Faculdade de Design,
Tecnologia e Comunicação
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GUILHERME DOVAL

ESTIMA DA SILVA

A SEMIOTIC AND USABILITY ANALYSIS OF DIEGETIC UI: METRO - LAST LIGHT

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Dissertação apresentado ao IADE – Universidade Europeia, para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Design e Cultura Visual realizada sob a orientação científica do Professor Doutor Flávio Almeida, Coordenador do Mestrado em Design e Cultura Visual, do IADE - Universidade Europeia e do Professor Luan Carlos Nesi, Professor no Departamento de Ciencias, Tecnologia, Engenharia e Matemática, da UniRitter – Laureate International Universities.

Dedicatória

Dedico este trabalho à minha mãe, que sempre acreditou em mim, me apoiou nos momentos difíceis e que é, sem sombra de dúvida, minha maior inspiração.

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Júri

Presidente	Doutor Carlo Turri
Arguente	Doutor Nelson Troca Zagalo
Orientadores	Doutor Flávio Almeida Coordenador do Curso de Mestrado Design e Cultura Visual do IADE – Universidade Europeia
	Professor Luan Carlos Nesi Professor no Departamento de Ciências, Tecnologia, Engenharia e Matemática da UniRitter – Laureate International Universities.

Palavras-chave Videogames, User Interface, Immersion, Semiotics

Resumo

A narrativa de um jogo é um dos principais componentes da criação da imersão do jogador. À medida que a tecnologia avança, novas ferramentas possibilitam aos desenvolvedores de jogos a criação mundos digitais cada vez mais complexos. A Interface de Usuário tem um papel crucial, fornecendo ao jogador feedback sobre os vários atributos e mecânicas do jogo. Alguns jogos buscaram integrar a interface tradicionalmente intrusiva dentro da narrativa e da arte do jogo, por meio das Interfaces Diegética. O objetivo desta tese é entender como a integração da interface na arte e na narrativa do jogo - criando o que é chamado de Interface Diegética - pode aumentar a sensação de imersão do jogador. Para identificar os processos através dos quais o significado é observado na Interface Diegética, contamos com a Semiótica Discursiva proposta por A.J. Greimas e para avaliar se essas representações Diegéticas afetam a Usabilidade, empregamos as Heurísticas proposta por Desurvire e Wiberg. A metodologia mostrou resultados interessantes acerca das relações entre Interface e Narrativa, bem como o impacto de Usabilidade derivado de tal implementação no jogo Metro: Last Light.

Keywords Videogames, User Interface, Immersion, Semiotics

Abstract

A Game's narrative is one of the key components of creating Player immersion. As technology advances, game developers increase their toolset for creating increasingly complex game worlds. The UI has a crucial role, providing the Player with feedback about the various attributes and mechanics within the game. Some games sought to integrate the traditionally intrusive UI within the game's narrative and art, by the means of Diegetic UI. The goal of this Thesis is to understand how integrating the User Interface into the game's art and narrative – creating what is called a Diegetic Interface – can increase the feeling of immersion for the Player. To identify the processes through which meaning is observed in Diegetic UI, we've relied on the Discoursive Semiotics proposed by A.J. Greimas and to assess if these Diegetic Representations affect usability, we employed Game Usability Heuristics proposed by Desurvire and Wiberg. The methodology proved to yield interesting results regarding the relationships between UI and Narrative as well as the Usability impact derived from such implementation in the game Metro: Last Light.

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LIST OF ABBREVIATIONS

HCI – Human-Computer Interaction

HCD – Human-Centred Design

UCD – User-Centred Design

VR – Virtual Reality

UI – User Interface

GUI – Graphical User Interface

HUD – Heads-up Display

PREFACE

This text was written in Standard English, a personal choice by the Authors who believe that scientific production should not be bound by language barriers. English is, undoubtedly the contemporary Lingua Franca and thus, was the reasonable choice for this work to be read and understood by all English-speaking members of the scientific community regardless of their cultural backgrounds. Another reason for this choice was the fact that most of the sources used through the Thesis were written in English. In the occasions where that was not true, we have translated the text to English and placed the original text as a footnote, this choice was made in order to avoid making sudden language changes during the text. The text also privileges British spelling, as it was the variant the author was more accustomed to, with the exception of citations and models proposed by the contributors, which were kept in their original spelling.

It is important to note that the author is accredited C2 Proficiency by the Cambridge Assessment English, enabling him to conduct research in the English Language.

If by chance, any of the contributors cited in this Thesis believes that the translation provided does not accurately portray the ideas or concepts conveyed in the original text, please do not hesitate to contact the Author.

While at first, the topics surrounding this work seemed rather simple, as I read through the many Books and Articles on the subject it became apparent that to truly grasp the subjective nature of Experiences - and to understand how something seemingly so simple as an interface can impact it - was truly a massive undertaking. Videogames are no longer subject to niche groups of researchers and have found their place of importance amongst the other, more traditional forms of entertainment. However, the lack of a mapping of the related topics of research proved to be one of the massive pitfalls that have plagued this research.

We often forget that videogames haven’t been a part of our daily lives for more than a generation, as a medium, it is still in its infancy and Game Designers are still trying to understand its own language. As such, we hope that this work’s contribution, however small it may be, paves the way for future research and development into the budding, but promising industry.

1. INTRODUCTION

As games become increasingly complex and realistic due to technological advancements, the subject of immersion in games becomes central to understanding how to design games for Virtual Reality (VR). However, VR games are not the sole candidate to benefit for research into immersion (Jennett et al., 2008).

One of the main goals for story-driven games is Player immersion into the game's world. Conceptually, the Player stops being an outside entity and assumes the role of a fictional character, with his own set of goals, beliefs and memories (Heussner, 2015). However, it is important to note that the definition of immersion is still unclear, especially regarding its use by gamers. The considerable number of definitions are problematic in the sense that each definition suggests different approaches to measuring and understanding how this elusive, yet very real phenomena affects the Player experience. With similar terms like Flow, Presence and Cognitive Absorption, it is understandable how there is such a confusion in defining what immersion really means (Jennett et al., 2008).

Considering games as multifaceted experience and considering the observations voiced by former Naughty Dog employee Richard Lemarchand on immersion, we might find an answer to what exactly immersion is and how to achieve it. Immersion is simply attention and elements of the game, such as beauty and aesthetics, story and narrative and finally gameplay contribute in its particular way to grab and maintain the Player's attention (Lemarchand, 2012).

The game's User Interface (UI), as the name suggests, bridges the information gap between the Player and the game, providing information regarding various status of the gameplay. In truth, some games rely on the UI as much more than just its informative function, in city manager games for example the UI is the means through which the Player selects the tool he wishes to use in order to complete the set goals.

The use of Diegetic UI can be seen in some form in various games such as the often-quoted example of Dead Space, and discussed by various authors such as Azevedo, Silva, & Frosi (2017), Fagerholt & Lorentzon (2009) and Salomoni et al. (2017)

The goal of this Thesis is to understand **how Diegetic Interfaces can potentially increase Player immersion and to assess if such implementation can prove to be detrimental to usability.**

This work was structured in three parts, starting with the research into related literature to formulate a theoretical framework to aid us in answering the research question. In this section, we contemplate the related fields of study and contributions from various authors the subjects. Within the theoretical framework, we start with User Experience by considering its history, with contributions from classic authors as well as experimental approaches, the importance of a human-centred approach to Design, the role of emotional engagement to create experiences and finally the various definitions of what an experience is. Afterwards, we delve into the related field of research of User Interfaces, from their origins in computers and how technological advancement enabled us to create increasingly complex Interfaces as well as the evolution of the Videogame Industry and computer interfaces influenced early videogame interfaces, followed by the Heads-Up Display (HUD) and how various game implement it and finally, the concept of Diegesis in UIs in Videogames and its implications to storytelling and Usability.

