direction of the design rather than defining the design itself. [4]

A competitive analysis can either be broad with a feel for the product landscape and its best practices, or it can be narrow which focuses on identifying how competitors found a solution for particular design problem. The following are steps involved in a competitive analysis: (1) identify and describe the purpose of the analysis; (2) set up the competitive framework; (3) gather and present data; and (4) document the conclusions.

1. Identify and describe the purpose of the analysis. There are two dimensions in a competitive analysis: a number of competitors and a set of criteria for comparison. A simple table can be used to visualize the comparison between the competitors that are aligned side-by-side, emphasizing their similarities and differences.

2. Set up the competitive framework. The framework has two dimensions, competitors and the criteria for comparison. This visualization can give information about the gaps in the product landscape which your design can fill.

3. Gather and present data. The framework is filled with data from the analysis when it is completed. The aim of the analysis is to highlight the similarities and the differences between products and therefore it is important to include them in the data presentation.

4. Document the conclusions. Interpretation of the data in relation to the client and the product is important. The future design work requires to draw conclusions based on the data in the direction set by the competitive analysis. In order to draw explicit conclusions, referring to clear design problems and a narrow analysis is needed.
4 Method

4.1 Project Management

In the development of the design of the game portal, an agile process was applied. Flexibility is important in an agile software development since the requirements can change, can be removed or added during the development process according to user needs and tests. There were meetings held with the stakeholders in every two weeks time period which helped keeping track of the progress and making decisions. These were mostly face-to-face meetings. Management application Trello was used to make sure the project was focused and organized to keep moving in the right direction. Trello keeps a good structure of what is implemented right now, what has already been implemented and what is to be implemented next by using lists and cards.

4.2 Pre-Study

Pre-study phase consists of two following parts;

Evaluation of Existing Designs

The pre-study study was conducted to investigate the already existing game portals, social web sites, on-line shopping web sites, etc and to compare their aspects on usability. In this process, competitive analysis is applied in order to find design principles, patterns and schemes which are repeatedly represented in the concepts. In pre-study section, the used web sites for competitive analysis are; Facebook, Google - My Account, Good Games, Steam, Kizi and Amazon.com. Detailed information about website that involved in competitive analysis is represented in the following table.

<table>
<thead>
<tr>
<th>Website</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook</td>
<td><a href="https://www.facebook.com">https://www.facebook.com</a></td>
</tr>
<tr>
<td>Google - My Account</td>
<td><a href="https://myaccount.google.com">https://myaccount.google.com</a></td>
</tr>
<tr>
<td>Good Games</td>
<td><a href="https://www.goodgamestudios.com">https://www.goodgamestudios.com</a></td>
</tr>
<tr>
<td>Steam</td>
<td><a href="https://store.steampowered.com">https://store.steampowered.com</a></td>
</tr>
<tr>
<td>Kizi</td>
<td><a href="http://kizi.com">http://kizi.com</a></td>
</tr>
<tr>
<td>Amazon.com</td>
<td><a href="https://www.amazon.com">https://www.amazon.com</a></td>
</tr>
</tbody>
</table>
4.3 Iterative Development

Websites

<table>
<thead>
<tr>
<th>Websites</th>
<th>Detailed Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook</td>
<td>Facebook’s purpose is to supply people the power to share to be more open and connected. People use Facebook to stay connected with friends and family, to discover what is happening around the world and to express themselves with what matters to them.</td>
</tr>
<tr>
<td>Google My Account</td>
<td>My Account gives users quick access to settings and tools which are related with users’ Google account.</td>
</tr>
<tr>
<td>Good Games</td>
<td>Goodgame Studios is a preceding, free-to-play online game development company. The company works across web and mobile platforms whilst serving more than 300 million registered users worldwide. Goodgame Studios has talented employees from all around the world and is among the biggest German employers in the gaming software industry.</td>
</tr>
<tr>
<td>Steam Powered</td>
<td>Steam Powered is a game portal that has a catalog including alternatives of PC, Mac, and Linux games. The games support Steam Play, which enables users to buy once and play anywhere, and Cross-Platform Multiplayer which enables users to play with all their friends, anywhere they log in.</td>
</tr>
<tr>
<td>Kizi</td>
<td>Kizi’s web sites and applications offer their services to more than 30 million players worldwide. Kizi has something for everyone since it has a very intuitive design which focuses on a wide range of games for people from all ages. Parents prefer Kizi since they find it safe and suitable to play for both themselves and their children.</td>
</tr>
<tr>
<td>Amazon.com</td>
<td>Amazon is an American electronic commerce and cloud computing company. It is the largest Internet-based retailer in the world by total sales and market capitalization.</td>
</tr>
</tbody>
</table>

