SEMINAR REPORT

ON

User Experience in Game Development

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2021-2022

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CERTIFICATE

This is to certify that Ms. Vaishnavi Sinha

has satisfactorily completed the seminar on

"User Experience Enhancement using AI in Game Development "

in the partial fulfillment of her term-work(Seminar) as a part of syllabus for T.Y.B.Tech. Computer Engineering for the Academic Year 2021-2022 as prescribed by MKSSS's Cummins College of Engineering for Women, Pune (An Autonomous Institute Affiliated to Savitribai Phule Pune University)

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ACKNOWLEDGEMENT

I would like to extend my sincere gratitude to my seminar guide **Dr. Anjali M. Naik** for her valuable guidance, suggestions, and timely help in the completion of my seminar report. I would also like to thank her for helping and supporting me throughout the completion of the seminar.

I am grateful to **Dr. Supriya Kelkar**, Head of Department, all the staff members of the Computer Engineering Department for their support and encouragement and guidance.

Ms. Vaishnavi Sinha

ABSTRACT

To create new methodologies for evaluating the user experience of video games, two core issues must first be addressed.

Consider how video games are currently developed. How do studios design and assess user experiences? This report will go over the video game development process and the practices that studios are currently employing in order to provide the best possible user experience. We'll look into how AI is used to improve the user experience in game development.

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Chapter 1. Introduction

1.1 Preface

The programming industry is flooded with new and upcoming games and programs, many of which provide functionalities but fail when used in real-time. This could lead to a drop in revenue in the video game development industry. Many video games have recently suffered from technical glitches or a general loss in decent gameplay. This drop in quality can be attributed to hasty game development and game loot box systems. So, how can we expect to improve? Let us see which successful games perform better. In comparison to the majority of failed games, the thriving ones are user friendly and provide users with a stunning experience. As a result, they are giving conventional games a run for their money. The User Experience (UX) connects your users to your products, meeting their needs while also helping you achieve your objectives. The user experience can help you create a useful, comprehensive, and enjoyable product or service. As a result, engagement, conversions, and income will rise. Furthermore, thanks to technologies like 3D scanning and facial recognition, users can effortlessly lock and unlock their games. As the world adjusts to the new internet era, Artificial Intelligence is being used in every field possible to reduce costs and increase productivity. That being said, can it improve the overall user experience in game development, and if so, how?

1.2 UX evaluations and Game Development

From the earliest stages of game creation, testing of user experience in games, as well as the scope of interactive entertainment systems, has been done. The first versions of digital games were created by the creators of early computer programs, developing a very basic form of testing user experience by simply trying to play a game - and wanting to understand why it was not fun in the end. The introduction of video games such as Tetris has shown that small changes in the gameplay of a game or story have a profound effect on the whole user experience. Various methods are used in the industry today to understand the various factors that contribute to the overall gaming experience.

1.3 Introduction to Video-games

At its most basic level, a video game is the implementation of a game in a computer-based console that uses some form of video output. One of the first challenges that game studies faced was creating a formal definition of a video game. Because a game can refer to a multitude of things, the following definition is used:

A game is a rule-based system with a variable and quantifiable outcome, in which the player exerts effort to influence the outcome, the player is emotionally attached to the outcome, and the consequences of the activity are negotiable.

The definition is expanded by specifying that the rules are covered by a story. The key phrase in the preceding definition is "exerts effort." In other words, the video-game user participates actively in the interaction process. Thus, when we talk about the experience of playing video games, we're talking about the interaction between the player and the video game. Our primary focus is not on the development, implementation, or design of the video game. It is also not the user's motivation to play a particular game or the psychological consequences that the user may experience after playing it. The emphasis is on the gaming experience, or the experience of playing video games on a one-to-one basis of interaction between player and game. As time goes on, we'll untangle this concept. To begin, we will discuss the concept of user experience in order to better understand what we mean by experience.

Chapter 2. User Experience

2.1 Introduction to User Experience

The concept of the user experience is understood as the relationship between the user and the application. Beyond the usability of the app, it focuses on the personal result that the user gets by interacting with the program while performing the task. Considering only user information as a personal or independent result is a problem within the realm of scientific knowledge. Scientific knowledge allows us to consolidate our understanding of the world. If we identify the subject being studied as personal, then we will not be able to give a general definition of this phenomenon. For this reason, unlike video games, we do not provide current definitions of in-depth user information. Instead, we will provide a constructive explanation that we use to understand the feeling of playing video games.

2.2 The Concept of User Experience

As we have discussed above, to define and understand the concept of User Feelings as personal or private only seems to be sufficient to provide a scientific approach. In this section, we present the definition of user proficiency which helps to bring the concept of user proficiency to a purposeful understanding. The discussion is based on a variety of assumptions about the user's knowledge, from the use of the dialogue to the various applications within Human Computer Interaction and philosophy.

2.3 Understanding Experience

In our day-to-day life, we often do not need more explanation when we talk about experiences. Experience is defined as the inner state of a person's life. All human activity creates and produces experiences; is part and product. Experience is the result of human interaction with nature. The term to design expe rience is about the user's consideration, function and context in designing a computer program. But since experience is a part of everyday human life, exploring the experience is not as clear cut as the design experience seems. The experience is described as personal and thoughtful, so exploring information is about exploring user-specific information.

Performance testing places emphasis on skipping usage by looking at the relationship between user and employee. Usability is how the app is used to allow the user to perform the task efficiently and effectively; the main focus is on productivity, allowing the user to perform tasks with good quality at the right time. The second principles are user choice and satisfaction. An examination of this relationship between the active user and the context supported by the application. We can explain information about how interactions feel to users; the app affects the mood, where during the interaction process, features such as entertainment, entertainment, fun or beauty.

2.4 The Experience of Playing Video-games

The feeling of playing video games is often understood as a relationship between the user and the video game without the actual use of the game. The launch is tied to the speed of the gaming console microprocessors, the ergonomics of the controls, and the usability of the interface. Experience is more than that, it is also considered a personal relationship. Understanding this relationship as personal is a challenge under the scientific community. Personal information and accurate information do not allow the theory to be generalized or fabricated (Popper 1994). In this chapter, we propose a theory to understand the feeling of playing video games, or play information, which can be used to test and compare different sensations.

This section introduces a comprehensive approach to understanding the game's self-perception under the aforementioned concept. It begins by introducing an overview of video games and user information to familiarize the reader with such ideas. Finally, the purpose and review of the entire chapter are presented.

2.5 How to Test User Experience?

User Experience (UX) still misses a clear definition. As of today, the term user self-awareness can be seen as an umbrella term used to encourage research to focus on intangibles and its commodity prices. The user experience includes the overall (standard) appearance of the user while interacting with the product, or the experience created during a specific product type, e.g., mobile phone. The current definition of ISO in the user experience focuses on personal perceptions and responses that result from the use or expected use of a product, system, or service. From a psychological point of view, these responses are actively produced in the psychological testing process, and it should be decided which concepts best represent the psychological components of the game in order to allow us to measure the user's knowledge features .The user experience in games is tested using different. of ideas that include immersion, fun, presence, engagement, engagement, travel, play, and play - and what makes playing fun, which includes social play. Given that user information is understood as a relationship between the user and the system, it is proposed to allow for a distinction between different independent experiences. Another test method that focuses on experiences and attitudes with video games is the use of semantic contrast. From a field perspective, the tools currently in use enable you to test user information closely linked to the game development stages. The tools used in the gaming industry can be defined in terms of various stages of development. During the conceptual phase, old user-centered development methods such as (paper) prototyping are used to allow for understanding if the game is fun to play or a technical demo is used to allow not only to understand the dynamics of technology but to enable initial experiments. In the pre-production phase, test methods such as heuristics are used; during production, user testing is one of the most effective ways to test user information. Post-launch user information testing is based on reviews and online forums. Based on a set of model lessons, to decipher the various aspects of user experience in games, we must understand that user experience depends on the experience of each player, that different stages during game play will evoke different types of knowledge, and user experience. will be influenced by various aspects of the game including the behavior of non-actors. The testing of the user experience depends not only on the various formats and features that contribute to the general knowledge, but may also greatly influence how the game format interacts with.

2.6 UX Test Methods for Games

Based on the various definitions and concepts used to test the user's in-depth information, the next section will introduce an overview of the currently used methods to test user information during various stages of game development. Game development can be organized by a set of development stages. Many of these categories are applied to standard software development processes; some special stages of game development.
The following sections are used to configure the overview of user experience testing games:

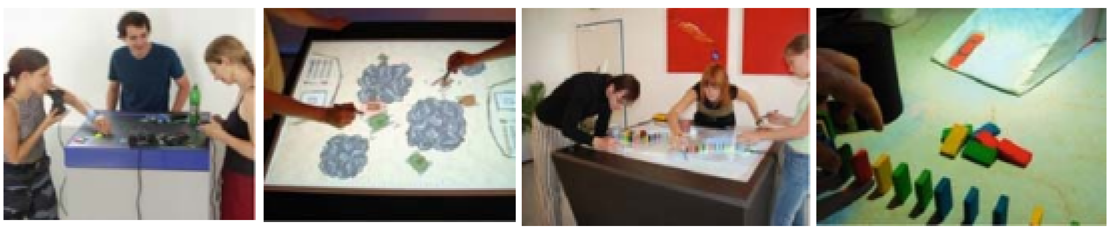
• Concept: This section is dedicated to the first concept of the game and is dedicated to producing the first concept document that describes the game. The development team in this category is usually small (e.g., which includes a designer, producer, artist, and producer).
• Pre-production phase: This phase includes the development of art style guides, production plans, and an initial description of the game design and technical design text.
• Prototype: The goal of this section is the first piece of software that allows you to display key features of the game and allow you to understand the basic concepts related to the game user's general knowledge ("Is the game fun to play?").
• Production: The production phase can range from development in a few weeks to planning years. This category can be customized, following steps such as adding a complete method, cascade method, or "repeat - until you go down".
• Local performance: An important category of games that will be delivered to different markets (countries) is the local performance category. At this stage, the game can be adapted to suit market preferences, to allow for translation and language editing on behalf of the local authorities.
• Alpha stage: This is the stage where the game is played from start to finish, allowing different test modes to be used to better understand aspects such as entertainment, play, and user experience.

• Beta Phase: The main goal during this phase is usually to fix bugs. In terms of the user experience at this stage, many adjustments are needed to develop more detailed user experience. The beta category includes steps such as certification or submission (the software developer of the authorization platform will test the game).
• Gold: At this stage, the game is sent to be made.
• Background production: At this stage, the following versions of the game may be released (including episodes and reviews) and allowed to improve the game user experience.
The goal of testing user experience during the concept phase is to understand whether the game will be fun to play and what kind of feeling the player will have during the game play. During the conceptual phase and other early stages of development such as the production phase and the prototype, the methods and techniques used are:
• Focus groups
• Conversations
• Informal play test
• List of questions
Pre-play (internal) play and analysis of existing play patterns can help to understand user experience in general and especially social play. Methods such as semantic variation and PIFF questionnaire allow for a common understanding of the game user experience. Methods such as the GAP method investigate the user experience of a special user group - an inexperienced player. During the implementation and evaluation phases, the following methods have been used successfully:
• Play tests (including biometrical measurements)
• (Semi-structured) interviews
• Awareness
• Video encoding
• Comparison of player behavioral comparisons
• Questionnaire based on user attitudes, information, etc.
• Heuristic testing (including gaming heuristics, tabletop)

Chapter 3. Using Heuristics to Evaluate the Overall User Experience of Video Games and Advanced Interaction Games

3.1 Introduction

The computer game industry has grown significantly in recent years. The number of units sold has been steadily rising, and video games have shifted from being a product of a few people to a widely used and accepted place. The growing game market also opens the door to a series of research-related activities. In particular the term user sense (UX) has become very important. Researchers want to find out how computer game players react to the game environment, and the industry is interested in finding ways to measure user information and interpret collected data (e.g., finding new target groups). Testing of user experience and user-related development of video games has been discussed in many books Several researchers have developed game testing methods using techniques from the field of usability such as performance testing and beneficial testing. In recent years, a number of documents have been proposed regarding the heuristic testing of video games, all of which cover transverse but varied subject areas with specificity and quality of interpretation. Social and physical interactions are a new frontier in entertainment. Today, countless apps have been created that offer entertainment to most people, but very few support the experience of truly new users. Nintendo's Wii1 controller is an excellent example of a novel interface that allows precise and natural communication that leads to new user experience. This even encouraged non-traditional audiences such as older players to try playing video games. However, people also still love traditional board games, such as Risk or Monopoly, mainly because of the rich social connections. Instead of sitting alone in front of a screen, playing with friends online or having a face-to-face experience, people still enjoy having a face-to-face experience. Most traditional board games are multiplayer games and game sessions are organized as community events. Encountering close social interactions such as laughter, fun, conversations or shouting makes classic board games attractive enough to win against video games, despite the limitations of interaction and complexity. On the other hand, modern comfort games and video games do not have all the basic features that are essential for face-to-face communication. On the other hand, normal board games are limited due to static game media that restricts the use of complex game situations and truly interactive game situations. So, the best result is a good combination of both, video games and regular board games to get new gaming experience. In various locations, digital tablets have been used successfully. For example, interactive tabletop communication has already emerged as an effective tool for integrated collaboration over digital art objects. Related research shows that in the case of shared work, a tabletop device can have much higher performance than a normal desk and promotes a higher level of creativity and interaction among users. Microsoft's Surface2 Table and SmartTable3 Smart are trying to bring digital tabletop applications to the next level by liberating available marketing platforms in the market. In the last few years, tablet installations and games have become very popular. The most recent work in collaborative realms is about virtual and virtual (digital) integration, enabling people to share the same information. Examples of apps are STARS forum, Augmented Coliseum, PlayAnywhere, PlayTogether or MonkeyBridge. Over the past four years, we have developed different tabletop games (see Fig. 3.1), focusing on collaboration strategies. During the development we have found that it is even more important for game designers to find a framework for identifying usability issues in both the original designs and the older prototypes. There is little research on the user performance of tabletop devices, and only a few official user studies are conducted to show the real benefits of tabletop games. Many studies have so far focused on setting the top top in general, and researchers are exploring highly interactive tables at a technical level (e.g. comparing different interaction analogs). In addition to our focus on measuring user information with the heuristics of a wide variety of games, we offer the field options for the smallest and most specific games: tabletop games.