We then proceed to the Methodology section where we outlined the Research Design of the investigation, by combining Semiotic Analysis and Usability Testing, to approach the research question, we have employed the methodology first proposed by Vitorino & Serrano (2017), consisting of a combination of a Semiotic Analysis, based on the work of Greimas (1976) and a Heuristic Evaluation based on the work of Desurvire & Wiberg (2009). This approach, which is qualitative in its nature, allowed us to understand how the interface is structured in order to create meaning, by becoming part of the discourse of a game's plot or universe.

Finally, we have conducted an analysis of a game's UI utilizing the method established, with insights and perspective established by the theoretical framework, the analysis contemplated ways in which meaning is created in the game, the game's discourse, its themes and figures, as well as the way these are expressed visually. We categorized the interface element in accordance to its design space and finally we considered the usability component by conduction a heuristic evaluation. This analysis provided us with key insights into to the relationship between Diegetic Interfaces in videogames and player immersion.

The object of the analysis is the game Metro: Last Light, published by Quicksilver and released in May 17th, 2013.

2. THEORITICAL FRAMEWORK AND HISTORY

Before we begin contemplating the specific aspects surrounding Diegetic Interfaces in games, we must first consider the subjective aspects surrounding a person's interaction with an object. We began by contemplating the various contributions to User Experience, Human-Centred Design (HCD) through its history and the various definitions of the term. This is followed by an history overview of the evolution of interfaces in games and how technological advancements enabled game designers and developers to craft increasingly realistic games and how this evolution impacted the way Interfaces were constructed in games, as well as defining key terms related to the research question.

2.1 User Experience

User Experience has seen a revival in the latest years, as social media, streaming services and videogames slowly crept into our daily lives it became apparent that software should be created with a focus on usability and accessibility for a successful adoption and customer loyalty (Garrett, 2011). Despite User Experience becoming a mainstream term across fields such as Design and Software Development, there is a great misconception about what User Experience in fact is, what it isn't and why it is important. In this chapter we will explore how User Experience came to be, its potential benefits for products as well as outline the core components of what Designers should think when designing with the user in mind. Starting with a historical analysis of User Experience, with the main contributors to the fields, focusing on the aspects that affect Game Design.

2.1.1 History. Although the term User Experience might have been coined by Donald Norman in 1993 while he was working as a User Experience Engineer at Apple, what we now know as User Experience is nothing new and, so far no one has been able to pinpoint the origin of HCD as a discipline, rather than a term (Nielsen, 2017).

Mayhew (2008) accounts that before the rise of Human-Computer Interaction (HCI) during the 1980s, there was little to no division of labour or specialization in software development businesses and programmers were responsible for everything ranging from coding, to software testing, to UI design, user support and in some cases, even sales and project management. This slowly started to change during the 1980s as specialized professionals started to take over business analytics, UI design, back-end

and front-end programming. Finally, there was the rise of HCI professionals, which tended to come from psychology or human factors background, these professions were considered unwelcomed by developers as their role was not fully understood.

During the 1990s User Experience Design was a brand new term, and with time it cemented itself as a broader discipline than just HCI and Usability. Hassenzahl (2018) relates his experience in working with in HCI in the mid-1990s as a frustrating experience due to it being, at the time, a discipline solely focused on the functionality of software. According to Marais (as cited by Hassenzahl, 2018), this functionalistic approach to design was purely based on rational principles and provided no room for the subjectivity of emotions and aesthetics. Mayhew (2008) also supports this claim, according to her experience, she found it difficult to divide her responsibilities for User Experience with other professionals such as Graphic Designers and Information Architects, and found that in many cases Usability principles came into conflict with Graphic Design and Branding principles, so in many cases compromises had to be made in order for projects to be successful.

Meanwhile in Denmark, Jakob Nielsen, another usability expert was exploring what would later be one of the most classic examples of usability evaluation techniques, the 10 Usability Heuristics are a cheap and fast evaluation technique for usability mistakes in UIs. According to Nielsen & Molich (1990:1), in most cases UI evaluations consist of heuristic evaluations, but little research is done about this kind of evaluation due to it being seen as inferior by researchers. Later in 1998, Don Norman and Jakob Nielsen joined forces to create what Don Norman would call an elite usability company and thus, the Nielsen Norman Group was founded as a company solely dedicated to User Experience Research and consulting (Nielsen, 2008).

According to Jakob Nielsen's analysis on the Nielsen Norman Group (Nielsen, 2017), the User Experience profession has seen considerable growth since 1950 and it is possible to estimate that it will grow considerably up to 2050 (Figure 1). Nielsen's analysis points out that this growth happened for several reasons: As computers became increasingly present in our daily tasks and Personal Computers (PC) started to become a common household item, the User Experience started to directly impact purchase decisions. Alongside the PC revolution of the 1980s, trade press publications also started to review software with one of the common criteria being the Usability. During the web revolution a significant paradigm shift occurred. Before the web, customers had

no idea if a product had good usability, only after purchasing the software did the user find out the product they purchased had terrible User Experience. When companies started selling their products and services online this order changed. Website's usability directly impacted the purchase decision, if a website had poor usability and the customer couldn't navigate around the website and find the products he's interested in and find relevant information about the products, he wouldn't make the purchase. This ensured that companies invested in their User Experience teams. Nielsen also points out that Usability had a great press coverage and User Experience slowly became mainstream, especially during the dot-com bubble. This positive portrayal of User Experience in the media raised further awareness of the benefits of investing in User Experience. According to Nielsen (2017), the PC revolution, the web revolution and positive press coverage are the main reasons behind the growth of User Experience Professionals up to the recent year.

User Experience Design has close roots in the technology industry, although many professionals had come from Human Factors or Psychology, their knowledge was employed in the context of developing software and making technology accessible and engaging for the consumer (Mayhew, 2008). However, it became clear with time that a User's Experience wasn't exclusively a discipline focused on Usability and Functionality as professionals became aware of the true meaning of what an Experience is (Hassenzahl, 2010). According to Redström, (2006): "If design used to be a matter of physical form, its subject matter being the material object, it now increasingly seems to be about the user and her experiences."

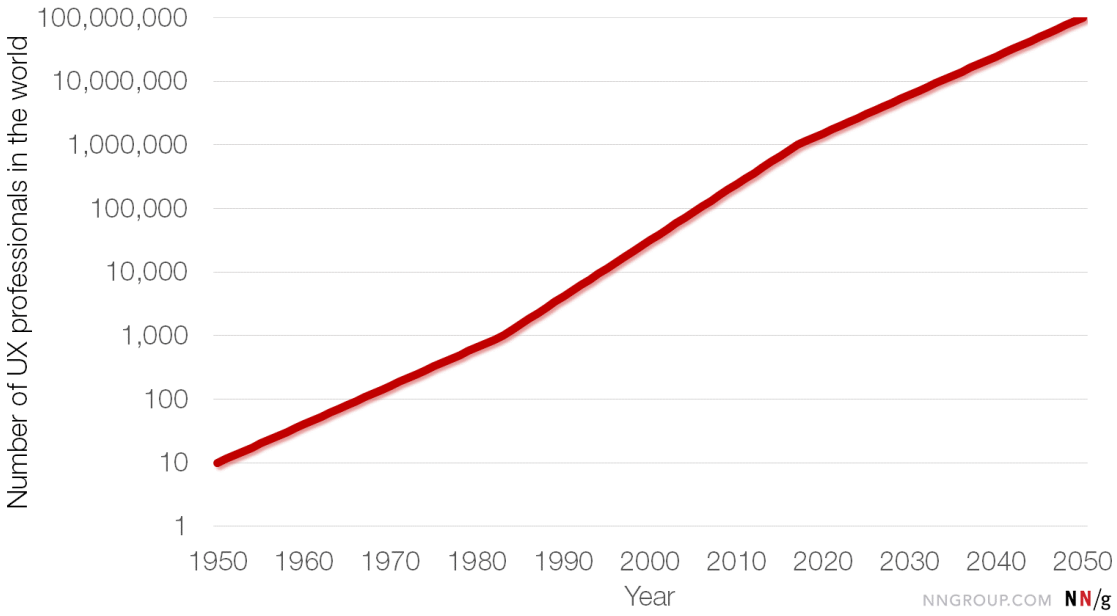

Figure 1: User Experience professionals in the world, with a logarithmic scale for the y-axis (Nielsen, 2017).