Table 4.1: Chosen Websites for Competitive Analysis

Mini-Workshop

This part of the study includes creating the user interface of the game portal design after the competitive analysis of already-existing user-based websites’ usability aspects. One of the main obstacles was to enable the user interface to be accessible and usable by any user. Main focus of mini-workshop was determining the design criteria which can be found on appendix A.

4.3 Iterative Development

An iterative development process was used during the design and implementation phase of this thesis. When encountered a problem, small parts in functionality were produced, altered, tested and corrected. Step by step the iteration on the previous work was done by extending the functionality of the system.

Prototyping

Prototyping done by using PyCharm application the front-end layer of the game portal designed with HTML, JavaScript and CSS coding. It is important to mention that the created front-end layer consumed the already-existing back-end layer by sending and receiving HTTP requests. Since an agile process was used, there were meetings with the stakeholders and small group of users (3-5 users) in every 2 weeks to make repetitive user-studies and alterations in the design. The results were gathered after every user-study and they
demonstrated feedback which were used to make accordingly changes in the design. Within 3 month time period the design of the game portal was at its final form and ready for usability test (SUM).

**Repetitive User-Study**

In this section, users were involved on implementation process of Game Portal repetitively in order to achieve high usability. For every user-studies, developer introduced new functions and designs those are added to Game Portal and users tried to perform on those new functions and design. During each user-studies, developer collected feedback from users by using think-aloud protocol.

**Feedback**

The feedback from the users were gathered to examine the design issues they addressed while they were using the new functions and designs (such as difficulty finding information, poor-structure in navigation, complex functions, etc.). Users recommendations were applied to user interface of the system to increase user satisfaction. The minor and major design changes were applied to front-end and back-end layers of web site according to users feedback.

4.4 Usability Test

This section consists of two parts; observation and think aloud protocol. In the usability test part, five female and five male users with age differences between twenty and thirty five have attempted in order to use and test the Game Portal. The users were given access to the web site of Game Portal, nine different scenarios (to measure task success and time efficiency) and a survey which consists of ten questions on paper (to measure System Usability Scale) in order to measure usability of the Game Portal. During each test, users were required to talk about their opinions while following the scenarios which is necessary for performing think aloud protocol. Furthermore, test leader was continuously observing and taking notes to find out if linking through the pages and using functionalities were easy or complex for each user. Additionally, test leader kept track of time for each scenario in order to find the time efficiency. After handing the usability test paper to user which can be found on Appendix[B], test leader explained the task failure and asked if there are any unclear parts. Task failure is defined as; if user asks a question to test the leader about the task that he/she is performing, it will be considered as task failure. Each usability test took approximately fifteen minutes. The following are performed scenarios by the user;

1. Play the Marathon game.
2. Logout from your account.
3. Play the Story game.
4. You have a notification, find it and take an action?
5. Send friend request to Stoffe. (username: Stoffe or e-mail: stoffe@rng.com)
6. Remove a friend from your friend list.
7. Buy one of the games as gift for one of your friend via GamePortal.
8. Change your profile avatar.
9. You have problem with one of the games and need to solve it, what will you do?
5 Results