(a) (b) (c) (d)

Figure 3.1 Different tabletop games: (a) NeonRacer4 is a car racing game, (b) PenWars is a drawing-based tank-war game, 5 (c) Comino6 is a domino game that combines real and digital world, and (d) IncreTable7 is a tracking game from Comino and allows one to transform a digital environment using tangible (tangible) objects. [5]

3.2 Overview

There are currently few methods that link the results of heuristic testing methods to user information. Especially in the field of computer games, where self-awareness is the leading factor, different aspects can be assessed using heuristics. Therefore, we first set out the main focus of this chapter in showing the connection between game heuristics and game user information. Next, we provide an overview of previously available heuristics and present a summary of the highest quality heuristics. To evaluate the effectiveness of our heuristics on user experience ratings, we perform heuristic analysis on a few games and compare resulting data with game updates based on user experience. Finally, we carefully consider our approach and provide development and ideas for the future. This discussion of the current interactive games game leads to the introduction of a test set of specific heuristics that works in the user experience of these games. Along with the above game heuristics (focused on game play / game story and virtual interface), we present a complete usable framework to test user experience for games in general or especially advanced interactive games.

3.3 Video Game Definition and Genres

Before discussing heuristics for video games, we want to get a clear understanding of the terminology “video game”. Definition for a video game can be: A video game is a game which we play thanks to an audiovisual apparatus and which can be based on a story.This definition contains four important elements that classify a video game: game, play, audiovisual apparatus and story. The mentioned audiovisual apparatus is not necessarily limited to two senses. Touch-based input and haptic feedback mechanisms allow a broader range of video game devices. We also want to point out the need to clearly distinguish games from productivity applications. Finally, to avoid misunderstandings about the term itself, we consider video games as an umbrella term for all electronic games, independent of their platform (computer, console, arcade, etc.). Still there is need to put games into certain categories to be able to unite titles of similar type. There are many different distinctions available, some more common than others. In 2001 a set of 41 genres were defined, being sometimes too specific (e.g. when defining Diagnostic Cartridges as a genre). A proposal was made to adapt the genre term and certain genre conventions from movies to games, but does not give a clear genre definition itself. A common and well-established genre definition has been created by the NPD group and is mentioned amongst others and used for their market statistics. This classification contains eleven well-known and established (super-) genres such as role-playing game (RPG), action or shooters, and abstains from introducing fine-grained subcategories. The use of theses genres is proposed in order to be able to classify games in accordance with the market/industry for our test in Section 3.7.

3.4 User-Centred Design in Games

A user-focused design is a design philosophy that describes a software development process driven by a template, in which the user is integrated between the design process and development. This approach has several repeated steps: needs analysis, user analysis, prototyping and testing. This method is also used for game building and central theme in Microsoft Game Studios8. It consists of three different developmental stages: thought-provoking, prototyping and play testing. The first phase usually involves complete planning such as goal identification, challenges, rules, controls, mechanics, skill levels, awards and story. These specifications are made by game designers and are written in game design documents. The second phase — prototyping — is used to quickly produce playable content, which can be used effectively to test play and evaluate attributes such as user experience, overall quality (often described as fun), easy use or to balance challenge and speed. In order to compile the results of these variables, a variety of useful methods such as systematic evaluation and repetitive testing and testing can be used. Suggestion for additional testing methods such as prototyping, empirical guideline documents or heuristics. We believe that especially heuristics can be a fast and inexpensive but effective and accurate test of in-depth user experience in games. Before that we will provide a brief introduction to heuristic testing as a professional-based approach. Heuristic testing is one of the ways to test professional-based performance. It is an effective and cost-effective analysis method that should be used repeatedly during the development process, from the beginning of the project design cycle. In general, heuristics can be considered as the sixth law that defines user pay for a particular system. The construction of heuristics affects everywhere rather than the practical guidelines. The heuristics must provide sufficient information to enable the examiner to assess any possible system problems. During a typical user interface testing, three to five experts (in the field of application, usability or both) evaluate the system according to known and established usability principles (i.e. heuristics). Heuristics allows system testing at the earliest stage of the design process (e.g. paper mockups). Although many heuristics are available for testing video games, there is no specific task on how to test user information using the presented heuristics.

3.5 History of Video Games Heuristics

Next, a brief overview of the history of heuristics of video games will be introduced, starting with the first namely the introduction of the concept of using heuristics to test games. Heuristics is mainly focused on educational games, with no image display, acoustic and computer possibilities offered by current video games. Heuristics is divided into challenge, myth and curiosity. Although this method of astrology was introduced in 1980, it was widely accepted in 1994. Since then, these 10 heuristics are the most widely displayed set of heuristics and are often used for a variety of applications. Initially, they were designed for normal communication, however they also (to some extent) apply to a few other areas such as full-blown games or video games. The effectiveness of these heuristics in the video game environment was tested. They were found to be useful and a set of 40 heuristics was developed. For all the best views and easy rendering of one problem in heuristics, they are divided into game interface, game tools and game play. The heuristics published by Federoff seem a bit out of place and sometimes do not include the whole level of facets offered for video games, especially considering the power of modern video games. In addition, they seem to focus on role-playing games and therefore do not apply to all possible game types. In 2004 Desurvire et al. released a new set of certified heuristics, HEP (heuristic testing of playability), based on the heuristics introduced by Federoff. In contrast to Federoff's method, these heuristics are divided into four categories: game story, game play, game design and game usability. Through further testing, these heuristics have proven to be effective. We assume that the heuristics of Desurvire et al. do not consider the significant impact of the challenge on the user experience. However, the division of the heuristics categories of video games into game play, game story, game design and game usability was taken into account when building our framework. Two years later Desurvire et al. design their own heuristics, The adaptability of these heuristics was tested in a ubiquitous game area. It was their basic assumption that no game-related features should be found in the heuristics of game play and game story. In addition, they expected the information to be contained in the game engineering categories and game usability, which were considered to be field-based. For this reason, these heuristics had to be reconsidered. The results of a study linked to their research revealed that heuristics related to game instruments are the same for all types of games. In addition to the ubiquitous game testing, mobile game testing has also become of interest to researchers. In 2006, Nokia released a mobile game testing framework. Their framework is divided into modules containing game heuristics, game usability and mobility. Modules do not need to be tested at the same time, and at least modules related to game play and game usability should be able to be used in other types of games, not just mobile games. Another way to test groupware was published in Pinelle and Gutwin (2007). Develop a Table-Collaboration Usability Analysis (T-CUA) based on Collaboration Usability Analysis (CUA). It is specially designed to test shared groupware and focuses on issues related to group activity. In April 2007, a white paper was released introducing a new version of the video game heuristics version. According to the researcher, the heuristics presented so far were not very clear, difficult to detect, very suitable for postmortem reviews and did not work during the design process. They provide a detailed heuristics set with illustrated examples of each heuristic that makes analysis easy, especially if it can be done by an expert in the field of computer games. Pinelle et al. introduced a set of heuristics based on game reviews in 2008. Through their work, five researchers reviewed 108 game updates on the GameSpot9 website and identified problems found in the last 10 heuristics. This approach provides an opportunity to test game performance without reviewing unnecessary technical issues and entertainment related issues. Based on the heuristics of the concept of universal games, research was developed that investigates the specific features and problems of ubiquitous games. Jegers criticizes former researchers Röcker and Haar as focusing too much on Smart Home technology and experimenting with too much speculation. Therefore, the Jegers developed a full game and performed repeated tests using different methods. When comparing his findings with Desurvire's HEP with traditional usage issues, he found that there were a few problems that could be incorporated into the principles outlined above. Therefore, he suggests further methodological research in this area.

3.6 Video Games User Experience

In recent years, the term "user experience" has become an issue in the HCI-focused community. According to Hassenzahl and Tratinsky (2006), this is a very important job response and work-related paradigm. However, this is not a completely new concept. American philosopher and psychologist John Dewey described the experience as “not just an emotional one; they are elements of circumstances themselves, which include natural phenomena, human affairs, emotions, etc. since 1934. However, a clear definition and basic understanding of the term is yet to be found. According to Act et al., A major problem is that user information handles non-essential aspects of interactions between people and machines. This means that user self-awareness is very focused on touch and hearing - two ideas that are very focused. It covers areas ranging from traditional use to aesthetic, hedonic, tactile or experimental aspects of technology use. Hassenzahl and the Law, leading researchers in the field of user information, describe it as "a temporary feeling, primarily of (bad) testing while interacting with a product or service". Therefore, the user experience creates pleasure and enjoyment instead of designing no pain. Therefore, the community has recently taken steps to better understand the meaning of the user experience and to find a cohesive definition through various forums, workshops, forums and more. In particular, the MAUSE COST Action 29410 aims to find the definition and measurement of in-depth user information. According to the literature, user experience in games can be measured using the following methods of quality and value: body measurements; specialist testing (heuristics, etc.); subjective, reporting measures; and usability testing. Key elements of the user experience are the flow and immersion that defines the level of pleasure and enjoyment. Multi-flow status measurement is one of the major topics of in-depth user experience in games and many see it as a complete self-indulgence when playing games. The concept of flow is very close to the concept of user experience and defines flow as "a positive experience resulting from a perfect balance of challenges and skills in a goal-oriented environment". The concept of flow was first introduced by Csikszentmihalyi (1975) and was developed to suit video games and entertaining players in Cowley et al. (2008), Sweetser and Wyeth (2005). Although Cowley et al. introduces a game map display flow, Sweetser and Wyeth try to combine heuristics into a model to help design and test fun in games. They found that there was some discrepancy in the investigated heuristics and flow concept. Based on this, Jegers has introduced a full-fledged game flow model that enhances the concept of game flow from Sweetser and Wyeth, with features specific to full-fledged game. Another concept that is strongly linked to user experience is immersion. One definition of immersion and your categories are suggested in Brown and Cairns (2004). With a little built-in conversation with seven gamers, they were able to divide immersion into three categories: engagement, concentration and total immersion. Marriage is the first phase of immersion. According to Brown and Cairns, the players must have enjoyed the game to reach this point. If the user continues to play the game after the engagement phase, you will access the login. When immersed in a game, the player's emotions are directly affected by the game. Complete immersion is the most immersive user can experience. You will be fully involved in the game and you will get a full presence, where only the game and emotions are generated by the game. In the follow-up work, Cheng and Cairns have continued to investigate various stages of immersion. They tested a game with changing graphics and behavior on 14 different users. In this experiment, Cheng and Cairns found that when a user is immersed in a game, he or she will be able to manage usage issues and not notice changes in game behavior. Our work is influenced by the first approach described in Sweetser and Wyeth (2005) to integrate heuristics into the game design process and in particular to apply it to user experience testing. Sweetser and Wyeth achieved this by combining the well-known heuristic eight-step flow as proposed by Csikszentmihalyi. However, we will not attempt to measure user information on the flow of the feature, especially as the GameFlow method has been criticized by Cowley et al. (2008) point out that by mapping important leases, if not the basic issues are missing and they question the need for social media as a key. Instead, we will provide a set of independent heuristics in the flow and will determine the usability and user experience of the tested games. A full overview of the plan will be provided in Section 3.7.

3.7 Overview and Review of existing video game Heuristics and their impact on user information

As introduced in Section 3.4 and discussed in more detail in Section 3.5, heuristics can be an important tool in video game design. In this section, we seek to introduce a modular framework based on previous literature and presented in Koeffel (2007). The framework consists of game sections / game story, visual interface, and device- and app-specific heuristics. A review of the existing literature as presented in Section 13.4 has shown that classifying heuristics into different categories seems to be very effective. In particular, as the classification allows for better expert reading and therefore more clarity during the review. Game category / game story contains heuristics about these topics. In the section on visual interface, the heuristics related to the visual interface shown and not the physical interface the player participates in. Device and application-specific heuristics must represent a replacement component that can be replaced by special-specific heuristics, such as tabletop games (see Section 3.6) or mobile games. Therefore, the heuristics dealing with the play / game story and the virtual interface usually apply to video games as set out in Table 3.1. For use with other devices (i.e., input devices, setup, etc.), a third party (device and specific application) has been created. Therefore, all the possibilities offered by those games can be covered. Next, the heuristics of the game / game story categories and the visual interaction of the framework will be listed. As an example of the modularity of the framework, the heuristics related to the special architecture of tabletop games will be presented in Section 3.6.

Heuristics related to game play / game story and visual interface:

Game / Game Story:

1. The player must be given "clear goals" in advance or be able to create his own goals and "be able to understand and recognize them". There can be “many goals in each level” so that there are more winning strategies. In addition, the player must know how to reach the goal without being caught.
2. The player must receive reasonable rewards. “Acquiring skills” can also be rewarding.
3. The player must “feel like he is in control”. That includes "character control" and "impact on the game world". "Regulation should allow the right managers to challenge." "The changes that a player is making in the world must continue and be visible." In addition, the player must be able to “respond to threats and opportunities”.
4. "The challenge, strategy and speed should be equality." "The challenges must be the positive aspects of the game."
5. “The first experience is inspiring”.
6. “A meaningful game story should support the game” and “be found as part of the game”.
7. “The game does not stop” and the player feels the progress.
8. The game must be compatible and "respond to user action in a predicted way". This includes

"agreement between game items and major settings and story". The story should “stop believing” and be taken as one view, i.e. the story should be edited to the end.