In the Preface of The Design of Everyday Things, Norman (2014) explains that in the first edition of the book the main focus was making products understandable and usable, which according to his own self-assessment (Norman, 2003), was heavily critiqued by Designers claiming that by following Norman's suggestions, the resulting product would be usable, but ugly and boring. Norman's response to his critics was an increased interest in the emotional aspect of Design, which will be discussed further in a later chapter.

What was once considered a subjective and elusive aspect of User Experience Design was now in the forefront of literature. "Emotions are inseparable from and a necessary part of cognition. Everything we do, everything we think is tinged with emotion, much of it subconscious." (Norman 2005:7). Authors such as Jordan have also argued against an approach purely based on usability, claiming that:

> (…) such approaches are limited, even dehumanising, as they tend to focus merely on the fit of a product to a person's cognitive and physical characteristics. Pleasure-based approaches, on the other hand, encourage a holistic view of the user, judging the quality of a design on the basis of the wider relationship between a product and the people for whom it is designed (Jordan, 2005:10).

This is also supported by Hassenzahl:

> Usability Engineering, stresses the removal of potential dissatisfaction. But even the best usability may never be able to "put a smile on users' faces," because it only makes the difference between bad and acceptable. Experience on the other hand addresses both, satisfiers (e.g., fulfilled needs,

> emerging emotions) and dissatisfiers (e.g., usability problem, technical problems) on an equal footing through its holistic nature (Hassenzahl, 2010:28).

Despite these significant advancements in our understanding of the importance of a holistic approach, in many cases User Experience designers are still employed exclusively for UI Design, the most common misconception about User Experience Designers is that they work mainly on UIs, web pages and apps and although UIs are indeed an important part of the design process, they are not the only responsibility of User Experience Designer.

"'User Experience' encompasses all aspects of the end-user's interaction with the company, its services, and its products." (Norman & Nielsen, n.d.), such definition is what causes confusion, User Experience is not one discipline such as Web Developer, UI Designer and Visual Designer but rather a design philosophy that aims to merge the service of multiple disciplines with the goal of achieving high-quality experiences for the end-user.

2.1.2 Human-Centred Design. When a project lacks human-centred design methodologies, it fails to account who is the target audience, their needs, their patterns of behaviour and their expectations from the product. If that is the case, how is the user to understand how to use the product? Human memories are primarily based on experiences, and so, if a user has a bad experience from a product, they might disregard it as too confusing and may become frustrated, confused or angry, on the other hand, if the user has a pleasurable experience he will have positive feelings, and since feelings are closely intertwined with our cognition, designers should have both in mind (Norman, 2014). There are in fact, numerous reasons for adoption of a HCD approach, such as increased usability, increased adoption rates, reduced development costs, increased productivity and increase in revenue (Benyon, 2013:20-21).

It is not the goal of this Thesis to discuss specific methods, but rather to argue for the utilization of such methods with the goal of designing for experiences. There are numerous HCD approaches such as the use of Personas, Customer Journey Maps, Storyboards and of course, User Research.

While the terms HCD and User-Centred Design (UCD) might appear similar and are sometimes used interchangeably, there is a clear distinction necessary to understand the more philosophical aspect of the discipline. In his analysis of the shift from Objects to Users as the centre of Design, Redström (2006) states that the world is inhabited by

people rather than Users, Users are instead something created by Designers by the means of the object/service they create. However, there are fundamental problems with how this approach is executed, as Users only exist after they have been presented with an object to interact with, by that point they become Users. If we consider this and accept the fact that there are no Users before there is an Object, how do we design for Users? Redström claims that the problem associated with this approach is that UCD operates on assumptions of how the User will behave and by consequence, the result of the process is not only the Object, but also the User. Redström also states that although participatory design methodologies where Designers work alongside their target audience might create the appearance that this is a non-issue, it does not change the fact that they're still working on assumptions, to better illustrate this, Redström give us the following example:

> Even though I, as the soon-to-be owner of a new house, can be involved in the process of planning it, designing it and even building it, I cannot live in it until it has been built. And in this sense, any ideas of what living in it will be like before I have moved in will relate only to intended use. In other words: while we do design the thing, we can only predict its use.

Indeed there are inherent flaws in such and object-centric approach, and authors such as Grudin (1993) had already established the issues that arise from the use of the word User in the context of designing interfaces for computer systems, claiming it reinforces an engineering perspective on the design of interfaces, and assumes that there is such a thing as an average user, or users.

In his timeless classic, Krug (2014) also states that not only does the so called average user not exist, that any attempt to categorize or describe users in the terms of their likes or dislikes are futile and counterproductive.

Human-centred design has a clear definition under ISO 9241-210:2019, which states:

> Human-centred design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance. (International Organization for Standardization, 2019)

As per its definition, its aim is in human-system interaction, which might include Users, but not necessarily, as systems could be built into the environment which people

inhabit, and react accordingly, such as the case of the field of Domotics, which also could benefit greatly from a human-centred approach.

Despite the ISO Standard defining what HCD is in the context of computer-systems, there are still plenty of applications of such methodologies in other areas. While explaining his definition of HCD Norman (2014) uses examples of objects such as doors, water faucets and refrigerators, objects that despite not being computer-based also require users, however, calling anyone who opens a fridge a user is very unusual.

UCD is typically focused strictly on a Human-System perspective, focusing on general usability principles and participatory design with the aim of optimizing usability of designed products or services by accommodating the user's already inherent preferences instead of imposing designs on the user (Kahraman, 2010).

HCD is a methodology used for purposes other than the interaction people have with digital products ('Clean Team', 2016). Buchanan (2001) states that the true meaning of HCD is often forgotten and claims that this happens primarily when we reduce the concept to pure usability and confuse it with UCD.

> It is true that usability plays an important role in human-centred design, but the principles that guide our work are not exhausted when we have finished our ergonomic, psychological, sociological and anthropological studies of what fits the human body and mind. Human-centred design is fundamentally an affirmation of human dignity. It is an ongoing search for what can be done to support and strengthen the dignity of human beings as they act out their lives in varied social, economic, political, and cultural circumstances. (Buchanan, 2001:37)

The relevance of such approach for the goals of this Thesis is that both methodologies contribute towards understanding how Designers might approach designing interfaces for new technologies, to Benyon, (2013) adopting a human-centred approach means:

- Thinking about what people want to do rather than what the technology can do
- Designing new ways to connect people with people
- Involving people in the design process
- Designing for diversity.

Perhaps the most relevant aspect of Benyon's list to the goals of this Thesis is the first, in order to understand the relationship between diegetic interfaces and play

immersion, we should first ask ourselves how people experience such interfaces, and what they expect the interface to deliver in terms of feedback and interactivity.

2.1.3 Emotional Design. Previously, emotion and aesthetics were considered a secondary topic when designing experiences. As the relationship between emotion and cognition was established it became clear that designing interactive products was not solely dependent on usability and functionality. Rather than considering emotional as a secondary aspect, as Norman had previously done, we now understand that our Emotions directly affect the way we think (Norman, 2005).

Much like movies, video-games rely on emotions to engross and immerse the Player (Tanskanen, 2018:26). According to Lindeman & Beckhaus (2009), in an enquiry about what constitutes Magical Moments, i.e. memorable experiences in VR games, strong emotions is the first in a list of four factors, which also include deep engagement, massive stimulation and escape from reality. Emotion shouldn't be ignored when designing experiences, Benyon (2013:95) claims that "Emotion is a very important part of experience as experience is about feeling.", this claim is also supported by Hassenzahl (2010:4) in a similar statement: "While many processes together produce experience, emotion is at its heart and has an accentuated position. One may go as far as saying that emotion is the very language of experience." He further adds:

> To me, it is beyond question that emotion is at the centre of experience. The most compelling argument for this is the observation that emotion, cognition, motivation, and action are inextricably intertwined. (Hassenzahl, 2010:3)

It has been established by this point the importance of considering emotions when designing experiences, but what is the definition of emotion?