5.1 Pre-Study

After competitive analysis, developer and stakeholders decided which design principles, patterns and schemes will be used on the system design. The following table 5.1 shows these design principles, patterns and schemes including their sources;

<table>
<thead>
<tr>
<th>Web Sites</th>
<th>Used Design Principle, Patterns and Schemes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook</td>
<td>Position of notification and profile editing.</td>
</tr>
<tr>
<td>Google My Account</td>
<td>Accessing settings and log out link under username.</td>
</tr>
<tr>
<td>Good Games</td>
<td>Navigation bar.</td>
</tr>
<tr>
<td>Steam Powered</td>
<td>Options for buying games and listing games on home page.</td>
</tr>
<tr>
<td>Kizi</td>
<td>Modal view.</td>
</tr>
<tr>
<td>Amazon.com</td>
<td>Position of shopping cart icon.</td>
</tr>
</tbody>
</table>

Table 5.1: Competitive Analysis Results

Having easy-to-use navigation is important for any web site, since users can easily find information that they are seeking for as shown in screen shot 5.1.

Figure 5.1: Good Games navigation bar design

Users can see all the notification on the right side of navigation bar as shown in screen shot 5.2. User can edit his/her profile in one place easily by clicking on the edit button for each parameter as shown in screen shot 5.3.
5.1. Pre-Study

Figure 5.2: Facebook notification design

General Account Settings

<table>
<thead>
<tr>
<th>Name</th>
<th>Edit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Username</td>
<td>Edit</td>
</tr>
<tr>
<td>Contact</td>
<td>Edit</td>
</tr>
<tr>
<td>Advert account contact</td>
<td>Edit</td>
</tr>
</tbody>
</table>

We've reorganised a few things. Password settings are now under **Security and login.**

User related functions are listed under username as shown in screen shot 5.4. User can understand settings for his/her account and logging out will be under something personal such as username.

Figure 5.3: Facebook profile editing design

Figure 5.4: Google - My Account design
Modal view is used for attracting user attention to one point while they are using the web site as shown in screen shot 5.5.

![Kizi modal view design](image1.png)

Figure 5.5: Kizi modal view design

When user decides to buy a game, there is an option for buying for themselves or as a gift as shown in screen shot 5.6a. Games are listed with cards and by using side arrow as shown in screen shot 5.6b.

![Steam Powered buying option design](image2.png)

(a) Steam Powered buying option design

![Steam Powered list games design](image3.png)

(b) Steam Powered list games design

Figure 5.6: Steam Powered Design

Shopping cart icon is always available for users on navigation bar as shown in figure 5.7 to help users see how many items they have and access quickly to shopping cart page.

![Amazon.com Shopping Cart design](image4.png)

Figure 5.7: Amazon.com Shopping Cart design
5.2 Iterative Development

Prototype

General system description, HyperText Markup Language and Cascading Style Sheets used for designing user interface of Game Portal. JavaScript is used for adding functions to designed user interface such as listing games, logging to your account, managing friends, etc. Finally, Hypertext Transfer Protocol is used for sending and receiving information over network to/from web server which is running back-end system. During prototyping, a graphical resource is used in order to provide avatar list for users to choose their profile avatar. The graphical resource is Bull’s-Eye Graphic Design[^1] from OpenGameArt[^2]. In figure 5.8, overall system is visualized for better understanding.

![System Overview](https://opengameart.org/content/avatar-pack-by-bullseye)

In figure 5.8, overall system is visualized for better understanding.

In the following section, user interfaces are described with implemented functionalities;

When user visits Game Portal web site home page, what user sees is represented in figure 5.9. The following is a list of functionalities that are accessible by user;

- Users can access basic pages and modal by using navigation bar which consist of home, shop, support, company, register and log in links.
- User can access a list of free and paid games through home page
- User can access a list of paid games through shop page
- User can click on Play button to play any free or already purchased game
- User can click on Buy button to proceed buying options
- User can click on the picture of a game and will be redirected to the game page
- User is required to log in to his/her account before playing or buying any game

[^1]: https://opengameart.org/content/avatar-pack-by-bullseye
[^2]: https://opengameart.org
5.2. Iterative Development

Figure 5.9: Home Page

When user clicks on log in link, he/she can access log in modal which is shown in figure 5.10b. When user clicks on register link, he/she can access register modal which is shown in figure 5.10b. The following are the functionalities that are accessible by user in this modal:

- User can use Log in modal to access his/her account
- Unregistered user can use Register modal to open an account.
- User can switch between modals by clicking on log in or register link according to his/her needs.