9. "It must be clear what is going on in the game, the player must understand the conditions of failure and be given a place to make mistakes".

10. “There must be flexible levels of difficulty” for “great challenge”. The game should be “easy to read, but difficult to understand”.

11. The game and the result should be considered appropriate.

12. The game itself should be played again and the player should enjoy playing it. However, "challenging tasks do not have to be completed more than once". The challenge should create a desire to play more. This includes the possibility of skipping non-playable content over and over again if it is not needed in a game play.

13. "Performance intelligence should be balanced", "visible to the player, in line with player expectations" and "yet unpredictable".

14. The game should be “quick to put pressure on but not frustrate the player”.

15. “Learning curve should be short”. "User expectations should be met", and the player should "have enough information to get started soon". Tutorials and adjustable levels should be able to engage the player quickly and be provided on request throughout the game.

16. “The game takes the player emotionally to the level of personal involvement (e.g., shock, threat, excitement, reward and punishment)”.

17. “A game should not require a player to perform boring tasks”.

18. “Game mechanics should feel natural and have the right weight and energy.” In addition, they should fit the situation the user is facing.

Visible connector:

1. "The player must be able to identify game features such as avatars, enemies, obstacles, superpowers, threats or opportunities." Things "should stand out, even for players who are visually impaired or visually impaired and should not be easily interpreted". In addition, things "should look like they are".

2. “Acoustic and visual effects should arouse interest” and provide a meaningful response in a timely manner. Therefore, the results should provide feedback to create a challenging and enjoyable interaction and engage the player by creating emotions. Feedback should be provided immediately in user action.

3. Visual connector should be “consistent with control, color, typing and conversational structure” (e.g., large text blocks should be avoided, with no abbreviations) and “not disturbing as much as possible”.

4. The player should not “calculate resources such as letters, health”, points, points and letters. This “relevant information should be displayed and important information should be highlighted”. Non-essential information should be left out. The user must be provided with sufficient information to identify his or her status and make appropriate decisions. Extra little user control should be avoided.

5. The menu should be “accurate and the definitions clear” and “seen as part of the game”.

6. "The player must know where you are on the small map if any and should not memorize the level design".

7. The player "must be able to save games in different regions" (applies to non-arcade games) and be able to "close and open the game easily".

8. "The player's first action is obvious and should result in a positive positive response".

9. Input methods should be easy to control and have the right level of sensitivity and response. Input methods should allow customization to bother maps.
10. Visual representation (i.e., ideas) should allow the user to have a clear, uncluttered view of the place and all visual information related to the location.
11. The game should allow the right level of action to be desired in terms of different features.

3.8 Heuristics Video Game

In Section 3.5, the existing heuristics of video games are condensed and criticized. As mentioned earlier, our video game heuristics are based on books and are based on the work and research of Nielsen and Molich (1990), Federoff (2002), Desurvire et al. (2004), Sweetser and Wyeth (2005), Koivisto and Korhonen (2006).), Röcker and Haar (2006), Schaffer (2007) and Pinelle et al. (2008). So these heuristics are derived from the usability field. A large part of the heuristics presented in Section 3.5 is also part of the approach introduced in Sweetser and Wyeth (2005). However, it is their main goal to establish a way to measure the flow of the game that we offer to the player. In addition, they set the usability equal to user experience, which proved to be a different concept (see Section 3.5). In addition, they only use their heuristics in the realm of real-time strategy games, while we want to produce a set of heuristics that work on a wide variety of games. The previously introduced heuristics focuses not only on usability but also on play, entertainment and entertainment – features close to user experience. In their work, Pinelle et al. focus only on usability issues. With their selection process based on game design reviews, they have removed all aspects related to entertainment, entertainment and technical issues. As our goal is to test user experience and game usability, we have not only decided to support our heuristics in the above-mentioned books, but also to include the usability issues identified by Pinelle et al. We therefore want to create a complete set of heuristics that not only focuses on user information or usability. In addition, we want to focus on all the features offered by video games, especially since the problems that occur affect user experience, and the quality of the game cannot be determined solely by usability. In their conclusion, Pinelle et al. even recommending the inclusion of heuristics based on user experience. In addition, they rely solely on their heuristics for reviews of the GameSpot.com website. We believe that while GameSpot is one of the largest and most comprehensive video game review sites, it is not recommended to rely solely on its reviews. The site has been heavily criticized in November 2007 for allegedly firing a reviewer due to negative reviews of GameSpot's sponsored game sponsor.11 Reliance on multiple sources can help reduce potentially biased updates. Table 3.1 contains final heuristics related to game play / game story and visual interface. These heuristics are selected based on the quality review of the sources referred to in Section 3.5. As mentioned earlier, the 29 heuristics presented in Table 3.1 are the result of extensive literature reviews of several different heuristics sets in the field of video games. In addition, the knowledge of the authors in the video game environment has influenced the choice of heuristics. For reasons of necessity and simplicity, reduced book-based heuristics are reduced to 29 statements as shown in Table 3.1. In addition, the most important features of video games are reflected in these heuristics. In particular, through literature reviews it has become clear that certain aspects such as the reading phase, intellectual load or logical practical wisdom have been addressed in a number of sources. Therefore, they have been summarized into one heuristic and given the right level of importance. Additionally, we have tried to keep the number of heuristics short, to allow for effective game reviews. From the initial intelligence to the present, heuristics has been continuously expanded to cover all the required areas, resulting in our final set of 29 heuristics. We think it is necessary to investigate the usability and user experience of a video game in order to determine its overall quality. As mentioned earlier, heuristics has already been employed in Sweetser and Wyeth (2005) to determine the flow of games. But contrary to our approach presented here, they base their results on the idea of flow. They took eight aspects of the Csikszentmihalyi flow concept and mapped them to computer games, building the GameFlow path to flow. As described in Section 13.5, this approach has been criticized among others by Cowley et al. (2008). By applying the method described in this chapter, we are able to overcome the weaknesses described as possible to lose basic information. First, we do not apply any type of map to the concept of flow. The 29 heuristics as presented in Table 3.1 represent a summary of existing heuristics, with no direct link or modification to flow theory. Second, the ambiguities mentioned above in social media are not treated in heuristics. In addition, they are not part of the device- and part of the framework of the framework presented above. In particular, as games on different devices offer different types of social media, this area has been moved to a different part of our framework as shown in Section 3.10. The work presented in this section leads us to the conclusion that it is possible to obtain computer game user information through heuristic testing. Our assumption that the game is fun to play should to a large extent be free of practical issues that prevent the user from enjoying the game. In particular, the heuristics focused on the game / game story sees fit not only in classic usability issues (non-response, etc.), but also in issues related to game entertainment and entertainment (challenge, fairness, etc.). In order to quantify user information using heuristics, we have established a way to validate this concept (see next section). Our method states that all user experience of video games can be determined by performing expert-based evaluations of the game in question, using the heuristics shown above. When heuristics are met, the higher the user experience, the more heuristics points to game errors, the worse the user experience.

3.9 The Heuristic Approach to User Experience

To prove our point that a heuristic-based expert evaluation of the game can be used to determine the in-depth information about the user, the performance of the test is determined. Larsen states in his work that general game reviews are largely based on a direct assessment of the game user experience from the point of view of the game reviewer (Larsen 2008). Game reviewers have been testing the knowledge of game users anonymously for almost two decades. Following this concept, a number of computer games have been evaluated using our 29 heuristics and comparisons of results and reviews of a standard game. Therefore, heuristics can be compared - primarily designed to detect usability issues - with game updates based on user information. In order to be able to make a quantity statement, try to find the link between the number of problems found in the heuristic test and the number of scores found in a few

game updates. Our testing process was designed as a heuristic test of video games. To get the best results, two researchers did the research. They both had experience in computer games and usability, one was a gaming expert with gaming experience and the other was the opposite. To avoid gender confusion, a female and a male researcher were selected. Since play habits and preferences may influence the outcome, testers are selected by different play habits and backgrounds. One inspector can be considered a person who often plays games of different kinds. The second tester represented a typical playground with knowledge of the different types (among them the main games). To test it, the games were selected from a few different genres to avoid bias in the same genre, as is the case with some of our review activities. In addition, the selected games should have been the most up-to-date in order to make the most of the available technical opportunities. To allow for a reliable comparison of our test results with a large number of reviews, five popular games were selected.
Therefore, the following games are selected:
• Shooter: Team Fortress 212 (Valve Software)
• Role play: Sacred 213 (Ascaron)
• Self-sacrifice: Sam and Max, First Season, Ep. 5: Reality 2,014 (Telltale Games)
• Racing: Racedriver GRID15 (Codemasters)
• Real-Time Strategy: The Siedler: Aufbruch der Kulturen16 (Funatics)

The five types mentioned above are selected based on their popularity in terms of commercial video game categories (ESA 2008). "Family games", although one of the top five, have been deliberately omitted, as games of this type tend to rely on a large number of people playing simultaneously (e.g., Wii party games), and our heuristics are primarily developed. traditional one-player video games. However, it has been decided to include one multiplayer game (Team Fortress 2) to prove the effectiveness of our heuristics with this type of game. Due to the lack of textbooks for the proper execution of heuristic video games, our testing process was described in terms of the literature available for heuristic testing, by adapting and paying for video games. Each inspector received a list of relevant heuristics as well as an evaluation report of the identified usability issues. Prior to the analysis, the reviewers met and pre-evaluated the heuristics to familiarize themselves with them and to avoid misunderstandings. Both reviewers tested each game by playing one-player campaigns or online matches with Team Fortress 2. Problems encountered while playing were noted in the test report. After playing the game, the experts reviewed the game and their knowledge gained according to heuristics. In game analysis, two different scales were used: the Nielsen density scale and the rating point scale (enabling better comparisons with the game review site).

Table 3.a Test results are calculated according to the problems identified, the scores obtained and compared with the results of Metacritic.com[3]

Rank	Ranking according to found issues	Ranking according to points	Metacritic.com ranking
1	Team Fortress 2 (18)	Team Fortress 2 (82.9%)	Team Fortress 2 (92%)
2	Sam and Max, GRID (22)	Die Siedler (79.65%)	GRID (87%)
3		GRID (77.93%)	Sam and Max (82%)
4	Die Siedler (26)	Sam and Max (77.7%)	Die Siedler (80.6%)
5	Sacred 2 (29)	Sacred 2 (75.17%)	Sacred 2 (78%)

First, the researchers reviewed each game after the game, using heuristics to classify the problems found in the intensity of Nielsen and Mack (Nielsen and Mack 1994), which led to the total number of practical problems found in each game as shown in Table 3. .a:
0. It is not a usable problem at all.
1. Cosmetic problem only: It does not have a profound effect on the game.
2. Small problem: It has little effect on the game and affects a little experience.
3. Big problem: This problem has a serious impact on the game and has a negative impact on user experience.
4. Interoperability crisis: This problem should be fixed to allow decent user information.

Second, the testers gave a score of 1 to 5 (1 worst, 5 best) in each heuristic one to determine how well the game performed each of them. At this rate, the measurement of the severity of the problems experienced was used as an indicator of the degree of fulfillment. In general, the problems and their robustness, obtained during the measurement at the above-mentioned scale, helped determine which heuristics were less dissatisfied. After the planning of the heuristics, the inspectors met again and discussed possible inconsistencies in their assessment. These issues were resolved through negotiations, and where necessary the assessment and / or standard was changed. The total point of the points obtained by summarizing the estimates by a single inspector and the median level calculation. The school is then converted to a percentage rating indicating how much the game complies with the heuristics (100% will mean achieving higher points). The resulting level is shown in Table 3.a. To compare test results based on heuristic expertise, they chose to select at least 10 game updates (on average 20) for each game to avoid bias from individual reviewers and ensure a meaningful rating. Metacritic.com fulfills exactly these requirements by collecting points from various review sites and calculating the weighted average. Their scores range from 0 to 100 so they can be seen as the most common percentage rate among site reviews. Unfortunately, Metacritic.com did not have a rating of "Die Siedler: Aufbruch der Kulturen". Therefore, they collected 13 different review points in a few review pages for our study and calculated the average rating. The resulting level of our research can be seen in Table 3.a. Indicates that the sequence of games tested according to the process described above is similar to the sequence found on

Metacritic.com. This trend indicates a link between heuristic testing and user information (which is the main focus of the review from Metacritic). In particular, the rate in terms of usability issues detected during testing appears to be consistent with results based on user information from Metacritic.com. In relation to the results from Metacritic.com, we can say that if the usability issues are detected too much during the heuristic test, the user experience becomes worse. The fact that the rating is as high as the rating according to Metacritic.com may be due to the fact that our heuristics focuses on usability issues that may not be detected during game reviews or that may not be surprisingly accurate. . On the other hand, we also acknowledge that the 2-hour test period per game was probably not long enough to achieve complete immersion. Therefore, certain effects as described in Cheng and Cairns (2005) such as problems with ease of use when completely immersed did not occur. However, in order to further prove this concept a more comprehensive test (with more games from different genres and longer) is suggested. This may also lead to the exact number of heuristics to be completed in order to provide detailed information about the user. To integrate research into both video game and tabletop applications and to complete the framework as presented in this section, Koeffel and Haller presented 10 heuristic to develop tabletop games, which will be described in more detail in the next section. .