To Norman (2005), both cognitive and emotional processing can be divided in three levels of processing (Figure 2), that work in conjunction, he argues that enjoyment of a product comes from incorporating all there levels in our Design, however he deems the Reflective level to be the most important, since it is the only level of processing that is conscious, whereas Visceral and Behavioral levels are subconscious.

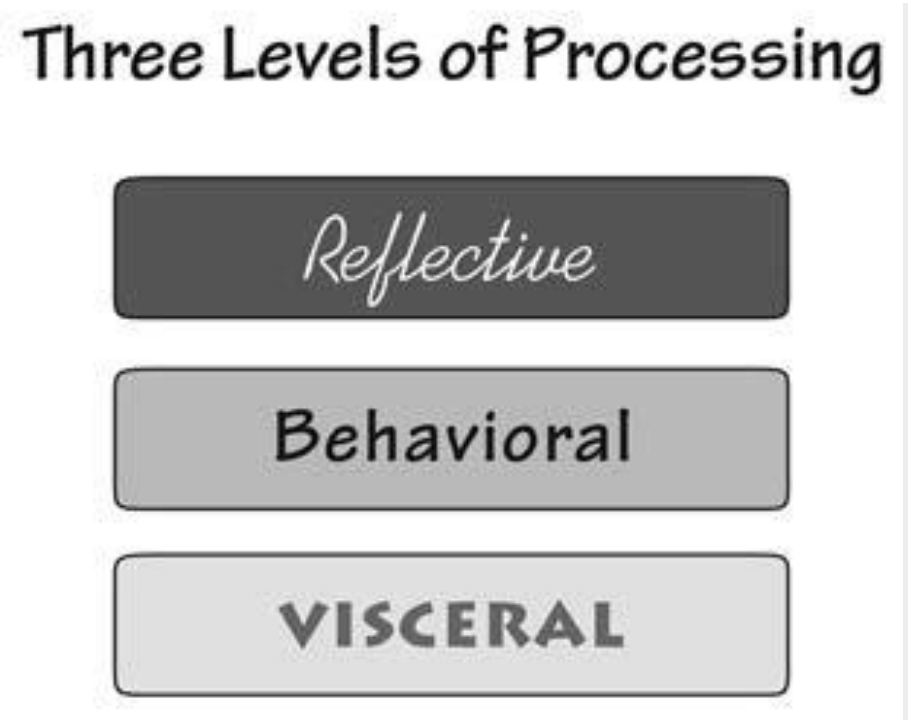

Figure 2: Norman's Three Levels of Processing: Visceral, Behavioral, and Reflective (Norman, 2014:50)

The three levels of processing are a useful tool to consider the emotional level with which Users interact with products. The levels can be understood as following:

- *Visceral:* The immediate emotional response provoked by a product, it usually is concerned with the aesthetics, that is, the first impression we have of a product. This process occurs at an unconscious level.
- *Behavioral:* Concerns itself with how effective a product conforms to the User's expectations of how it should behave, in other words, its related to pleasure and effectiveness of use. Products that are easy to learn and use cause positive feelings, confusing products on the other hand cause the opposite effect – i.e., classic usability. It also occurs at a mostly unconscious level.
- *Reflective:* As the name suggests, the reflective level is concerned with the conscious analysis of a product, that is, how the User relates personally to the product. Norman considers this the most important level, to him, the Reflective level is the home of higher levels of emotions.

Emotions are powerful tools when properly employed by designers. They can create powerful impressions and memories and outright set how someone relates to the object that created such memories, for that reason, it is ideal that designers should consider creating a product that encompasses all levels of emotional processing, a

product that is visually appealing, easy to use and learn and with which the people they're designing for can relate on a deep level.

Jordan's contribution makes similar claims to that of Norman's. Following a post-usability approach to creating experiences through what he calls the "Four Pleasures". Pleasure, he claims, is something humans have sought through history by various means, such as physical activities, creativity, self-expression, interactions with our environment and of course, object we create. He associates three main benefits which humans derive from interaction with products: Practical Benefits, Hedonic Benefits and Emotional Benefits, thus, "Pleasure-based approaches to product design can be seen as approaches that consider the all of the potential benefits that a product can deliver." (Jordan, 2005), these benefits can be also framed under Norman's three levels.

2.1.4 The Definition of Experience. All of the topics previously discussed – the history of User Experience, the importance of a human-centred approach to design, the consideration of emotions when designing products – are essential in discussing one of the main themes of this Thesis, one that is at the heart of the research question. To design immersive experiences, it is important to question the very nature of what constitutes an experience. As it was previously established, Emotions are at the heart of experiences. According to Hassenzahl:

> An experience is an episode, a chunk of time that one went through—with sights and sounds, feelings and thoughts, motives and actions; they are closely knitted together, stored in memory, labelled, relived and communicated to others. An experience is a story, emerging from the dialogue of a person with her or his world through action. (Hassenzahl, 2010:8)

Hassenzahl avoids the distinction between User Experience and Experience, as to him, the only difference is that User Experience focuses itself on interactive products as creators, mediators and facilitators of Experiences. He notes that these interactive products are not experiences in themselves, but nonetheless provide experiences through their abilities to shape how we feel, think and do. According to Hassenzahl, experiences are essentially subjective, holistic, situated, and dynamic. Hassenzahl (2010:27) relates: "An experience will never be objective; it will never focus on a small proportion of processes and aspects only, and it will never be context-free or static.". There is however an aspect that is not intrinsic to experiences in general, which is the positive aspect. Experiences are not always pleasant, and the objective of classic

usability driven approaches is to reduce the chances of having negative experiences, they do not account, however, for creating Positive experiences.

Anderson (2011:10) shares similar views on usability: “Usability clears the way for a good experience by eliminating troublesome interface distractions, but a great experience stems from something more—an awareness of why people could or do care.” The last part of the Sentence also relates to Hassenzahl’s model of goals, which he uses to illustrate the Holistic aspect of experiences. At the top of this hierarchy of goal is the Be Goals, that is, the Why in experiences.

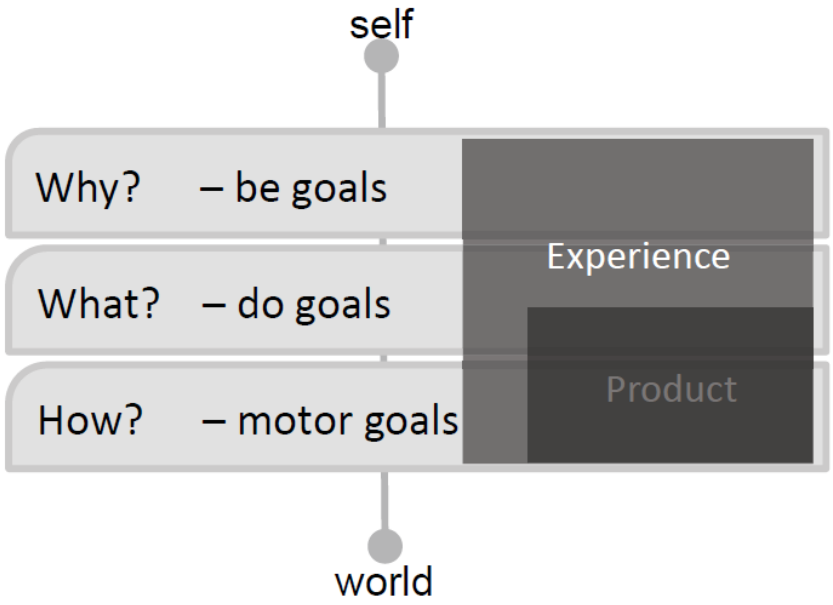

Figure 3: Hassenzahl’s Hierarchy of Goals (Hassenzahl, 2010: 12).