Figure 5.10: Account Related Modals

When user log in to his/her account or register new account, following changes happen on navigation bar and it shown as in figure 5.11. The following functionalities are accessible by user in this modal:

- User can access his/her own games, shopping cart, friends.
- User can access settings, gift and log out links by clicking on his/her username.
When user clicks on friends icon on the right side of navigation bar, he/she can access friends modal which is shown in the figure 5.12 below. The user can access the following:

- User can access his/her friends list shown as in figure 5.12(a)
- User can add friends or send invitation shown as in figure 5.12(b)
- User can access friend request list shown as in figure 5.12(c)

Figure 5.11: Username Dropdown Menu

Figure 5.12: Friends Modal
5.2. Iterative Development

When user clicks on gifts link, he/she can access gifts modal which is shown in 5.13. The following functionalities are accessible by user:

- User can access his/her pending gifts list shown as in figure 5.13a
- User can enter gift activation code which is received by user’s email shown as in figure 5.13b

![Gifts modal](image1)

(a) List pending gifts  
(b) Gift code by e-mail

**Figure 5.13: Gift Modal**

When user clicks on settings link, he/she can access profile modal which is shown in 5.14. The following functionalities are accessible by user:

- User can edit profile avatar
- User can edit name and surname
- User can edit e-mail address
- User can edit password

![Profile modal](image2)

**Figure 5.14: Profile Modal**

When user is redirected to game page, represented web page is shown in figure 5.15. The user can access the following:

- Detailed information about the game itself
- User can click on buy for myself button in order to add items into shopping cart and user will be redirected to shopping cart page
- User can click on buy as a gift button to send gifts his/her friends and select friend modal will be opened
5.2. Iterative Development

When select friend modal is opened, represented modal is shown in figure 5.16. The following functionalities are accessible by user;

- User can select friend/s from list which are going to receive the gift
- User can enter e-mail of his/her friend to send gift via e-mail with gift code
- User can press the next button to add items into shopping cart and will be redirected to shopping cart

When user visits or is redirected to the shopping cart page, represented page is shown in figures 5.17. The following functionalities are accessible by user;

- User can access items list that he/she wants to buy shown as in figure 5.17a
- User can delete items from shopping cart by clicking on Remove button
- User has to agree with terms and conditions before proceeding to checkout by clicking on checkbox
- User can click on Checkout button to proceed to payment
5.2. Iterative Development

- User can use Stripe modal for entering related e-mail and credit card information for payments shown as in figure 5.17b.
- After payment, user can play purchased game/s by clicking on the provided link shown as in figure 5.17c.

When user clicks on interactive icon on the right side of the navigation bar, represented dropdown menu will be opened as shown in figure 5.18. The following functionalities are accessible by user:

- User can access game page by clicking on picture of the game
- User can click on play button in order to play the game

Figure 5.17: Shopping Cart and Payment

Figure 5.18: User’s Games
5.2. Iterative Development

Repetitive User-study and Feedback

Repetitive user-study and feedback helped the developer to find out if linking through the pages and using new interface and functionalities are easy or complex for each user. Using feedback from the users improved overall usability score of the system. Applied user’s feedback are;

Press enter key on keyboard instead of clicking on related button such as log in, sign in, next buttons when user is finished typing in input area.

Modal views have ‘x’ button on right top corner to close the modals, when user hovers on this button with pointer, the color and design alters as shown in figure 5.19.