3.10 Heuristics Framework for Testing User Experience of Tabletop Games

Although the heuristics presented in Section 3.7 is well suited to most video games such as the standard PC platform or console games, it does not have the features of the tabletop. According to Jegers (2008), full-blown games differ in many ways from traditional computer games. This principle also applies to tabletop games, especially as it incorporates new social and physical sensations as described in Section 3.1. Therefore, within this section a set of specific device heuristics will be introduced, covering social issues as presented in Jegers (2008), Sweetser and Wyeth (2005) and specific issues that arise when interacting with a tabletop game. This section completes the above-mentioned framework (see Section 3.7) for specific features in the table, some of which may appear similar to other heuristics in the framework at the outset. However, 10 selected heuristics are designed for tabletop games and can have a significant impact on that and the usability of such a game. To emphasize this point, these heuristics are deliberately placed in the corresponding part of the frame device. In order to achieve the most complete set of rules as possible, a duplicate method based on existing tabletop-related function is selected. Our approach, first described in Koeffel (2007), began by creating the first set of 12 heuristics, based on existing literature work and research experiments in the field of application. After further research, these heuristics were tested for weaknesses, refined and defined by specific words. The second repetition focused on understanding and tried to better complement the original concept of heuristics such as the "six rules". An additional response from experts initiated the creation of a third duplication of heuristics. These 11 rules are now used to conduct heuristic tests. Six different games were tested. Twelve participants (3 practical experts, 3 double experts, 3 game specialists and 3 moderately experienced users) were given 11 heuristics from the third set and instructed to play each game. They were asked to identify

the problems and give them the same heuristic afterwards. The results and findings of this study led to the final version of the proposed heuristics of tabletop games. This final set of tabletop-specific heuristics appeared in the third set after the heuristic test was performed. It has seen the inclusion of sub-categories in order to improve the assistance of aid inspectors by clarifying potential abuses. The following shows the last heuristics we have achieved: A full description of all 10 heuristics (shown with pictures depicting current events) can be found in Koeffel (2007).
Tabletop specific game heuristics:
1. Mental performance: The offline mental load in game play (i.e., related to acquisition of skills, viewing, screen layout and input methods) should be reduced.
2. Challenge: The plan should be designed in such a way that the challenge satisfies the conditions of the tablet setup and the target group.
3. Access: Player access must be commensurate with the game's game requirements.
4. Simulation: Players should not be prevented from exploring the area required by the game.
5. Adaptability: The system must be flexible to the player according to the set.
6. Collaboration: The collaborative approach should satisfy the player's expectations and follow the thinking of the game.
7. Default level: The player must be able to perform all game-related actions alone.
8. Collaboration and communication: Interpersonal communication and collaboration should be supported throughout the game (such as game play and setup).
9. Feedback: Feedback and information should be relevant to tabletop game opportunities, fully utilized and provided to players when appropriate.
10. Portable setup comfort: Setup settings (including display) should be comfortable to use and not require the player to take the wrong position.
Our application-based heuristics to determine the user experience of video games can be converted into tabletop games. As presented above, heuristics related to specific tabletop gaming features focus on specific attributes and conditions that tabletop games can offer. In particular, social features and issues connected to physical settings such as luxury are factors that profoundly affect user experience when playing tabletop games. We therefore consider 10 heuristics as presented above and the rest of the framework (see Section 3.7) as appropriate to test the user experience of modern tablet games. In order to establish a good combination between the three areas of the framework, additional studies should be conducted. The inclusion of all potential issues by heuristics should be verified. Since there are no possible ways to compare results with fixed reviews, such as game updates, reference values should be obtained through investigated methods to differentiate game user experience, such as physical ratings.

3.11 Summary and Future Challenges

This chapter introduces an opportunity to test the comprehensive user experience of classic video games and interactive enhancement games using heuristic testing. The term user self-awareness has significantly gained prominence in the HCI community and although the established definition does not exist, research strives to apply it in modern interaction testing.

The user experience experienced while playing a computer game has been one of the main issues in most recent publications. Although it is a straightforward theory, researchers want to test it accurately and to explain it well (Phillips 2006). Current opportunities include mainly self-assessment methods but also specific methods such as physical performance measurement are used. A growing area of importance, not only in the field of video games, but also in the field of advanced communication, heuristics-based experiments. Therefore, we have analyzed and reviewed the most common heuristics of video games and interactive games and built a framework for our findings. This framework consists of the following three components: game / game story, virtual interface and device- and certain operating system features. We have demonstrated the use of device- and app-specific heuristics with a set of heuristics designed for use of tabletop games. We used the video game related component of our framework to conduct expert-based evaluation of five different video games to determine weaknesses and issues. We then try to prove that heuristics can be used to measure the level of comprehensive user information by comparing the results of our research with the latest reviews from several different gaming sites. Since these reviews focus on defining how the game user experience is perceived by the appropriate author, we view it as an official description of the game user experience. We acknowledge, however, that we use a lot of points from the reviews and not the quality data that represents the actual content of the review. Such a point cannot represent a fully written review and is therefore less accurate. However, using a review score allows us to come to the conclusion that the user experience of the game is much worse if it clings slightly to heuristics. In order to further corroborate this statement, we propose an in-depth study involving many games of a few different genes in addition to the five tested so far. Also, games with multiple ratings (e.g., games with very low ratings) should be included. Additionally, the developed test games can further confirm the concept of using heuristics during all stages of the development process. A positive result of such an assessment would be the exact number of heuristics that must be completed in order to provide detailed information about the user. Further research is also proposed to investigate the best combination of the three areas covered by our framework and to improve the heuristics of tabletop games that offer a new opportunity to explore advanced interactive games. Additionally, testing tabletop-specific heuristics based on the same set of updates as Metacritic.com will allow for a more reliable measure of our heuristics. For the full use of the whole framework, it may be possible to upgrade the application- and heuristics specific to the device for advanced interactive games outside of tabletop games. Therefore, the full use of the framework for different types of games can be tested. Especially in heuristics, self-disclosure has shown that an additional category related to image quality and connected issues may be needed to further analyze the game. In addition, segregation related to various features of the virtual interface (e.g., main menu or in-game menu) is required. To allow for a better understanding of single heuristics, the inclusion of model images is recommended.

Chapter 4. Beyond the Gamepad: HCI and Designing Game Controller and Evaluation

4.1 Introduction

In your short history, human-computer interaction (HCI) has developed a number of strategies for measuring and evaluating user information technically. Most of the design considerations and usability issues that arise in game software are very different from what is experienced in other types of software. For example, a game that allows a player to complete demands quickly and easily may earn high scores by respecting ISO 9241-11 (1998b) software and achievement standards, but it may be extremely low in terms of user satisfaction due to scarcity. challenge. As a result, in recent years we have seen the emergence of HCI research focused on computer games, addressing the unique challenges posed by this environment. The visual and audio presentation capacity of the stadiums has grown significantly over the past 20 years, and much of the associated research has focused on these aspects of the games. However, the game control, and how that control is supported in the game, can have a profound effect on a player's sense of play. Control system art is an important part of many games. In order to have an enjoyable game play experience, it is important for players to feel in control of the game's visual interface and compatible game controls. In this chapter, we explain how McNamara and Kirakowski's (2006) theoretical framework for understanding interaction with technology can be applied to the assessment of game controllers. Using this model as a guide, user surveys are conducted to evaluate the use of the game controls range in terms of functionality, usability, and user experience. The framework is described in Section 4.3, below. The results of this study are presented and discussed in Section 4.4.

4.2 The Evolution of Game Controllers

Since the 1950s, targeted computer platforms have been used to develop and play computer games. Existing input and output capabilities on computer hardware are developed for gaming purposes. For example, in 1961, the first launch of "Spacewar!" the game, which runs on DEC PDP-1, used the switch name switch switches to insert the player. However, even in those early game areas the possibilities for special game controls have been realized. The location of the switch switches in DEC PDP-1 (c. 1960), in relation to the visual display, gave one of the players the opportunity to easily see the display. To overcome this problem, a dedicated control box is built to cover these changes. In addition to using the required switch function, the control box setting also used an additional and more accurate map of controls, e.g., a rotating switch was adjusted so that moving the switch right caused the art to rotate right; the lever style controller can be moved to speed up the manual operation. Graetz, one of the "Spacewar!" developers, he said, said that the new style of control “improved the performance of the game, making the game more enjoyable” (Graetz 1981). Over the past decades, the development of processing and storage speeds has been equated with advances in the field of input and output machines. At this point, the emergence of game software and game controls are seamlessly connected. Games have contributed to the formation of game controls, and game controllers have influenced the design of games (Cummings 2007). Many games, especially those played on social media platforms, are designed to take advantage of existing platform controls. However, the development of new generations of dedicated stadiums, and sometimes specific games, often puts a new invention in the field of game controllers.

4.2.1 Standard Game Controllers

Most games are designed to run with stadium (or fixed) field-specific controls, e.g., each game console has its first fixed company controller associated. Today, most games running on consoles support standard console control; many games playing on personal computers support keyboard and mouse input; mobile games are played using standard phone controls; and the recent expansion of devices that include touch screens also support that interactive gaming experience. Therefore, most games are designed to include support for existing controls. Much of the renaming in the game controls area has been associated with dedicated stadiums. There are a lot of popular media books that cover the development of the console gaming industry and technology. Throughout almost 40 years of game console development, new generations of concerts are often accompanied by a certain level of development and innovation in the related game controller. In many cases, the rate of renaming the new console controller was relatively low, and in some cases there were significant changes and new naming, e.g., Nintendo Remote Control, Nintendo Entertainment, and System gamepad. Traders who are traditionally dedicated stadiums are strongly integrated with console system electronics, which supports firmware / software and games. In the 1970s and early 1980s, players used various controls (switches, dials, and slides) that were an integral part of the console itself, e.g., the Magnavox Odyssey 100–500 series, and the Coleco Telstar series. From the early 1980's onwards, it became common for controllers to have different objects (usually gamepads or gaming sticks) that were connected to the game console via a cable, or to more recent systems, a wireless connector. Each consoles of today's game has a "standard" controller designed with the capabilities of its console in mind and firmly integrated into that system. A "standard" controller, which has support that is applied to games in a similar way, can help ensure a consistent user interaction while playing games on that platform. Many games take a series of steps and adhere to the recommended control guidelines for their targeted platforms. The widespread use of standard controls, as well as the use of similar controls between multiple game modes, makes controls one of the most difficult areas to create new items within the game.

4.2.2 Focus on Innovative Game Controllers

While the similarity of the game controls support can be beneficial, it can also be limited to both the game designer and the player. Even in the early years of game console systems, when console and game controls were part of the same enclosure, there were attempts to create controls aimed at a particular game or game type, e.g., Atari Stunt Cycle and steering. control. These types of developments are similar to what happened in the theater industry, i.e., the use of dedicated controls for flying games, running games, etc. In recent years, a growing number of games have added support for new and innovative controls in their games. games. Incorporating new controls into games provides game opportunities to differentiate themselves in the market place. Custom controls, designed to work with specific games, provide opportunities to improve user experience in games by enabling impossible interaction styles using standard controls, as described above. Although designing and using a custom controller offers great game-enhancing opportunities, it also introduces additional important function, additional risk of project schedule, and possibly an increased sales price for a game-plus-controller. However, apart from the field-specific checklist, the advice available to guide designers and developers considering new or innovative controls is very limited. Support for new controls should be carefully planned and designed, and their performance evaluated. Issues related to the development and use of custom control support are listed in the postmortem reports published monthly in the Game Developer Magazine 2008 (Game Developer Magazine 2008). For example, Guitar Hero for the February 2006 program, Metal Gear Solid for the May 2006 program, and Tony Hawk for the January 2007 program.

4.3 Testing Game Controllers: Experience, Usability, and Performance

Like all other technologies, interaction between people and game controllers is multifaceted and complex. This section describes McNamara and Kirakowski's (2006) theoretical framework for understanding technology interactions and discusses the implications of using this model in game controls.

4.3.1 Introduction to the Components of Human Computer Interaction

Recent developments in HCI have highlighted the importance of focusing on user knowledge in technology development. This need for high-quality user experience is very important in computer games, as its main function is to entertain. This revelation has led to theoretical dilemma, as the concept of user knowledge does not easily enter the HCI fields of general usability and ergonomics. In order to fully understand interaction with technology, we need to understand the various components of interaction and how these components interact. McNamara and Kirakowski (2006) propose a three-dimensional model for understanding human-technology interactions, represented in Fig. 4.1.

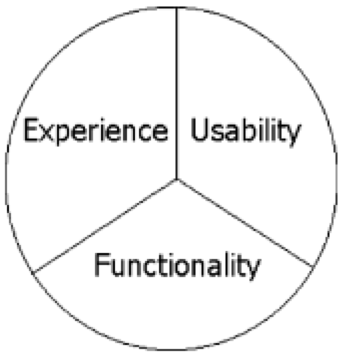


Figure 4.1 Components of the use of technology by McNamara and Kirakowski (2006)[2]

This theoretical framework presents three distinct but interdependent components of human and computer communication. "Performance" refers to the technological aspect of interaction, focusing on the technological capabilities of communication. In contrast, "experience" describes the human side of interaction. This feature looks at how the interaction affects the victim by asking questions such as “Do they enjoy working together?” and "Do they enjoy it?". Lastly, "usefulness" refers to the ability to interact with itself, is it efficient, effective, and satisfactory? They suggested that in order to fully understand interaction we should read each of these three sections.

4.3.2 Functionality and Game Controllers

This feature defines a technology-only component of interaction. The key questions in this section are “Does it work?” and "What?" This is one aspect of independent interaction with the user environment. If you look at the game controls, it is clear that the main function is to simplify user interaction with computer game software. Traditionally, controls only support one-way interaction from user-to-game, with visual audio devices that provide game-to-user feedback. However, the recent development of controller response means that interaction with game controls is now two-dimensional. For example, haptic gamepads, steering wheels, and speakers included in the WiiMote. This upgrade means that when we consider the performance of a game controller, we must consider the scope of the input and the response that the control system is provided. In some cases, the controls may not have the required number of controls to allow the player to use all of the game commands. For example, flight simulation games usually support a larger number of game commands (usually more than 30) than real controls on a low-level joystick. In this case, the player must select a subset of game commands that will be given to their joystick controls, and the remaining commands can be requested by the keyboard (or perhaps not used at all by the player).