Understanding the role of the Experience in products is a common theme across this Thesis, despite the varying opinions of authors of how to achieve these so-called positive experiences.

For Norman (2014), usability is key in creating good experiences, by minimizing the friction between the object and its user through the user of constraints, affordances, signifiers, feedback, mappings, discoverability and ensuring a good conceptual model is employed, as well as considering the three levels of emotional processing

For Jordan (2005), pleasure-based approaches that employ the Four Pleasures framework allows identifying the pleasures derive from activities and products and how to link them to Product Design,

Hassenzahl (2010) proposes to move beyond product design as the source of experience and to understand that experiences are only derived and facilitated by products, however, they're not experiences in themselves. By considering human needs and attending to those needs through products, Designers can enable positive experiences.

It might be surprising to discover that the most unusual products may be the providers of such lasting experiences. Even objects that are not designed with the goal of providing such experiences can nevertheless be at the core of someone's memory. Computers in their inceptions did not aspire to provide anything beyond complex calculations of mathematical problems, they have, nevertheless, become providers of experiences. From social connection with loved ones, fun provided by videogames to enabling the creation of digital art, it becomes clear that the potential of the virtual realm for creating memorable experiences is as vast as Designers imagination allows.

2.2 User Interface

The history of UIs in computers and videogames is very convoluted, even command line prompts were a considerably recent addition, with earlier computers having only keyboards as a way for the User to interface with the computer. What we now take for granted, the Desktop, keyboard and mouse, WIMP interfaces and even Gamepad Controllers are the result of decades of technological experimentation. Not to mention Smartphone UIs, which heavily rely on gestures for interaction and have only been a part in our daily lives for little more than a decade. How people interface with technology appears to be changing at the rate with which technology advances and more devices are created, posing new paradigms for Interface Design. Some devices are interfaces in themselves, responsible for inputting information, such as the keyboard and mouse, others are responsible for outputting information, such as a monitor, a sound speaker and Head-Mounted Displays. In this Thesis, we will be specifically considering UIs – specifically Graphical User Interfaces (GUI) – in the context of video-games, how they evolved, some of the common types of interfaces found in games and how they affect the Player's experience.

2.2.1 History and Technology. In the Videogames Industry, User Experience is highly dependable on UIs (UIs). In games, User Experience is made possible by two main elements: (1) A *Graphical User Interface* and (2) *Interaction*, being the latter directly dependent on the former. According to Azevedo, Silva, & Frosi (2017), even games with elaborate concepts, story elements, plot and gameplay mechanics can be compromised by a precarious interface, affecting negatively the Player's interaction and experience. The process of creating a GUI is, however, one of the most challenging aspects of video game development, due to the sheer amount of information that needs to be conveyed in contrast to a very limited amount of screen real-state (Russell, 2011).

In one of the earliest examples of games, the 1958 Tennis for Two (Figure 5), there was no distinct graphical interface to speak of, no points counter, no timer or anything of the sort. Games of that era, such as the 1962 Spacewar (Figure 4) – which was built upon the Programmed Data Processor-1 (PDP-1) Computer, which featured a phosphor-based Cathode-Ray Tube display, capable of a 1024 by1024 resolution – were held back by technical constraints such as memory and processing power, to contextualize, the PDP-1 had the equivalent computing power as a 1996's pocket organizer, with less memory. (Hafner & Lyon, 1998:55)

Figure 4: Spacewar being played on a PDP-1.

Figure 5: Tennis for Two being shown at the Brookheaven National Library in 1958.

Controllers for these early games also had to be built from scratch, in Tennis for Two, a large box-shaped controller was created for the game, which allowed players to move their racquets using a dial and whack the ball by pressing a button. Similarly, Spacewar required a dedicated controller to be built to replace the PDP-1's built-in 18 switches (Donovan, 2010:13-15).

Most of the modern computer interfaces are derived from the works of important figures such as Douglas Engelbart, which during his time at the Stanford Research Institute is credited with the creation of the computer mouse, as well as the concept of hyperlinks and windowed displays. Many of his fellow researches at the Stanford Research Institute (SRI) later left to join the famous Xerox Palo Alto Research Center (PARC), and with them borrowed the concepts established by Engelbart and the mouse. PARC refined these concepts and created the first operating system to incorporate all of the concepts proposed by Engelbart. The result was the Xerox Alto, released in 1973.

In a year prior to the Alto's release, the first videogame home console, the Magnavox Odyssey (Figure 6) hit the consumer market. Despite its status, the Magnavox Odyssey was graphically unimpressive, the console was only capable of displaying three squares, which were controlled by a set of two controllers. The behaviour of the squares depended on what game was being played and the console depended on plastic overlays that were placed over the television set. Despite seeming prehistoric by today's standard, to the average home consumer something as moving around dots in a screen was a novelty. (Donovan, 2010)

Figure 6: The Magnavox Odyssey.

The 1970s were marked by the advent of home consoles, Pong became an overnight hit and propelled a small company called Atari into the spotlight. Games of the early to late 70s were characterized by being mostly in black and white, lacking audio, without the ability to change games through ROM cartridges and were graphically very basic, consisting mainly of lines, dots or blocks, these are considered first-generation game consoles. From the late 70s to early 80s, there were significant changes in games, as technology advanced, games were able to display up to 16 colors with simple sprites and consoles such as the Atari 2600 started featuring ROM cartridges, each holding its own game, as well as audio. Despite graphical advancements, the GUI of these games showed little advancement from games of the previous generation. But a series of events would eventually change the video game industry, one of the most significant events starts at PARC, with the Alto.

By all standards of the time, the Alto was not the average minicomputer. And among a list of innovations – and perhaps most important to human-computer interaction – is the GUI. The Alto was the first system designed from its inception to support an operating-system based around the concept of a GUI and features most of the elements found in modern operating systems: windows, the desktop metaphor, files and

folders, What You See is What You Get (WYSIWYG) editors and of course, a mouse. What doomed the Alto however, was Xerox itself, as its executives failed to see the value in what was created at PARC.

PARC's advancements found their recognition outside of Xerox in 1979, when a 24-year-old Steve Jobs payed a visit to PARC, he was flabbergasted by the GUI and in a later interview claimed that he was sure that the GUI would be the future of computing. Xerox allowed this visit in exchange for purchasing shares of Apple.

Soon after the visit, Jobs immediately ordered that the Apple Lisa be redirected to utilize a GUI. Despite the Lisa's commercial failure, the next computer from Apple, the Macintosh released in 1984 popularized the GUI and mouse. Despite a low start in sales, the Macintosh outsold its competitor the IBM PCjr and soon after, every computer company wanted to have its own GUI. The revolution caused by the Macintosh and Apple computers directly affect game developers and caused a paradigm shift to both game development and the games themselves.

The video game industry crash of 1983 moved developers away from the home console market into the up-and-coming personal computers such as the Macintosh, IBM PCs and the Commodore 64 for their superior memory and processing capabilities, as well as ease of distribution and the fact that computers were not exclusively meant to play games.

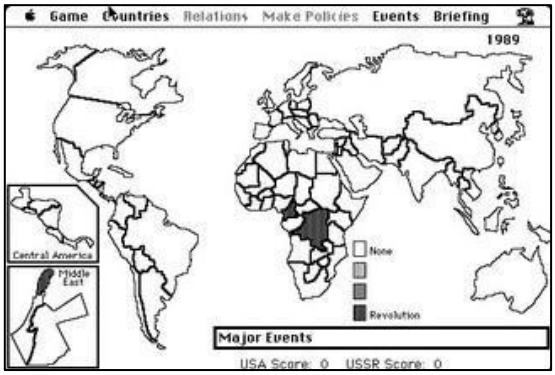

Figure 7: Balance of Power.