![Close Button](a) x button without focus ![Close Button](b) x button with focus

Figure 5.19: Close Button

On the shop page, if user wants to buy a game for his/herself which is already owned by that user, the warning message appears on picture of the game to inform user as shown in the figure 5.20.

![Warning Message](You owned this item)

Figure 5.20: Inform User

On friends modal, under add friends tab, buttons’ name were changed for the users to better understand the functions of the buttons as shown in figure 5.21.

![Buttons’ Names](Send Invitation)

Figure 5.21: Buttons’ Names
5.3. Usability Test

Visual response is implemented while the user is waiting for the server to respond as shown in figure 5.22b. Also visual feedback implemented in order to confirm right or wrong user behaviour as shown in figure 5.22a.

(a) User behaviour related visual feedback

(b) Server Response Related Visual Feedback

Figure 5.22: Visual Feedback

5.3 Usability Test

Under this section, usability test results are explained with four sub-headings;

Effectiveness

In the following figure 5.23, effectiveness is shown by using successfully completed scenarios. During usability test, each user tried to complete given scenarios and results are recorded as succeed or fail for each scenario. The graph below shows succeeding users’ percentage per scenario.

Figure 5.23: Successful Completion Rate Graph
5.3. Usability Test

**Time Based Efficiency**

During usability test, time was recorded for each user by the test leader while they were performing the given scenarios. Also, same process was applied to the expert in order to compare the time spent by users with the time spent by expert. In the following figure 5.24, average time spent by users and expert for each scenario can be compared.

![Time Spent Graph](image)

Figure 5.24: Time Spent Graph
5.3. Usability Test

In the following figure 5.25, time based efficiency is shown by using time spent for each scenario. Time spent by users is used to find time based efficiency according to the equation 3.2 in the Theory chapter under the Time Based Efficiency title. The result of this equation is number of tasks that user can successfully complete for per minute. In order to compare user efficiency for each scenario, expert efficiency is also added to the graph. Expert efficiency shows expected efficiency for the system. Additionally, there are various time differences between scenarios, so time based efficiency graphs for scenarios are shown in three different ranges for better comparison and understanding.

(a) Time Based Efficiency Graph - Range 1
(b) Time Based Efficiency Graph - Range 2
(c) Time Based Efficiency Graph - Range 3

Figure 5.25: Time Based Efficiency Graphs
5.3. Usability Test

Test Level Satisfaction

In the following figure, test level satisfaction is shown by using System Usability Scale survey which was filled by users at end of usability test. The graph shows test level satisfaction for each user and average test level satisfaction is 94.5%.

Observation and Think Aloud Protocol

Key notes from observation and think aloud protocol with respect to effectiveness, efficiency and satisfaction results;

• Users were able to navigate quickly and successfully since the design and functions are similar to commonly used popular websites.
  - Navigation bar was clear enough so users could see listed options for them.
  - Notifications were easy to locate and understand.
  - Settings and log out links were easy to find since they were under username.

• Users took different paths to accomplish the given scenarios. The first scenario ‘Play the Marathon game.’ can be accomplished in two ways; user can click on play button and login/register modal will open so that the user can register to the game portal or user can first register to the game portal and then click on play button. The seventh scenario ‘Buy one of the games as gift for one of your friend via game portal’ can also be accomplished in two ways; user can use home page to find the game that he/she wants to buy from ‘buy to play’ list or user can click on shop link on navigation bar to find the game.
  - For the first scenario, some users first registered to the game portal and then click on play. Some users first clicked on play button and after login/register modal opened automatically, they registered to the game portal.
  - For seventh scenario, some users first clicked on shop link on navigation bar to search for a game. Some users stayed on home page and search for a game from ‘buy to play’ list.
• Modal views worked as intended for modal view related tasks. When modal view popped up on screen;
  – User was quickly focused on modal view and started to perform the given task.
  – This feature prevented unnecessary screen scanning by the user.