Another important problem with game controller performance is the level of controller support in a particular game. A controller with a wide range of input and output may be of little benefit if in-game software does not support us. Checking the performance of the controller separately from the software is straightforward, as the range and sensitivity of various input and output can be easily tested. However, related to this and in-game performance is a complex problem, as the scope and sensitivity of the controller may not be supported or required by a particular game.

4.3.3 Usability and controls of games

The old usage definition is "The extent to which a product can be used by specific users to achieve certain goals effectively, efficiently and satisfactorily in a particular user environment" (ISO 1998a). This definition highlights four concepts that are central to collaboration: efficiency, efficiency, satisfaction, and context of use. Each of these concepts is important when discussing a game controller design. Performance defines the user's ability to complete certain tasks professionally. This exceeds the basic functionality, as not only should technology be able to perform tasks, the user must also be able to use sufficient technology to actually complete these tasks. The importance of success in building a game controller is obvious: If users are not able to use the controller to perform game tasks, they will not be able to interact with the game in any meaningful way. The importance of efficiency in the construction of a game controller is a very complex issue. Efficiency considers the resources that the user must use to complete tasks. These resources can be mental effort, physical effort, or time. With regard to computer games, this is closely related to the concept of difficulty: that is, if the game requires a large amount of resources (time, skill, mental effort, etc.), then it is defined as difficulty and, conversely, if it requires fewer resources, is defined as simplicity. This may seem to be of limited importance when discussing game controls, as the main focus of the games is to enjoy playing, not to complete tasks successfully. However, as Csikszentmihalyi (1975) reported, completing simple tasks can be tedious and difficult tasks can be frustrating. This need for efficiency balance presents a problem in game controls. The concept of satisfaction is related to how the interaction affects the user; are they free from mistreatment and have a positive attitude about cooperation? Here again the importance of this concept in the construction of the game controller is obvious, as playing computer games is a fun activity, and interaction should be satisfying. Unlike efficiency, efficiency, and context of use, satisfaction depends only on. Although some contextual information may not be directly detected to some degree, satisfaction should be evaluated on the basis of user feedback. This can cause problems in game controls, as variables such as usage context can affect user feedback and distort the findings. The context in which it is used differs from the other ideas discussed in that it is not an integral part of usability, but is a factor to be considered in learning efficiency, effectiveness, and satisfaction. Basically, the context of the application describes the situation in which the interaction takes place. It is important to consider that this refers not only to the physical environment, but also to the individual diversity and social environment in which interactions occur. While this concept is important when studying all types of technology, it is especially important when working with control devices because, as communication aids, they present additional complexities to consider. The device the controller used to control it has a significant impact on the use of the connection. Depending on the game controls, this means both hardware (PC or console) and software (specific game) should be considered in the build.

4.3.4 Game Experience and Controllers

This last aspect of collaborative design is probably the most recent to be explored. Experience means the psychological and social impact of technology on users. While this is related to the practical sense of satisfaction, it has a much broader scope, which looks at working with a broader perspective than simply completing a task. When learning experiences, non-interaction concepts should be considered, for example beauty, marketing, social impact, adherence, and attitude can all affect users' interaction with technology. Again, the nature of game controls as intermediate devices can make studying this part of user interaction difficult. In addition to the social, psychological, and environmental factors to be considered when considering the technology of any technology, the hardware and software being controlled may affect user experience with game controls. There is little research or theory related to user knowledge about game controls, which makes it difficult to predict what features are important to the user experience in this area. However, the tools needed to explore this area already exist; Positive psychological approaches such as critical narratives, minimal dialogue, basic theory, content analysis, and ethnography have been used to test knowledge in a variety of fields (McCarthy and Wright 2004), and their flexibility means they can easily. used in the game controls study.

4.3.5 Evaluation and Design of Game Controllers

This section discusses the impact of McNamara and Kirakowski's framework on research and design in the field. First, current literature is reviewed and discussed in terms of design implications. If you look at recent research on controls it often shows that a large number of research papers have tested the performance of pointing devices (including mice, touch pads, and trackballs), keyboards in desktop / laptop computers, and the use of keypad on portable devices (Card et al. 1978, MacKenzie 1992, Silfverberg et al. 2000). In recent years, HCI researchers have also explored a variety of interactive growth strategies including touch, touch, haptics, and writing styles (Dennerlein et al. 2000, Forlines et al. 2007, Albinsson and Zhai 2003). Much of this work was concerned with the efficiency and effectiveness of the input methods, but user satisfaction was also considered (Brewster et al. 2007, ISO 1998b). In addition to the fact that game control has highlighted many subjects as an important game-building element (Federoff 2002, Johnson and Wiles 2003, Desurvivre et al. 2004, Adams 2005, Hoysniemi 2006, Pinelle et al. 2008, Falstein and Barwood 2008), little research has been done to regulators. begeyme. Another work has studied the development of input devices and how they affect user performance (Kavakli and Thone 2002, Pagulayan et al. 2003, Klochek and MacKenzie 2006); however, the effects of game controls on user information are yet to be fully evaluated. According to the McNamara model and Kirakowski (2006), we will not be able to fully comprehend the interactions involved with game controls until we have examined them in terms of functionality, usability, and user experience. The current practice of designing a game controller continues with this pattern, with an emphasis on functional aspects but the less attention paid to usability, the less the user experience. For example, game play and console compliance testing tasks include control support tests. The associated checklist usually contains very specific advice regarding the work to be done on the buttons. Apart from this forum-specific advice, guidelines and heuristics related to standard control support are very limited. The next question to be answered is how does adopting this model affect the game controller design? At the moment, little research is available to help focus on game control tests on game control features that have a huge impact on user interaction. This lack of focus leaves control designers with two options when it comes to analysis: either make a comprehensive checklist to ensure that all control features are tested, or do a few tests and trust that many important issues are available. None of these solutions are ideal, as the first is costly and may be even more expensive to fix all the found problems, and the second is likely to miss important issues and produce poor product. The McNamara and Kirakowski (2006) models highlight different parts of the collaboration, allowing designers to make a few experiments but also to explore each part of the collaboration. Ensuring that controller functionality, usability, and user experience are all tested means that all important features of the controller can be tested without making a large checklist.

4.4 Case Study

In order to further explore this area, a case study was designed to test both the use of common and new computer game controls in the game. This study focused on controlling racing games and tested the keyboard and mouse, the normal game pad, and control wheel control mechanisms for each user interaction, as described by McNamara and Kirakowski (2006). This study is designed to highlight the benefits of using user experience testing, within the context of multi-component game control.

4.4.1 Justification

In order to fully evaluate the interaction between the user and the game controller, each controller has been evaluated in terms of functionality, usability, and user experience. Evaluating each of these component steps brings unique challenges.

4.4.1.1 Performance

Performance means only a technology-based component of interaction. As this component is relatively independent in both location and user, it can be measured by examining the technical limitations of each game controller This test is performed by comparing the number and scope of the results produced by each controller with the possible inputs detected by the game. In addition, the input usage is measured by custom logging software.

4.4.1.2 Usability

This quality depends not only on the user, but also on the location where the connection takes place. Each usability component as defined by ISO (1998b) is measured independently. Efficiency is measured by the mental effort required to use the controls: when the minimum mental effort required, interaction with the controller. Psychological effort was measured using the self-report Subjective Mental Effort Questionnaire (Arnold 1999). Performance was measured during lap time. Fast users can finish the lap using a controller, which is when the interaction is most effective, as eliminating the fast lap is a key activity in running games. Satisfaction is measured by the Consumer Product Questionnaire (CPQ) (McNamara 2006), a standardized measure of consumer satisfaction with consumer electronics products.

4.4.1.3 Experience

Since this aspect is completely dependent on the environment, it can be difficult to quantify and depend on a variety of psychological and social factors outside of the interaction itself, including beauty, advertising, and public interest (McCarthy and Wright 2004). The Critical Incidents Technique (CIT) (Flanagan 1954) was used to collect quality data describing user information. This method involves asking each user to report the three best and the worst three with the controller in an open questionnaire. This method was chosen for two important reasons. First, as a measure of the performance of the game in the background, it will not affect the experience of the game itself. Many modes during play such as loud talking can change the feeling of playing the game and reduce the validity of any acquired. Second, CIT is open and does not require a knowledge base in the test environment. This is important, as the lack of previous research in this area means that other methods of leading the researcher are not appropriate. In addition to the CIT assessment, each study was asked to state its preferences between administrators in a set of three regulatory preferences (from “preferred controller A” to “preferred controller B”).

4.4.2 Method

Twelve subjects participated in the study. The gender balance was proportional to the studies of five females and seven males. Participants' age was 24.6, ranging in age from 19 to 30 years. Participants were also asked if they were driving regularly as this might give them a better chance with steering wheel control; five answered and said. They were also asked if they had any experience of racing games, all of which except title 1 answered with little or no. The test system was HP Compaq dc7800p running Windows XP. The following three controls have been tested in the study: Keyboard. Dell USB Keyboard. Game pad. Logitech Dual Action is a USB game pad, with two mini-joysticks (similar to those commonly used in game consoles) and 12 digital buttons. Steering. Logitech MOMO Racing is a USB response tool, with analog steering wheel, analog accelerator and brake pedals, and 10 digital buttons. One game was used in the study, Colin McRae Rally DiRT (Codemasters 2007). In order to minimize the impact of game-related artifactes on analysis, a number of game settings have been modified. The same level of difficulty (amateur), control assignment, view (behind the car), car (Subaru Impreza), and track (Avelsbachring) were used in all subjects. This study used a design of repeated measures, with each study participating in all cases. Independent variables were a type of control system used and operated under three conditions: Gamepad, Keyboard, and Response Control Wheel. In order to reduce the confusing flexibility between situations, many controls have been used. The order of the terms was challenged to counteract any of the consequences as a result of the study. Each case used the same software as the hardware, except for the control method, to minimize the potential impacts on the test.

4.4.2.1 Procedure

After completing a brief list of population statistics, the titles are introduced into the game and the first control method they would use. They were then asked to play the game until they felt comfortable with the control system. How long this step is taken left in the participants' view and varies from 5 to 20min. The participant then performs two timed sessions on the test track. Once they have done this the participant was asked to complete the questions for CPQ, SMEQ, and CIT. This process is repeated for each control method.

4.4.3 Results

4.4.3.1 Performance

Compared to performance management, there are two things to consider. First, "Are all game commands supported by the controller?" and second, the issue of how control is supported. The DiRT game has a small set of commands. In addition to steering, acceleration, and brakes, a small number of additional commands are also supported (switch camera, handbrake, left / right / back, and gear up / down). Although the use of all game commands was not tested in the study, various controllers had adequate controls for all of the game commands to be given, i.e., 100% of the game commands could be given to the controllers. Both the gamepad and the steering wheel support analog steering. However, as Table 4.a highlights, their reaction characteristics are very different, as the wheel is accurate several times in terms of angular resolution. This data shows that depending on the performance in the context of this game, the steering wheel is a higher control system, with a wider range of movement and sensitivity. In contrast, the keyboard has very poor performance, allowing only binary inputs for both steering and acceleration.

4.4.3.2 Usability

The functionality of each game controller is rated according to functionality, efficiency, and user satisfaction. Table 4.b shows the results of each component analysis of the three controls. It shows poor performance of the steering wheel compared to the other two control methods for both completion time and SMEQ (low SMEQ values indicate mental effort required). Gamepad effects and keyboard for these two steps seem very close. Based on CPQ results, Keyboard reports a much lower satisfaction result, with the Gamepad and the slightly more efficient Steering Wheel (50% on CPQ device rating, depending on the CPQ website). A series of one-way repeated ANOVA measures were used to determine the statistical significance of these results. ANOVA has been used as a solid method for diagnosing differences, and performing multiple t tests will increase the chances of type II error.

In this experimental study, an alpha level of 0.05 was used.

Table 4.a Functional differences between gamepad and wheel controls[1]

Control parameter	Gamepad	Wheel
Physical range (approximately)	25	240
Analog counts	255	1024
Deadzone	Yes (center)	No
Angular resolution (approximately)	<10.2	4.3

Table 4.b Specifies the points in terms of usability[1]

Controller type	Completion time	SMEQ score	CPQ score (%)
Steering wheel	04:39	72.92	20.83
Gamepad	02:59	34.42	15.08
Keyboard	03:13	42.58	6.25

Table 4.c ANOVA results for usability measures[1]

	Completion time	SMEQ score	CPQ score
F value	5.876	7.258	3.268
Degrees of freedom	10	10	10
P	0.021	0.011	0.081

Table 4.d P values for completion time ANOVA STEP analysis[1]

Completion time	Steering wheel	Gamepad	Keyboard
Steering wheel	–	0.014	0.027
Gamepad	–	–	0.4
Keyboard	–	–	–

Table 4.c shows that the ANOVA results show significant results at the alpha level of 0.05 completion time and SMEQ scores. CPQ school results show the importance of the data method, but failed to reject the null hypothesis at the alpha level of 0.05. In order to further investigate the differences, post hoc STEP analysis was performed on each significant ANOVA effect. Table 4.d shows the potential STEP analysis of expiration time data and reveals significant differences between Gamepad and wheel, keyboard and wheel. This shows that the steering wheel performs worse than the other two methods in terms of efficiency. Table 4.e reveals similar results for STEP analysis of SMEQ data. Highlights found between the steering wheel and the Gamepad and between the steering wheel and the keyboard. This indicates that the steering wheel also performs worse than other performance control systems. In short, the usability data collected shows an interesting trend in terms of steering wheel. This controller scored worse than both other efficiency and efficiency control measures (as measured by Completion Time and SMEQ), but achieved higher scores on user satisfaction rating. This set of results suggests that although the steering wheel was not an effective or efficient controller, participants were happy to use it. Keyboard data shows the opposite trend, with better results and more effective results, but less satisfying results. In the end, the Gamepad did the best of the three controls in terms of usability, producing the best interaction times, the lowest SMEQ scores, and the rational score on CPQ, compared to other controllers. It is also worth noting that all three control systems performed poorly in terms of user satisfaction, with a score of 6.25 to 20.83%. The lack of statistical significance may be due to the “low” effect, i.e., CPQ scores may not be so bad.