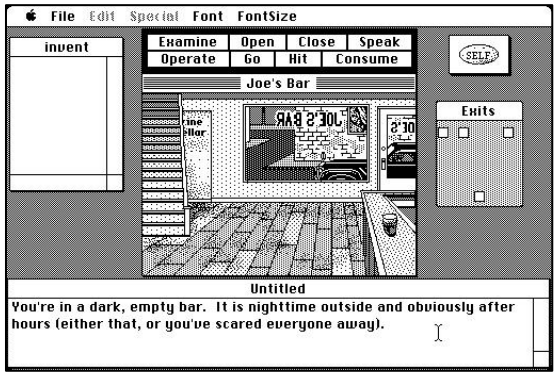

Figure 8: Déjà Vu.

Gone are the days of the infamous text-based games such as Adventure, MUD, of ASCII based games such as Rogue, as well as the blocky sprites found on consoles like the Atari 2600. With the new graphical capabilities of Personal Computers and the revolution brought forth by the advent of the GUI, games were now exploring the potential of the digital medium for storytelling and creating rich and engrossing

experiences. Déjà Vu (Figure 8) was directly impacted by the Macintosh's GUI and gave up the traditional method of text-input found in earlier adventure games in favour of selecting actions from a list in the screen.

Before this period, the main elements found in GUI's were primarily concerned with scoring, indicating how many lives a Player had left or a timer, all regarding information about the game's current state. However, they were rarely ever used for direct interaction. Will Wright the creator of Sim City reportedly stated that the interface for the game was heavily based upon the MacPaint software for the Macintosh.

While many assumed the home consoles to be a dead end after the crash – with retail stores going as far as to not sell video game consoles or reducing stock significantly – a Japanese company called Nintendo would revive America's dying videogame market with the release of the Nintendo Entertainment System.

The NES's game line-up established some of gaming's most iconic characters and games, with titles like Super Mario Bros., Castlevania and Metroid only to name a few.

Figure 9: Super Mario Bros.

Figure 10: Castlevania.

By this point, we began to see icons starting to be used to represent information instead of text, such as the case in Super Mario Bros. (Figure 9) where the indication of the amount of coins the Player has is represented by the coin itself. In the same way, in Castlevania (Figure 10) hearts are indicated by the heart icon, as well as the selected weapon, which is represented by the icon of the weapon itself.

Games where now starting to integrate the interface into the game art, leaving aside text only where it was necessary, but still employing icons as representations of the information that needed to be displayed. As the evolution of graphics in consoles and PCs continued, so did the GUI found in those games, as more processing power meant the ability to display sprites in the screen. Even in late NES games such as The Legend of Zelda (Figure 11), the interface is primarily composed of icons instead of text to indicate the Player's health, selected weapon and items. However, these interfaces where still secluded to a section of the screen dedicated solely for this purpose, and while games such as Rad Racer (Figure 12) stylized the interface section in order to simulate a car's dashboard, it was still in another layer, separate from the game world. This however is an example of *skeuomorphism* in early game's interfaces.

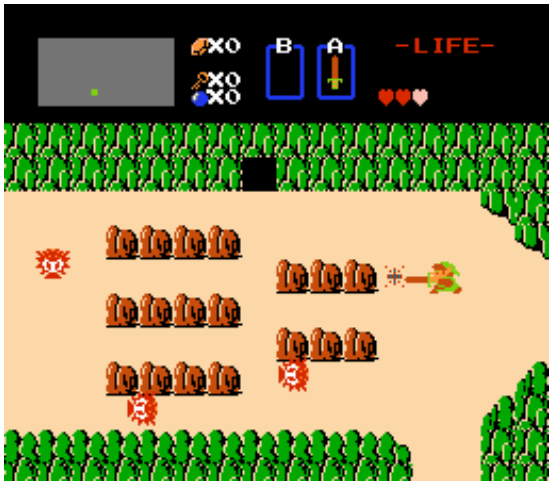

Figure 11: The Legend of Zelda.

Figure 12: Rad Racer.

With Nintendo establishing a foothold in the United States and the game's industry revival, it became clear that videogames were not a thing of the past, and companies like Sega followed suit with the release of their respective console – the Sega Master System – to compete with the NES. Both Nintendo and Sega dominated the home console market for the following years, and by the end of the 1980s and the beginning of the early 1990s, released their new 16-bit consoles, the Super Nintendo Entertainment System and the Sega Genesis. The increased processing power allowed for better quality graphics, seemingly more realistic and fluid than their earlier predecessors. Nintendo's iconic characters and games received a significant graphical improvement, as did their interfaces. Interfaces were becoming increasingly stylized to fit the game's aesthetics, by styling fonts and increased resolution found in icons, the interface space however was still largely unchanged. Different genres have characteristic

interfaces, each influenced by its heritage from previous instalments, in some cases however, genres are defined by the platform they're played at.

With the console market seemingly booming, games found their way across the homes of the consumer market, but the games found across the consoles were largely different from the ones found on PCs. Whereas consoles were the home of sidescroller games, racing games and fighting games – usually aimed towards younger consumers –, the PC was the home of text-adventure games, strategy games, role-playing games and first-person shooters, mainly due to the PC being primarily used by a more mature demographic. Whereas consoles where designed for plug-and-play controllers and cartridges, PCs where by their very nature modular and allowed their users to customize the machine by increasing its memory, processors, sound cards and external peripherals. This meant that the two distinct platforms developed their own interface design language. Games like SimCity 2000 (Figure 13) employed an interface designed for use with the mouse, with which the Player selects the desired tool. In The Secret of Monkey Island (Figure 14) the Player uses the mouse to select actions he wishes to perform, influenced by early adventure games like Déjà Vu.

Figure 13: Sim City 2000.

Figure 14: The Secret of Monkey Island.

The PC's upgradability allowed for increasingly complex games, and with the advent of 3D games such as Id Software's Wolfenstein 3D (Figure 15) and Doom (Figure 16) defined the first-person shooter genre. Doom's influence was such that it impacted the whole gaming industry as a whole, according to Donovan, (2010): "Video games were never quite the same after Doom. It was to games what The Beatles' Sgt Pepper's Lonely Hearts Club Band was to pop: a paradigm shift.", it also propelled the sales of Graphical Processing Units (GPUs), accelerating the transition from 2D to 3D.

By the late 90s, the PC became the home of famous titles such as the competitive shooter Unreal Tournament and the real-time strategy of Age of Empires 2 and with the popularity of the PC and Home Consoles, games became ubiquitous. Despite the revolution brought forth by Doom in the gaming industry, it still carried over a UI philosophy similar to early games, where there was a distinct separation from the UI space and the game space.

> From about 1992-1996 FPS user interfaces were designed with a clear split between a "world view" and a "tool bar" similar to the layout seen in productivity tools. There was often a distinct frame dividing the part of the screen concerned with the game world from the part concerned with providing player feedback and information. (Fagerholt & Lorentzon, 2009:6)

Figure 15: Wolfenstein 3D.

Figure 16: Doom.

John Carmack, the responsible for programming Wolfenstein's and Doom's engine summarized Id Software's opinion on game narrative claiming that videogame stories were like those found in porn movies – expected but unnecessary (Donovan, 2010:297). Other authors such as Bissell (2010) are even harsher in their retrospective of Doom, claiming that the game is full of clichés and suffers from shallow narrative elements.