• Repetitive user-studies’ feedback provided comprehensible design and functions;
  – User-study guided button names helped users to better understand functionalities of buttons for adding friend task.
  – Visual feedback helped users to better understand server’s response or confirm right or wrong user behaviour.
6 Discussion

This chapter contains the following sub-headings to discuss the results emerging from this study, the advantages and disadvantages of the chosen method and the work done in a wider context.

6.1 Results

This section discusses the results of this thesis.

Pre-Study

The results of the pre-study yielded many different possible design principles, patterns and schemes to create usable game portal. These possible solutions are helpful to design a website that users are familiar with.

Iterative Development

The user interface was designed to be non-complex and to have a well-structured navigation which was aimed to help the user hover through the pages with ease and find the information they are seeking for. Another design property in this process was making the notifications easily perceived by the user and handling simple tasks without page reloading with modal views. Simply, a modal view is a scripted effect that allows the developer to overlay a small element over a web page. The primary benefit of modal view is to avoid the need to use of conventional window pop-ups or page reloads. In short terms, modal views are meant to quickly show information to users on the same page that users are working on, thus improving the usability of the system and decreasing unnecessary page reloads.

Usability Test

During usability test, it was observed by test leader that users were familiar with implemented design and functions since competitive analysis was used. It can be seen that competitive analysis has a big impact on usability by the scores of effectiveness, efficiency and satisfaction of the system. Under effectiveness section of result chapter, we can observe
that all the users have successfully completed the given scenarios. This result represents that effectiveness of the system is 100%. Users could accomplish given scenarios successfully since they were familiar with the design and functions. Under time based efficiency section of result chapter, users’ efficiency is compared with expert’s efficiency (expert’s efficiency is expected efficiency from all users since expert is the developer of the system) in order to measure overall efficiency of the system. It can be observed from three different graphs that first time users’ time based efficiency is close to expert time based efficiency. Users could accomplish given scenarios in short time compared to expert because they were familiar with the design and with the help of modal view, users attention was gathered to one point on the web page. So users have not spend extra time to find the information that they were looking for. Under test level satisfaction section of result chapter, it can be observed that average user satisfaction of the system is higher then 85% which is called ‘excellent’ on Mean System Usability Scale [5] and this shows that users are satisfied with the current design and functionality of the system. The user satisfaction results were very good because repetitive user-study shaped the design and functions of the system according to the user needs and competitive analysis provided familiar design and functions for users. Additionally, some of the given scenarios could be done by choosing different paths which users also done so. It was observed that frequent e-commerce website users and users who are familiar with account-requiring websites were choosing different ways to finish a task.

6.2 Method

This section discusses the method used in the thesis. Advantages, disadvantages, what could be done differently or could be improved are addressed exclusively.

Project Management

Working with agile methodology provided quick adaptation to changing requirements of the design criteria[30]. Since the stakeholders were involved in the process, it helped preventing making inefficient decisions in early stages and making sure the context of the system is within the context of client’s requirements. Also, using Trello to keep track of the project’s backlog worked very well in conjunction with the weekly meetings. This is because it was easy to show what progress had been made from week to week and what should be done next with lists and cards. As it is mentioned on theory chapter, agile methods are subsets of iterative methods. In this study, instead of iterative methods, incremental methods could be used for development of the system which can be less time consuming.

Pre-Study

With help of competitive analysis, it is possible to find design principles, patterns and schemes are repeatedly represented in the concept which can be considered as innovative solutions. So, requirements for design criteria were well constructed by using competitive analysis[4].

Iterative Development

Using short iteration which is a part of agile methodology prevented inefficient design choices by meeting with stakeholders and doing repetitive user-studies between each iteration. Repetitive user-study was applied to design process for testing new iterations during iterative development. Involving small user groups at the end of every iteration helped the developer to understand how users use and react to new designs and functions. Using think-aloud protocol to gather users feedback allowed the developer to see which path users take
and on which point they get confused. On the other hand, applying repetitive user-study to design process was critical for this project because it is time consuming to find users and get their feedback. However, since this is an academic study and took place at an university, there were many students available which made it easier for testing the system. Repetitive user-study is a part of user-based design process and helps to increase usability of the system. On the other hand, user-centered design process can also be used to increase usability of the system. During user-centered design process, users and developers work together in the same environment while developing a system.