Table 4.e P-values of SMEQ ANOVA for STEP analysis [1]

SMEQ results	Steering wheel	Gamepad	Keyboard
Steering wheel	–	0.014	0.027
Gamepad	–	–	0.4
Keyboard	–	–	–

4.4.3.3 User Experience

Data collected to measure user self-awareness took two forms: First, user preferences were measured and secondly CIT was used to report users' attitudes toward devices. Table 4.f highlights the most popular intermediate points and shows the gamepad preferences compared to the other two controls and keyboard preferences above the steering wheel. To test the significance of these effects, repeated steps of one-way ANOVA were performed at an alpha level of 0.05, producing a F value of 3.015 with 10 degrees of freedom. This falls outside the critical region so it does not reflect the importance of statistics. As CIT generates quantitative data, more detailed analysis is required. The answers for each game controller are structured into categories using content analysis. This approach involves grouping comments into categories, based on the content of those sections, in order to identify key areas of user experience and game controls. Table 4.g shows the results of the content analysis of the steering wheel comments. This table highlights Sensitivity, Response, Easy to Take, and Real Activity as the most reported features users experience with this device. Sensitive comments highlight the high sensitivity of the left / right steering wheel using the wheel. Example: "... amazing accuracy while playing." " (Article 7, opposition) “It is difficult to control. The steering wheel was very sensitive. ” (Topic 11, negative) Although most of these comments are incorrect, show frustration for the most sensitive controls, three studies have listed this as a positive factor that has improved their game perception.

Table 4.f User preferences scores on a 1–5 scale[1]

User preference	Keyboard – gamepad	Keyboard – steering wheel	Steering wheel – gamepad
Mean	4	2.5	3.92
Standard deviation	1.28	1.57	1.44

Table 4.g Analysis of content of steering wheel comments[1]

Steering wheel categories	Positive comments	Negative comments	Total
Sensitivity	3	9	12
Feedback	7	4	11
Easy to pick up	7	4	11
Realism	9	2	11
Physical characteristics	4	3	7
Learning potential	1	3	4
Miscellaneous	0	1	1
Total	31	26	57

Comments in the Response section discuss the power response generated when using a steering wheel. Example: “Wheel movement when in a bad position (shaking) adds to the experience of a crash.” (Chapter 6, beautiful) “The vibration of the wheel has had a positive effect on the appearance of the surface, like grass.” (Article 12, good) “Wheel movement / vibration often makes wheel rotation very difficult - it was slow and smooth” (Article 6, negative). Again, commenting on this section is both positive and negative. Positive comments show appreciation for the fun and reality that compels feedback that adds to the interaction, while negative comments address situations where they disrupt the gameplay. This shows the attention that should be applied to the changing control features to add to the game experience without being distracted by the basic features of the game, in this directional example. Easy to picked comments discuss situations where this control system existed or was not easy to pick up and use. Some studies have found that standard steering and pedals provide an intuitive control system, but in others the production of driving conditions was not accurate enough to be easy to pick up. For example: “Using a steering wheel is easy; obviously it works. "(Article 6, agrees)" The accelerator and brake pedals were not easy to use at first and I was not really comfortable with it. " (Topic 3, negative) The Realityism category produced an excellent commentary on the steering wheel, with only two negative comments from 11. These comments highly commend the reality of this control, and two comments call for more realism. Example: “Wheel combined with pedals has made it seem like a very real driving system. ” (Article 6, states) “The steering wheel has only one turning wheel rather than 1.5 as is normal for driving.” (Article 8, negative)

Table 4.h Content analysis of keyboard comments[1]

Keyboard/categories	Positive comments	Negative comments	Total
Ease of use	10	3	13
Sensitivity	3	8	11
Physical characteristics	5	6	11
Realism	0	3	3
Comfort	0	2	2
Feedback	0	2	2
Familiarity	2	0	2
Total	20	24	44

Table 4.h shows the results of the keyboard content analysis. Significantly, this is the only control system that has received the most negative feedback. The sections that contain the most comments and the main focus of the test are Easy Uses, Sensitivity, and Physical Factors. The Easy Use section contains comments that discuss how easy it was to use the keyboard. Much of this is a good comment focused on the recovery of the interface, but some talk about the limited controls provided by the keyboard control. Example: “Actions did not translate into a game. Although the controls were simple, it was difficult to control and control the car. ” (Article 7, negative). The category that contains the most negative comments was Compassionate, which contained comments related to the binary nature of the keyboard input.

A few opinions have praised this as easy to use, while most of them criticize the lack of empathy. Example: "It is easy to make growing changes during administration." " (Topic 3, negative) Comments on the body language section discuss the impact of visual keyboard layout, praising local-made controls or criticizing it as overcrowded. Example: "Small selection area - eg arrow keys between simple finger list" (Top 2, good) "Input key space is slightly congested." (Topic 9, Negative) Table 4.i shows the results of the content analysis of the game pad commentary and reveals that comments in this category are distributed evenly across all productive sections; this suggests that no interactive features are available to all users. Sensitivity, Personal Favorites, and Easy to Use.

Table 4.i Content analysis of gamepad comments [1]

Gamepad – categories	Positive comments	Negative comments	Total
Comfort	8	2	10
Learnable	4	3	7
Sensitivity	3	4	7
Personal preference	2	5	7
Ease of use	6	1	7
Feedback	0	3	3
Realism	1	1	2
Misc	2	0	2
Total	26	19	45

Comfort is the largest category produced and contains excellent reviews. This comment is just about how free the gamepad is. Example: “I am very comfortable. I could hold it all day. ” (Article 3, good) “Make my thumb hurt after a few minutes of play.” (Topic 1, negative) Comments on the Read section talk about how easy or difficult it is to become accustomed to using the game keypad controller. Example: “It is very common. I knew exactly how it works in a very short time ”(Article 3, good). “Perhaps if someone uses this for the first time it will be difficult to explain” (Article 7, contradictory). It is interesting to note that although few users say that this method is easy to learn, no one talks about how accurate it is, as they did with both the steering wheel and the keyboard. This may suggest that it may be more familiar with the device than with the precise interaction that makes learning easier. Sensitive Comments highlight the positive and negative effects of directing, acceleration, and sensitivity to breaks. Example: “Natural feeling, good sensitivity” (Topic 1, Good) “Speeding and brakes did not work well together. It was difficult to brake a bit; you should have stopped completely. "(Article 11, negative) Comments in the Personal Preferences section discuss issues related to controlling game preparation. Most of these comments are bad, probably representing the fact that participants were not allowed to change these settings during the study. "”(Article 2, negative)“ The break button must be to the right, not over the speed. ” (Topic 8, negative) The ease of use section contains comments related to the simplicity (or lack) of using this control method. Most of these comments are good, and only one comment means this device is difficult to use. For example:

“It is very easy to use. Actions are accurately displayed in the game. It was easy to judge how much movement / strength was needed. ” (Chapter 7, reassured) “A toy stick sometimes seems a little difficult to use.” (Topic 5, negative) In addition to highlighting some of the key issues in the game controller user experience, this data revealed an interesting trend, a combination of positive and negative comments in all related categories of all three control modes. Most of the sections found contain both positive and negative comments; this trend highlights the importance of individual diversity when analyzing game controllers. What some users may see as a positive or negative aspect of the game, others may view it as a negative. For example, when discussing keyboard dualism, one theme found it much easier to direct, while the other found the lack of sensitivity to distraction. "It's easy to make growing changes during administration." (Theme 2, keyboard, beautiful) "It's very difficult to control the control / action just by pressing a single key." (Topic 4, keyboard, negative).

4.4.4 Combining the Results

Although each test produced positive results, a complete picture can be obtained by looking at a combination of all three steps. Although a complete analysis of all the data collected falls outside the scope of this chapter, this section highlights one issue that has been reported in several analytical methods and examines it in detail. The issue of control sensitivity is one that seems to have an impact on all three aspects of collaboration. User experience analysis highlights control sensitivity as an important part of the experience of each control method. The sections within each analysis revealed the benefits and risks of each control approach in terms of sensitivity. The results suggest that this interaction factor was the main factor in the use of the steering wheel, as nine comments imply empathy as a problem. However, with the operation of the steering wheel it is clear that we are high, sensitive when we get small degrees in terms of steering, acceleration, and braking. To explore this in more detail, an analysis of the data collected for the drug cutting software for study 1 (a topic with the best cycling cycles) and topic 5 (a topic close to the average cycle of cycles) was performed. . Figure 4.2 shows the captioned software for cutting logs in headings 1 and 5, while using the game pad and steering wheel to control the steering axle while driving two timed rounds of track. Chart is a general distribution of the frequency of control reports. Both controls report different range of values in response to movement. To show them all on the same X-axis scale, data from both controls is standardized; -1000 is the extreme left-hand control axis; +11 is the extremely right axis controller; and 0 is the central area of the controller. The Y axis represents the total number of reports of a given value.

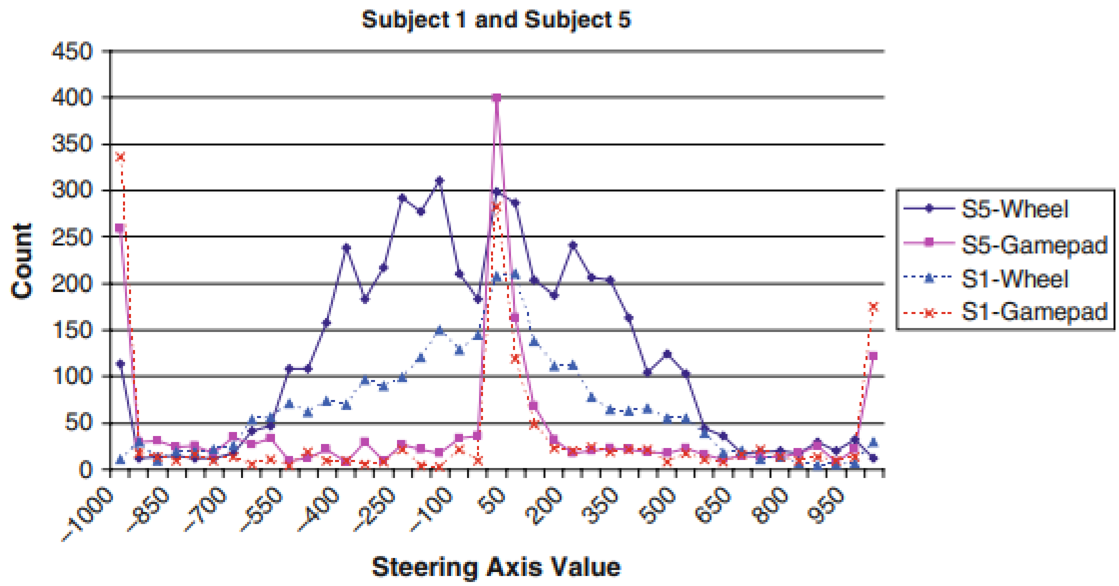


Fig. 4.2 Device steering reports for subjects 1 and subject 5[8]

The data bias on the left side of the chart is the result of an anti-clockwise track. As can be seen in Fig. 4.2, the profile of the reports produced in both topic 1 and article 5 while using the gamepad is very similar. The data distribution shows that a small amount of analog mini-joystick capability in the gamepad is used. Most of the reports are near the axis center (mini-joystick is located in the center "deadzone") or at the device's edge limit, that is, the gamepad mini-joystick is used as a digital control method similar to the keyboard. The profile profiles produced by both studies while using the steering wheel are clearly different. Increased number of player reports for Player 5 vs. Player 1 is an indication that Player 5 took more time to complete two wheels while using the wheel, and thus generated more reports. In contrast to gamepad data, analog wheel power is used. Player 1 graph, which had the fastest driving time of the wheel, shows the convergence of reports about the center of the wheel. In contrast, the Player 5 graph shows a broad distribution of data, as it struggles to control a car using a wheel, that is, significantly above the steering wheel. This suggests that, although a sensitive control approach is a useful tool for a skilled user, it has little benefit for those with less experience. As a few of the participants had a lot of experience with steering wheels in sports; this may explain the negative comments about the steering wheel, as they found it frustrating to use it without time to master it. The disturbance caused by this abnormal sensitivity may also be somehow related to interpreting the usefulness points reported in the string. The analog nature of the brakes and pedals on the steering wheel control allows the player to perform a variety of real-world rally driving techniques in the game, such as "heel and toe" and "left-foot brake". However, no study studies have used these methods.

This example highlights the main advantages of using this multi-component analysis: the ability to fully explore a story highlighted in one way or another and discover its origin. Although routine use or user experience testing may find that sensitivity is a major problem for these control devices, they may not be able to fully diagnose this problem, as this multi-component testing has taken place.

4.4.5 Critique

In considering the results of this study, there are several shortcomings that may be considered. The most obvious of these is the list of methods used. While this allows for more data to be collected in each component of the collaboration, it also means that consistency must be achieved when testing each component. For example, when testing user information, McCarthy and Wright (2004) suggested a field-based analysis, but the current study used laboratory space to test simultaneous performance. The lab was set up to match close to home, but it is impossible to re-create specific conditions for field research. Another factor to consider is the inexperienced participants. Only 1 of the 12 reported regular play racing games, and none of them had more than a few hours' experience with steering wheel controls. The results should be interpreted with this in mind, and it may not be possible for experienced players.