Truthfully, games don't necessarily require a profound story to succeed and Doom proves this, spawning many similar games (Bissell, 2010:63), but there always had been studios trying to push the medium to its full potential with games like Déjà Vu, The Secret of Monkey Island and even earlier text adventure games. Narrative was the domain of the Role-Playing games and Adventure games, but narratives were about to become a part of the popular first-person shooter genre, with the first game from a small company called Valve. The game was called Half Life, instead of approaching first-person shooters like its predecessors, Half Life starts with an unarmed character in 20-minute monorail ride across a research facility, the character is also the most

unlikely of heroes, not a space marine like in Doom or anything similar, the players control Gordon Freeman, a theoretical physicist. As the story events unfold, we see the narrative being told through changes in the game environments, visual cues and comments from other characters about what they're experiencing. What differentiated Half Life from other story driven games were its show-don't-tell approach to deliver its story, all events were seen from the perspective of the Player – as soon as the game first starts, the control from the Player is never removed (Bissell, 2010:64). Half Life was lauded by its balance of storytelling and combat action, proving Id Software's opinion regarding storytelling in first-person shooters wrong.

Figure 17: Half Life.

Half Life's interface (Figure 17) was also very much *linked with the game's narrative*, as most of the on-screen elements – represented though a HUD – only appear after the Player encounter a special suit, implying that the information conveyed on-screen is being provided by the suit (Fagerholt & Lorentzon, 2009:8).

It became clear with the technological advancements that games were not exclusively meant to serve as a form of instant gratification, while it is true that many games still rely on the fun factor – and these can still be incredible games –, it was apparent that alongside the ludic aspect of game design, there was also the storytelling potential. However, balancing the two is a hard task to accomplish, some games make compromises in either gameplay or storytelling in favour of the other. In comparison to

Doom's interface, with its effective approach to an action-oriented gameplay, with big health, ammo and armour indicators showing the Player the most important information in order to survive the action, Half Life's HUD however is much more subtle, being overlaid on top of the Player's perspective, with some elements fading when unnecessary, such as the weapon selection menu (which appears occluded in Figure 18).

> There is still much debate about the relationship between story and gameplay. Some people are so story-oriented that they believe that adding gameplay is guaranteed to ruin a good story. Others feel the opposite—that a game with strong story elements has been cheapened somehow. Still others prefer a middle-of-the-road approach. (Schell, 2014)

2.2.2 The Heads-Up Display in Modern Games. One of the main elements of GUIs found in videogames is called a Heads-Up Display (HUD), according to Fagerholt & Lorentzon:

> A head-up display, or HUD, is any transparent display that presents data without requiring the user to look away from his or her usual viewpoint. The origin of the name stems from the user being able to view information with their head "up" and looking forward, instead of angled down looking at lower instruments. In games, the term HUD refers to the method by which information is visually conveyed to the player whilst a game is in progress. The HUD is frequently used to simultaneously display several pieces of information such as the main character's health, items, and indicators of game progression and goals.(Fagerholt & Lorentzon, 2009:1)

The concept of a HUD is a borrowed term from aviation, where, according to Kim (2016) and Vitorino & Serrano (2017), it projects information into the user's view. For pilots, it provides real-time combat and navigational information on a transparent screen. In many cases, the terms HUD and GUI are commonly used interchangeably. From this point on, we will make a distinction between the two based on its respective original definitions.

We understand HUD in videogames as any overlaid frame which conveys information regarding the Player's current status, such as health, ammo, map, compass and enemy's health. The elements positioning is static, although in some cases HUD elements can be occluded when not in use and has the clear purpose of conveying information.

The GUI is the larger system which consists of all on-screen elements, including menus and other non-gameplay related elements that don't require the Player's constant attention (Fagerholt & Lorentzon, 2009:4).

Traditionally, the HUD is found in games such as First-Person Shooters, Racing or Action Adventure games, HUDs usually have a very predictable structure and have become crystalized across the years. The HUD is usually expected to incorporate into the game's overall aesthetics and art direction in order to reduce noise. There are examples of games such as First-Person Shooters with Role-Playing Games elements that are comprised of interface elements found in both genres, such as the case of Borderlands 2.

Figure 18: The HUD in Borderlands 2.

Figure 19: A skill system menu part of the overall GUI in Borderlands 2.

The work of Azevedo et al. (2017:43) shows that in earlier games, the HUD possessed certain pseudo-skeuomorphic visual elements, such as statues adorning the frame of the game area or such as the case in Rad Racer where the HUD mimicked a car's dashboard. According to Azevedo et al. (2017) this was a common practice, contrary to the idea that only essential elements should constitute the UI, however as the industry matured this practiced was discontinued.

The HUD has a long history in games, and proto-HUDs can be seen as early as in games such as Solaris for the Atari 2600. However, many authors have been heavily critic of the long-standing use of HUDs, claiming that:

> Many elements found on a typical HUD are there not out of necessity, but out of convention; they represent a sort of "info overkill" that, for the vast majority of players, has no impact on gameplay at all (Wilson, 2006).

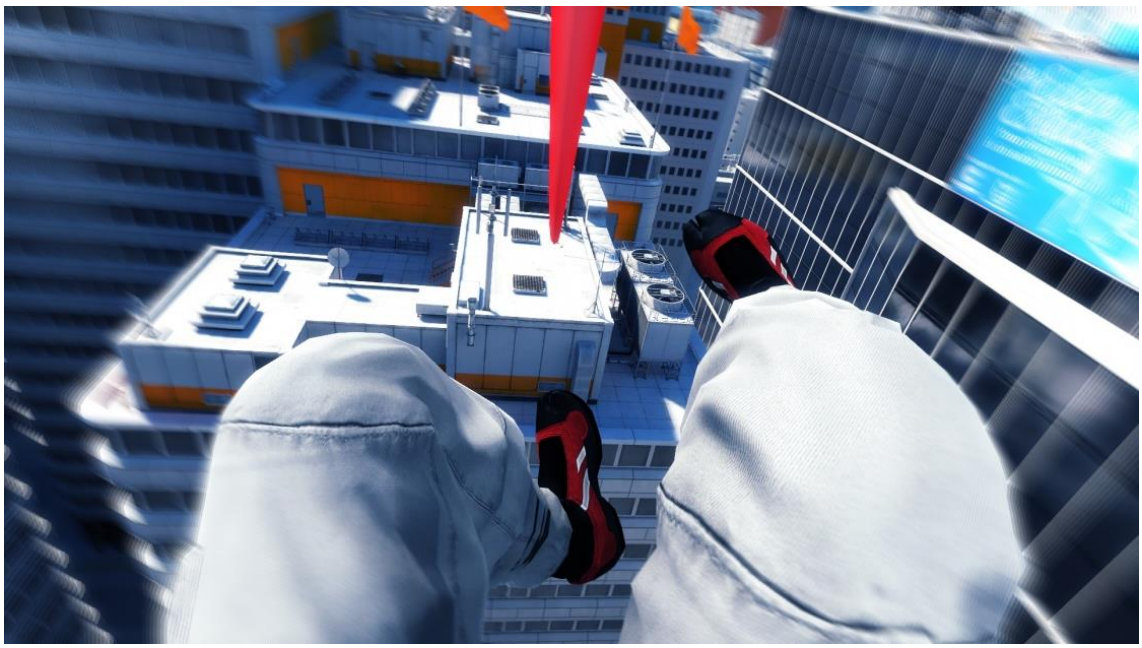

Figure 20: Mirrors Edge.

There are significant examples of first-person games without HUDs, such as the case of Mirror's Edge (Figure 20), which presents an interface that is completely HUD-less.

> Instead of presenting user information in a layer on top of the game, the 3D geometry itself is utilized to guide the player throughout the game by highlighting environmental objects that are of interest for the player (Fagerholt & Lorentzon, 2009).

Some games take advantage of the HUD in the narrative, such as the case in Metal Gear Solid, where during a cutscene, the main character is tortured and the Player

must repeatedly press a button to resist the torture, with the health bar depleting. However, as the HUD is usually not visible during the cutscene, this use of the HUD also breaks the Player's immersion and he is reminded that he's just playing a game.

Other games, however incorporate HUD and GUI elements in game objects which are part of the game's world, such as the case in Metro: Last Light (Figure 21) where the objective list is represented by a clipboard. As the clipboard is a part of the game's universe, it is also affected by the world's physical rules, and in dimly lit areas the Player is required to brighten up the clipboard using a lighter. This type of approach to designing GUI elements does not break the Player's immersion, by integrating the HUD's elements into the game world, it is possible to create a heightened sense of immersion and a better overall experience with the game (Azevedo et al., 2017).