**Usability Test**

In the usability test, task success (with time recorded for each task) is used to measure effectiveness and efficiency of the system. Task success can provide accurate results since it uses a binary system (success = 1, fail = 0) and users can not partially finish a given task. This study focuses on task success as a usability metric, however, learnability could have been used in usability testing to measure user’s progress over time. Using System Usability Scale was really helpful to measure satisfaction of the system since it can quickly and easily gather user’s subjective rating of a product’s satisfaction. SUS was selected since it was a small scale system. It is very easy to use since it has only ten questions and a simple calculation for overall result. Also, taking SUS survey was easy and understandable for users during the usability test for this system. Since Kirakowski says that reliability of SUS is 0.85 over 1 and Wonile and Gavriel provides that optimal sample size for test users to detect 80% usability is $10 \pm 2$, the result of SUS is valid. For measuring test level satisfaction, other surveys can be used with more detailed questionnaires such as Standardized User Experience Percentile Rank Questionnaire (13 questions), Computer System Usability Questionnaire (19 questions), Questionnaire For User Interaction Satisfaction (24 questions) and Software Usability Measurement Inventory (50 questions). As it can be seen, Standardized User Experience Percentile Rank Questionnaire can be used since it has only thirteen questionnaires similar to SUS.

### 6.3 The work in a wider context

An ethical concern that this study may have would be regarding personal integrity since some personal information is stored in the system such as email addresses. This is always done with the user’s knowledge, permission and can only be done if the user supplies the information. Another issue would be the payment information supplied to the payment service. The system does not handle the payment information, all the payment information is handled by Stripe which the users have to trust with their sensitive information. This reduces the responsibility on the developer’s side regarding the handling this information.
The purpose of this thesis was to develop and design a usable web site for motion-based games which is called a Game Portal. This purpose has been fulfilled by using agile methodology, competitive analysis and repetitive user-study as represented on the results chapter.

Regarding the research question, how to design and implement a web game portal for motion-based games to achieve high usability, possible solutions would be; a clear and understandable navigation bar makes it easier for the user to navigate and to get an overview of the website. The developer suggests the navigation bar should always be placed at the top, visible at all times. It should include the links that are used very often and are important. Also, the navigation bar should be interactive by highlighting the hovered and clicked link for the user. Notifications should be easily perceived and understandable by the users. The developer suggests that the notifications should be fixed on the right side of the navigation bar, such as friend related notifications. Username is a personal variable on the website and listing user related functions such as settings and log out under username can help the user easily find these functions. The developer suggests that username should be fixed on the right side of the navigation bar, so users will instinctively click on username to find such functions. Modal view will help the user to find the information they are seeking by gathering user's attention to one point and prevent page reloading. The developer suggests that modal views should be used to show the information quickly to the users on the same page they are working on in order to improve the usability and decrease unnecessary page reloads. While changing the password or sending a friend request, visual feedback from the website is very important to inform the user about the result of their action. Therefore, implementing visual feedback functions to the website is helpful to confirm right or wrong user behaviour. In addition, the layout, size and colour through all pages of the website should be implemented in the same theme for a consistent website with a clear and attractive design.

In general, using repetitive user-study and agile methodology together improved overall usability score of the system since users' feedback was involved in designing and adding new functions to the system. Additionally, using competitive analysis helped to create well constructed design criteria which are proven to be usable by users. Finally, using task success
and system usability scale provided understandable and accurate usability score of overall system.