4.4.6 Conclusions

The steering wheel is an attractive device that supports all the functions required by game commands, so it can be a game-selling platform. In the hands of an inexperienced user, however, it will lead to poor performance of the game. However, at least initially, users will feel satisfied about it. Although the gamepad comes out on top of the steering wheel and keyboard in terms of usability, the keyboard has the advantage that it is considered very easy to read. The "experience" and "usefulness" in this case seems to tell a variety of stories. What should a game designer take if there is a choice to be made? If there is a trade-off between the keyboard and the gamepad, the designer may choose not to support the gamepad if user information is the main issue. The sensitivity of the controller reflects the complexity that exists in understanding a small part of the user's in-depth information about the game controls. It highlights not only the need for additional user understanding of the game controls, but also the need for consistent research of both functionality and usability in order to understand interoperability as a whole. Overall, all three tested devices were able to support game command functions, and the steering wheel was also able to transmit additional output using a haptic response. Therefore, we can conclude that in the game and the learning devices, the game controller was 100% operational. However, the devices differ from the way the user interacts with the game. This study shows that user interaction is actually an important aspect of game play, and how one can assess its impact on simple and straightforward laboratory tests.

For experienced facilitators, a course like this should not take more than two days. According to the game controller user experience, a few issues have been highlighted that seem to be important to all tested administrators. These include: Sensitivity, Ease of Use, Realism, and Comfort. This information represents the primary basis for a user experience of the game controller, which may be evaluated in future research.

4.5 Discussion

Many of the on going game play tests performed as a normal part of the development process are accomplished using informal techniques. Such informal testing may also be accompanied by additional systematic review of control support, as described in the user survey. It is fast and easy to do and can be especially useful during the early stages of development in support of benchmark control.

4.5.1 Implications and Recommendations

Between the discussion and the model lesson presented here, the advantages and disadvantages of multidisciplinary testing are highlighted. The main benefit demonstrated is the ability to identify the source of the problems found in any experiment. The downside is that when compiling a checklist at the same time, there should be a flexibility similar to the use of laboratory space. In terms of practical implications, these findings suggest that a multi-component model like this can be useful within the game development process, where it is important not only to highlight problems, but also to find their source and fix them. However, the consensus to be made in the assessment process means that testing the user-focused information may be better suited to the academic environment, where a complex understanding of the subject is of paramount importance.

4.5.2 Future Research

In terms of user experience, the case study presented did the basic task of assessing how the game controller affects the user experience. After discovering some of the key issues in this area, the next step is to explore these issues in more detail with in-depth data collection and analysis, such as discussion and basic theory.

This user study is intentionally banned because it only examines the first stages of game play in each control in one game. However, with extended game play, players will become more familiar with both the game and the controls. As a result, longitudinal studies will be needed to assess problems arising from the context of long-term game play. The same strategies used in this user study can also be used in the context of long-term studies, and then the data is then analyzed to evaluate the change over time. The data collected in the study contains both data collected during game play (via login software) and later data collected as complete questionnaires. Data collected during game play in the study is limited to reports produced by game administrators. It can be useful to supplement this in-game data with biometric data and video capture (with emphasis on facial expressions and body movements). This will probably allow for better interpretation of in-game reports and complement the background game information collected in the quiz list. Future studies should seek to elaborate on the practical effects of practicality and knowledge. For example, where possible, see effects on game players in settings where game controls, controls, and support devices provide different levels of functionality as described in this chapter.

Chapter 5. Integrating AI to bring a new solution

5.1 Introduction

Games have long been popular benchmarks for Artificial Intelligence testing, and more recently have become a central feature of AI / CI in the field of game research. Many researchers have studied algorithms and methods that attempt to measure the best play in different computer games such as Chess, Go, Car Racing Games, Ms.PacMan, Real-Time Strategy (RTS) games and Super Mario Bros. . Sometimes these research teams come up with another type of competition that tests different methods with an integrated benchmark. However, most of the time agents have what is called a certain skill, and this skill is developed with the knowledge of proper game rules and best practices. By testing algorithms for game-based competitions we provide relevant and reliable benchmarks based on activities that prove to be a challenge to human awareness, but such competitions also make the results easier to understand and interpret. This contributes to AI research awareness and drawing competitors, and competitive software programs are often doubled as students' tests in addition to their role as key AI benchmarks.

5.2 Integrating Conceptual AI

Since conceptual AI is independently designed from games, an integral approach is required for use by game developers. Game developers should be able to select and connect AI solutions to the game. is achieved by registering AI administrators with intellectual property. In order to provide control, partial or complete, for a business in a game in a specific AI, the corresponding control must be validated and registered with the business specs in the CDS. AI then controls the business of the mind, effectively managing the business in the game. For example, a game developer can apply two AI solutions to a racing game, one to control computer rivals on the tracks and the other by drastically changing race diculty in player performance. Every time an adversary on a computer is heard in a race, a new model of driving AI is created and registered with its conceptual speculation. As for diculty AI, it can be created at the beginning of the race and registered with a real-time player performance test. For every controllable concept that is denied by CF engineers, the visual interface of the controller is translated along with it. The visual interface describes the functions AI has to use in order to be able to properly take control over an object object. Not to be confused with mind controls, which are also challenged by CF engineers, AI that can be used to control the object of thought and used by game engineers. Figure 5.1 shows the difference. It is possible for many controllers to share control over the same thing. For example, an NPC can be controlled by different AI solutions depending on its nature. It may have complex AI combat that starts only when the NPC enters the combat zone and otherwise stays alert, while a different AI is used when the NPC is in a state of inactivity to roam, roam or rest. Many controls, however, can lead to interaction in situations with limited control. Another way to solve conicts is for AI controllers to have a table showing the critical level of control of each concept. Cognitive control calls will then be issued by regulators with priorities and lined up for resolution. Yes, when multiple AI controls are integrated into a complete solution, this problem can be handled by the solution writer in any way they can and only a complete controller may be needed to provide an important table of mind control. Figure 5.2 shows how many controls can be registered with a concept object. First, the object in the game, the Undead Peon, was created. Following this, its speculation on the CDS, NPC, is constructed and linked to the Undead Peon. Finally, a few autonomous AI controls, one to generate neutral behavior when the Undead Peon is inactive, the other to generate public behavior where the Undead Peon is close to other Undead Peons and other NPC species and to produce combat behavior where the Undead Peon faces enemies. , created and registered with NPCs on CDS. In this case, there is no overriding control of the NPC with different AI solutions. Using this registration method, the AI controller can also verify that its dependencies are working and reach you with a concept object. Examples of functions found in the control areas of the controller are the review function and event holders. The update function is used to update the internal AI status and can be called for each game cycle or for an improperly set update level. This function is illustrated in Figure 5.3 .Note how the NPC in the CDS does not have an internal update cycle. this is because there are no variables in the CDS. The items in the CDS are game demonstrations and are only modified as a result of changes in game items. Event handlers are used to notify AI controllers about game events, such as one executed unit. When an event occurs in a game, the conceptual guess is red on the display of the object of the game involved. Incidents that may involve a concept object are determined by CF engineers and are used to create a visual controller connection. AI Controller does not need to manage all events. This is obvious to the partial directors. Therefore, it is possible that AI controllers may ignore other events. Event handles are shown in Figure 5.4. Other examples are the functions of pausing and restarting the controller. When game developers integrate AI solutions into their games, they can statistically integrate them during build or upload them flexibly during operation. Uploading AI during operation makes it easy to test AI solutions and can allow players to connect their AI to the game. Usually, AI will work within the video game process, or it may be interesting to consider splitting its execution. Posting AI with a different process means it can work on a different machine. The final e can be configured for AI processing or can be online, enabling AI engineers to create AI as a service. Multiprocess design can be easily considered, as shown in Figure 5.5.

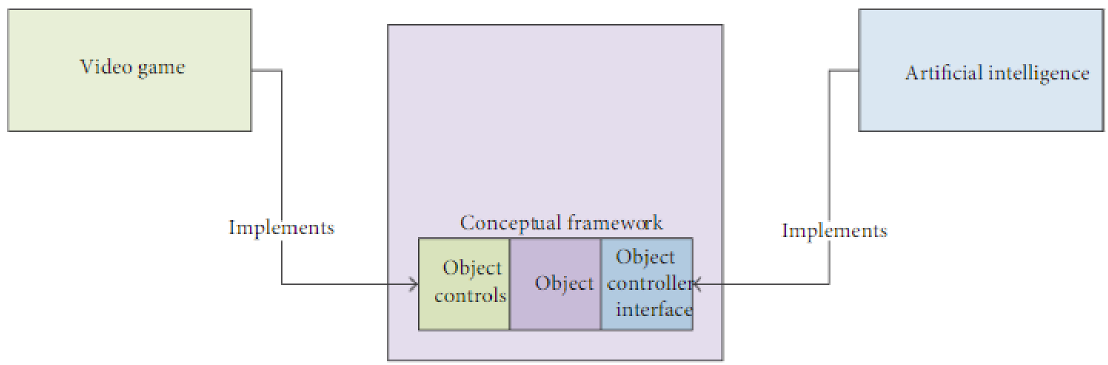


Figure 5.1 depicts the conceptual controls and controller interface. The CF developers reject both. Game developers must implement conceptual controls, while AI developers must implement the controller interface. [6]

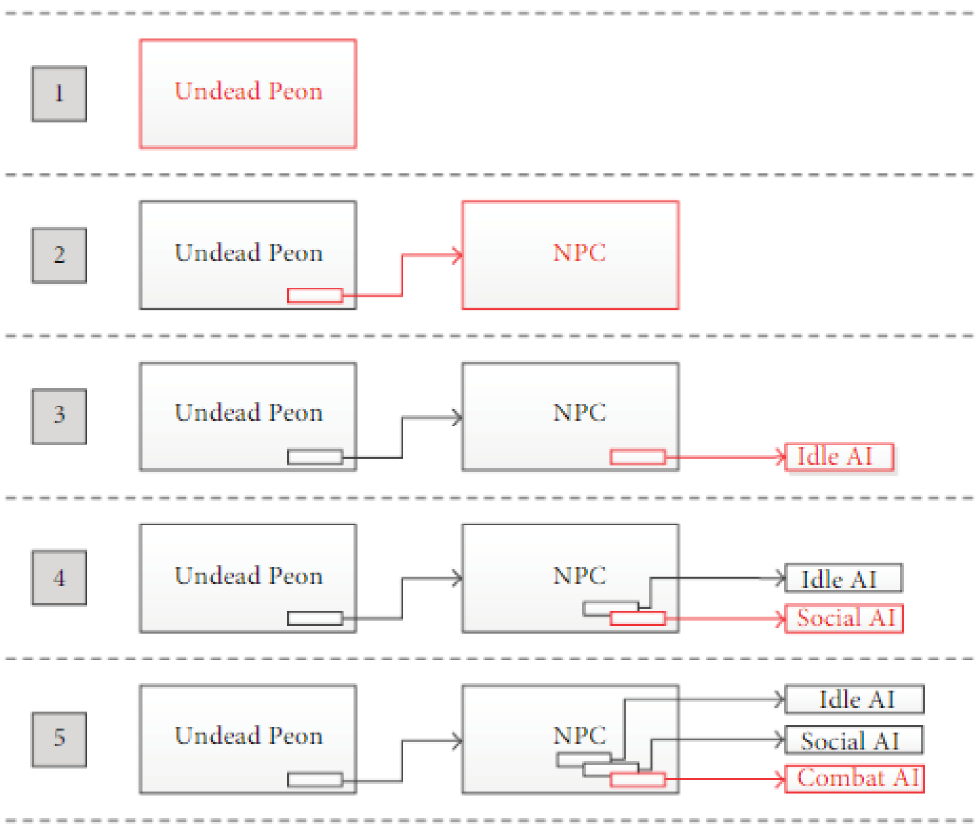


Figure 5.2 shows how to register multiple controllers with a conceptual object. The Undead Peon is controlled by one of three AI solutions, depending on its state.[3]

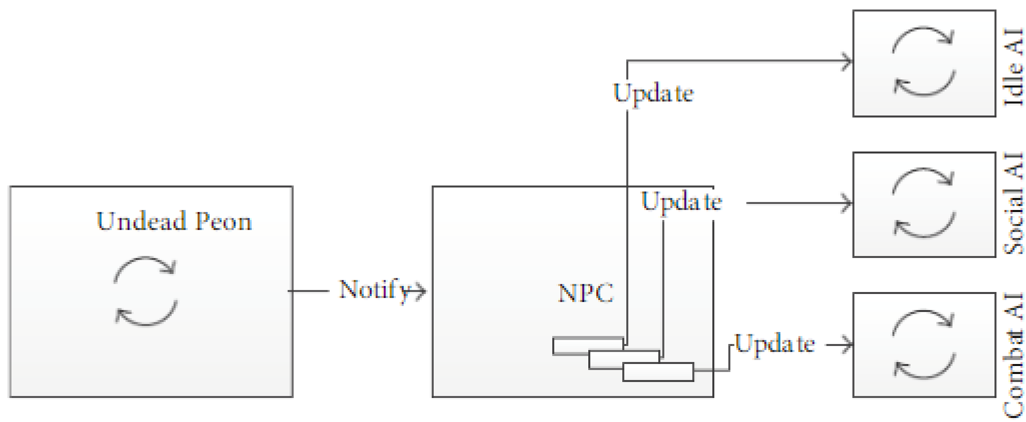


Figure 5.3: Updating AI controllers' internal states when game objects update theirs. It is worth noting that CDS objects do not have an update cycle.[6]

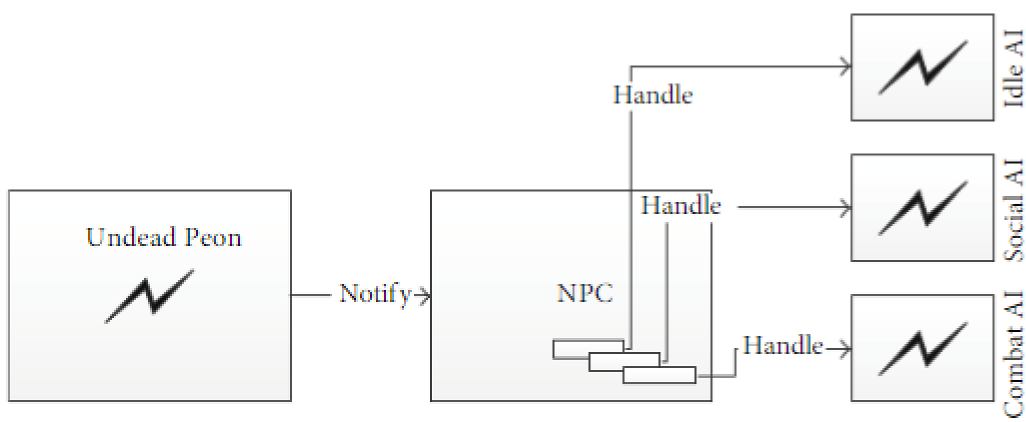


Figure 5.4: AI controllers handle events. Before being sent to AI controllers, game events are projected into CDS.[4]

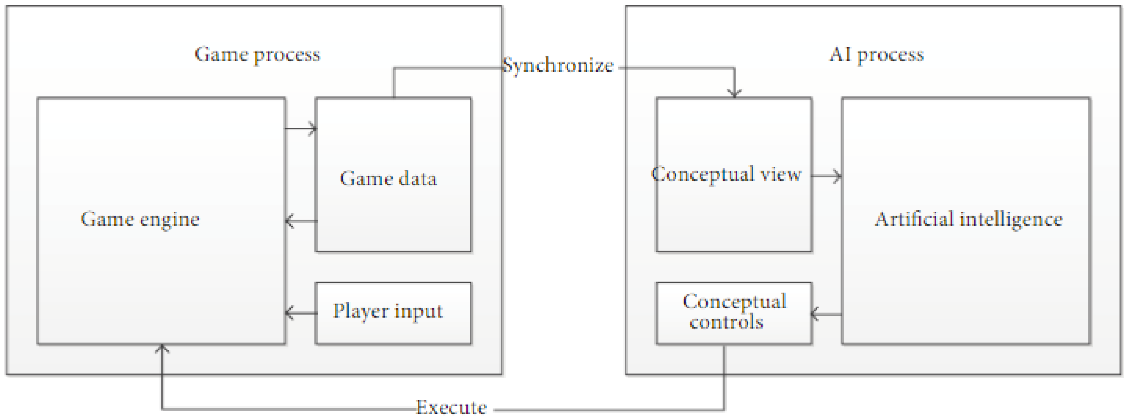


Figure 5.5: AI is operated in its own process. To synchronise a conceptual perspective with game data, an interprocess communication method, such as sockets or remote procedure call (RPC) systems, is necessary. The mechanism is also required for conceptual controls to be applied.[6]

Since humans prefer to use things that seem natural and familiar to them, such as touch, it is only natural to design technology in such a way that the user will be drawn to it. A game console concept was developed in which the console is built in the shape of a watch. This design involved integrating the concepts of a smart watch and a game console.This device employs sensors to monitor things like pulse, hand movement, wrist inclination, gravity, and so on. Individual data does not necessarily matter much, but combining this data in various combinations might allow the developer accomplish a lot more, such as identify the users' moods, and so on. These can be useful information for both testing and actual implementation.

The future is unclear, but games that embrace new technologies and offer next-level competitiveness keep players interested. What the human development team could not perform on their own, AI has made possible. The future has AI game developers make video games employing powerful AI approaches to plan strong frameworks within games. Characters who can now self-learn from their actions and evolve as a result. A game will exist that can comprehend and react to your in-game activity, anticipate your next move, and behave accordingly. AI learns from a player's wins and defeats by determining where and how they occur. That is advanced evolution.

Appendix

A-Frequently Asked Questions

Q.1 What does a gaming artificial intelligence (AI) programmer do?
AI programmers develop the game's brains. Non-playable characters (NPCs - those that cannot be controlled by the player) must make decisions and react in ways that are believable, engaging, and give varied degrees of difficulty to the player.
Q.2 Does AI play a role in game development?
AI is also being used by game developers to evaluate game flow and make modifications by implementing game logic. AI now allows game makers to assess and manage game flow by running infinite-state game machines.
Q.3 How is AI employed in games?
Artificial intelligence in gaming refers to responsive and adaptive video game experiences. These AI-powered interactive experiences are typically generated by non-player characters, or NPCs, that act intelligently or creatively as if they were directed by a human game-player. The AI engine governs how an NPC behaves in the game world.
Q.4 What exactly is a Watson?
Watson is an IBM supercomputer that combines artificial intelligence (AI) and complex analytical tools to function optimally as a "question answering" machine.
Q.5 What Is Artificial Intelligence in Gaming?
Artificial intelligence in gaming refers to responsive and adaptive video game experiences. These AI-powered interactive experiences are typically generated by non-player characters, or NPCs, that act intelligently or creatively as if they were directed by a human game-player. The AI engine governs how an NPC behaves in the game world.
Q.6 What do you mean by AI that plays games?
Artificial intelligence (AI) is used in video games to provide responsive, adaptive, or intelligent behaviour in non-player characters (NPCs) that is similar to human intellect. Rather than machine learning or decision making, it improves the game-playing experience.
Q.7 In artificial intelligence, what is a game tree?
A game tree is a form of recursive search function that explores all possible movements and their outcomes in a strategy game in order to determine the ideal move.
Q.8 What exactly is the perfect decision game in AI?
A game with perfect information is one in which agents can examine the entire board. Agents have access to all game information and can watch each other's movements. Chess, Checkers, Go, and other games are examples.

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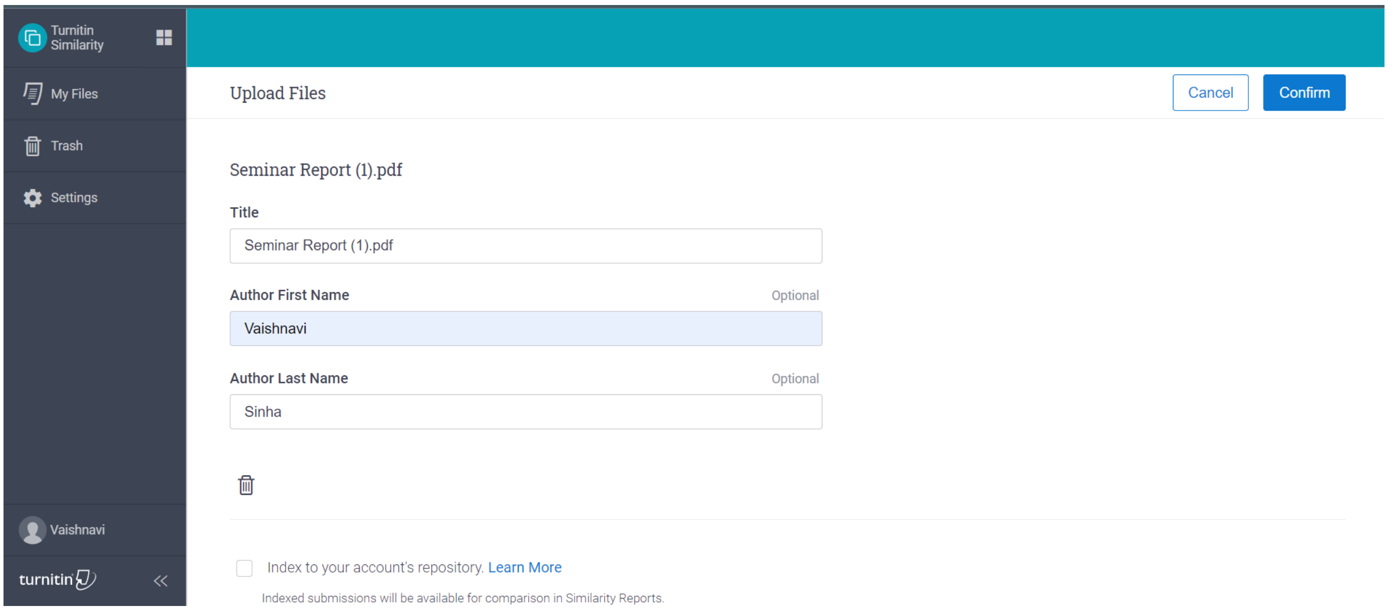

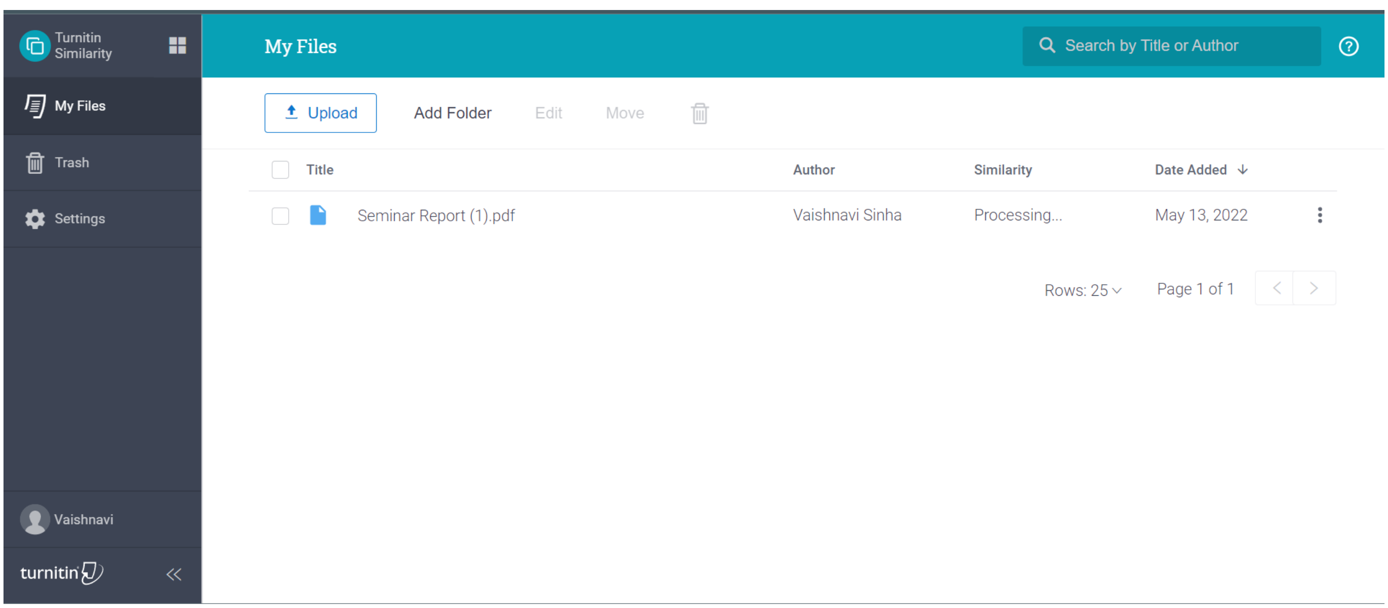


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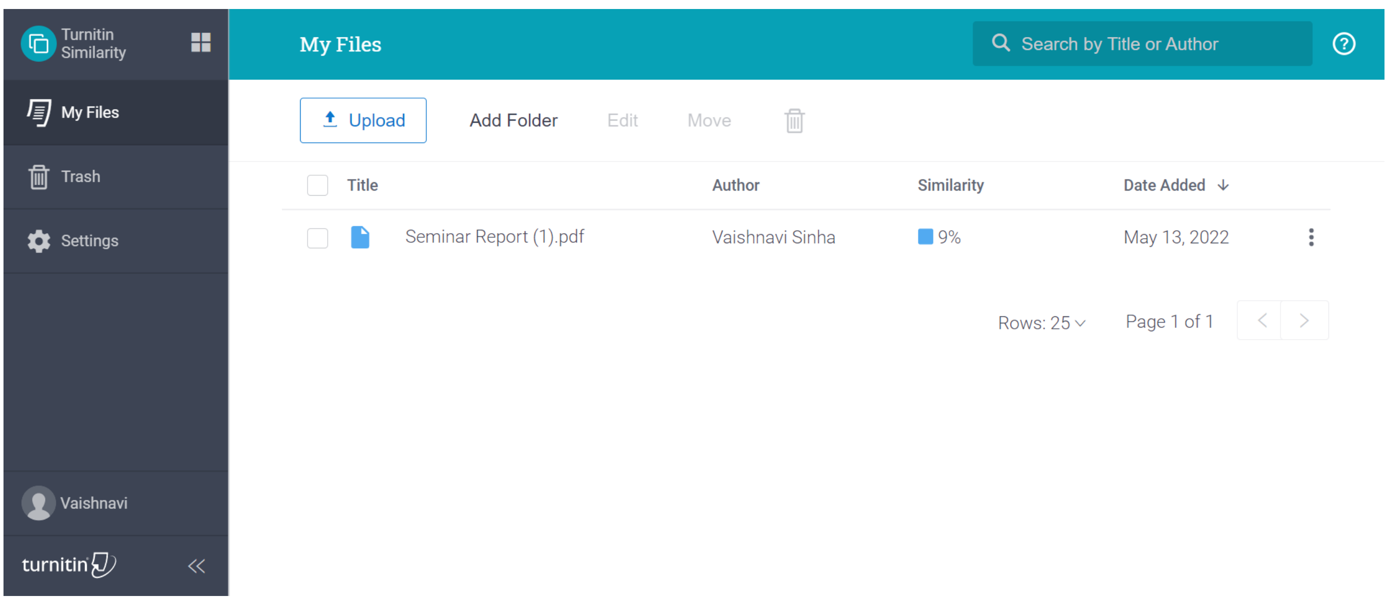
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