7.1 Future Work

Designed and implemented web site is the first version of the Game Portal with basic user interface and functions. In further versions of the Game Portal, more complex user interfaces and functions will be added to make the system more comprehensive and inclusive. These further additions may cause the overall system to be more complex, thus making it less usable. Any future study can be done to investigate how to improve the system while maintaining the usability. Furthermore, the study can be extended to investigate what other usability metrics can be used to measure usability.
Bibliography


[33] *Web Server*. URL: [http://whatis.techtarget.com/definition/Web-server](http://whatis.techtarget.com/definition/Web-server)

In this appendix, design criteria are listed which are decided after meeting with stakeholders and competitive analysis:

- Navigation bar on top of home page with home, shop, support, company, register and log in links
- List free and paid games on home page
- List only paid games and item on shop page
- Play button for free games
- Buy button for paid games
- Log in modal for existing users
- Register modal for users who does not have account
- Require log in to user’s account before play or buy game
- Add user games, shopping cart, friends and user name links to navigation bar after log in to your account
- Friends modal for accessing friends list, add friends and friend request functionalities
- Under user name link, access settings, gift and log out links
- Settings modal for editing profile avatar, name and surname, e-mail address and password
- Gifts modal for accessing pending gifts
- Buy for myself and as a gift buttons on visited game page
- Select friends or send by e-mail modal for sending as a gift to user’s friend/s
- List items that user selected to buy on shopping cart page
• Continue shopping link to redirect to shop page on shopping cart page
• Remove button/link for each item in order to delete it from list on shopping cart page
• Check box for agreeing term and conditions before proceed to checkout
• Checkout button for proceeding to payment
• Stripe modal for entering related e-mail and credit card information for payment
• Link for accessing bought game/s on shopping cart page
• Navigation/footer bar on bottom of home page with Games, FAQ, About, Privacy and Terms links
• Design notification for friend request and pending gifts on right of navigation bar like Facebook
• Design profile editing layer by layer for each profile item like Facebook
• Design accessing settings and log out link on right of navigation bar under username like Google My Account
• Design navigation bar, size of text and color of Play button like Good Games
• Design buy option, color of buy buttons and presentation of games like Steam Powered
• Use modal view for basic function to attract user attention like Kizi
Usability Test

Following scenarios and survey are used for usability test of Game Portal

Scenarios for Game Portal

When you start to use GamePortal and follow the scenarios, test leader will apply think-aloud protocol. Please talk about your actions when you are following scenarios. The provided motion-based games are still under development, so when you try to play one of the games, you will end-up with the information page which is expected. After each scenario, please rate difficulty of the task. Also on the GamePortal, you will do online payment and use the following credit card information; Card Number: 4242 4242 4242 4242, Expiration Date: 09/20, CVC: 478.

Follow the scenarios

1. Play the Marathon game.
2. Logout from your account.
3. Play the Story game.
4. You have a notification, find it and take an action?
5. Send friend request to Stoffe. (username: Stoffe or e-mail: stoffe@rng.com)
6. Remove a friend from your friend list.
7. Buy one of the games as gift for one of your friend via GamePortal.
8. Change your profile avatar.
9. You have problem with one of the games and need to solve it, what will you do?
Survey

1. I think that I would like to use this system frequently
   Disagree  Agree
   □  □  □  □  □  □

2. I found the system unnecessarily complex
   Disagree  Agree
   □  □  □  □  □  □

3. I thought the system was easy to use
   Disagree  Agree
   □  □  □  □  □  □

4. I think that I would need the support of a technical person to be able to use this system
   Disagree  Agree
   □  □  □  □  □  □

5. I found that the various functions in this system were well integrated
   Disagree  Agree
   □  □  □  □  □  □

6. I thought that there was too much inconsistency in this system
   Disagree  Agree
   □  □  □  □  □  □

7. I would imaging that most people would learn to use this system very quickly
   Disagree  Agree
   □  □  □  □  □  □

8. I found the system very cumbersome to use
   Disagree  Agree
   □  □  □  □  □  □

9. I felt very confident using the system
   Disagree  Agree
   □  □  □  □  □  □

10. I needed to learn a lot of things before I could get going with this system
    Disagree  Agree
    □  □  □  □  □  □