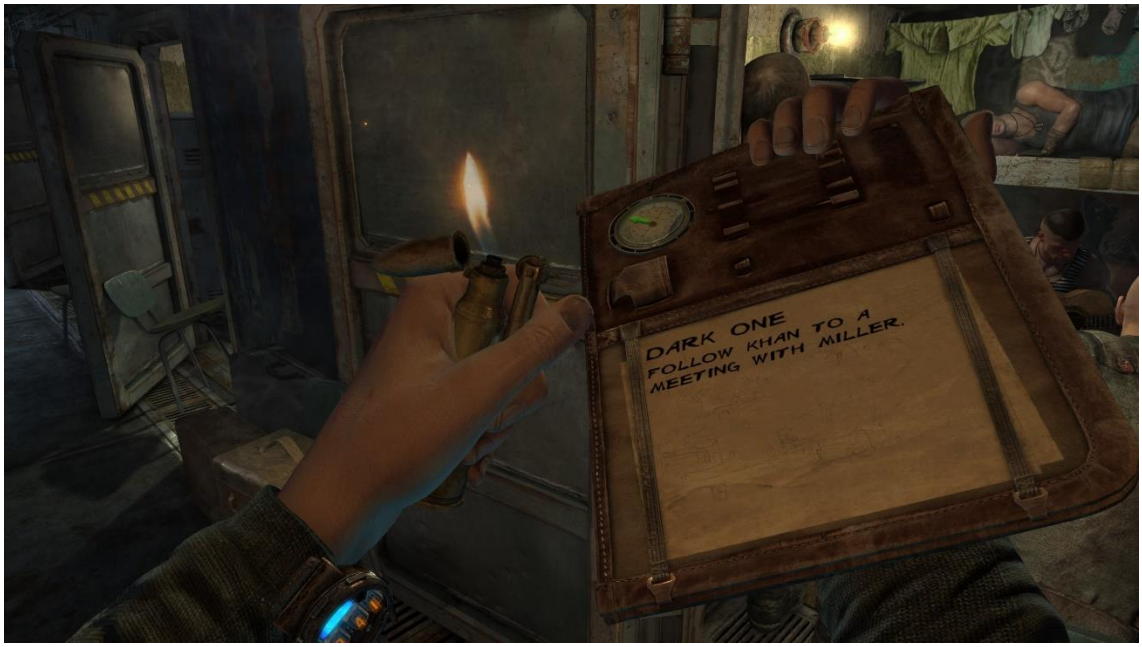

Figure 21: Metro: Last Light.

2.2.3 Diegetic Interfaces. Video-games, like movies, are commonly narrative driven experiences, and although many successful games rely on gameplay alone instead of complex plots, the universe in which the game takes place is still, in many cases, fictional.

The search for a definition of the term Diegesis first arose with the postulates from Plato and Aristotle. Diegesis, from the Greek *διήγησις,* means 'to narrate, set out in detail, describe' (Liddell & Scott, 1996). Diegesis would be aligned with poetic imitation, known as *Mimesis*, that is, they were practically the same thing. To Plato, *Mimesis* and *Diegesis* were two distinct terms: Whereas *Diegesis* stands for the

narration, *Mimesis* represents the Poetic Imitation. Aristotle, however, saw narrative as closer to Poetic Imitation in relationship to Plato's concept (Azevedo et al., 2017) . Through the times, these concepts were revised by many authors, such as Lodge (1984), who proposes that Plato's and Aristotle's definition is exceedingly limited to classify all the variations and nuances in a fictional narrative. Furthermore, it is a common occurrence where narratives show a thin line between *Diegesis* and *Mimesis*. As such, it's paramount that more diverse and complex forms of classifications are proposed (Azevedo et al., 2017).

In games, the study of *Diegesis* in the context the HUD in First-Person Shooters was approached by Fagerholt & Lorentzon (2009), where they proposed that *Diegesis* in games refers to the world in which the game's story takes place, defining whether an element is part of the game's world and if the characters that inhabit this world can perceive it.

The relationship between interface and narrative has been explored by many authors, expanding upon the relation using the traditional story-telling term of *Diegesis*. "(…) Diegesis refers to the world where a story's events take place, defining whether or not something is a part of the virtual world and if the character that inhabit this alternative world can see it." (Azevedo et al., 2017). From this definition, it is possible to separate video-game interface elements into six distinct types (Figure 22).

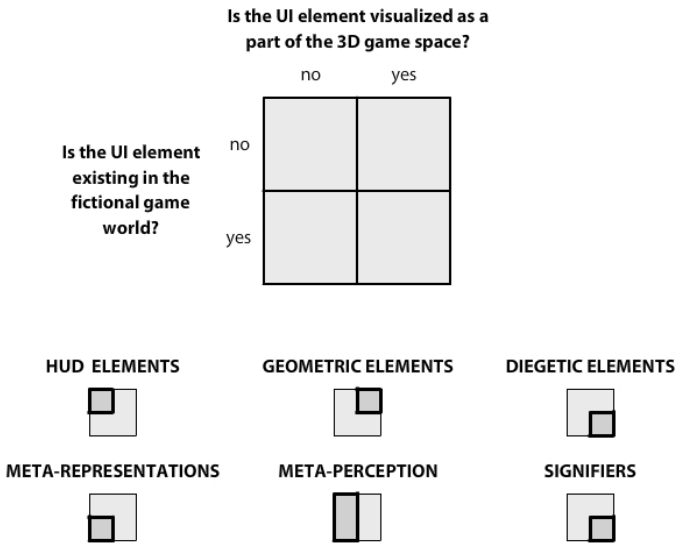

Figure 22: Types of interfaces distinguished by their presence in the narrative and 3D space (Fagerholt & Lorentzon, 2009).

From the six types proposed by Fagerholt & Lorentzon (2009), we will not consider signifiers, as per the author, they are merely a sub-category of Diegetic elements. The defintions of the elements are:

- *Non-diegetic* Elements or HUD Elements are presented in an overlaid fashion in the game's world, they can be seen by the player but not by the player's avatar and are not part of the game's narrative and makes up the majority of interface types found in First-Person Shooters (Fagerholt & Lorentzon, 2009).
- *Diegetic elements* are UI elements that exist within the game's narrative, they are presented as if viewed by the player avatar's perspective (Fagerholt & Lorentzon, 2009).
- *Meta-Perception* elements do not belong to the spatial dimension but play a role in connecting the player by emulating the player's character senses, a traditional form of this is the blood splatter indicating that the player is suffering damage, commonly found in FPSs (Fagerholt & Lorentzon, 2009).
- *Meta-Representations* present the player with information that exists within the game's world but is not represented spatially, one example of this could be the computer terminals found in Fallout 3 (Fagerholt & Lorentzon, 2009).
- *Geometric* elements are presented in the 3D geometry but do not belong to the game's narrative. One such example could be the Runner's Vision in Mirror's Edge (Fagerholt & Lorentzon, 2009).

It is important to note that HUDs which are well integrated with the game world, provide a more immersive interaction and user experience, however, traditional HUDs usually are not a part of the narrative, since the characters are not aware of these elements and therefore, by definition, are considered non-diegetic elements (Azevedo et al., 2017).

Games posess a varying degree of these elements, such as the case of Fallout 4 (Figure 23), where the Player's main menu for selecting weapons, armor and performing other functions is a diegectic representation of an in-game item (Figure 24), as the Player scrolls through the item it is possible to see the playable character interacting with the it.

However, during normal gameplay the game possesses a traditional HUD, with a health bar, compass, action points, ammo, enemy's health bar and the aim reticle. The

game also features meta-perception elements indicating Player damage and some geometric elements, through the aim-assist feature in the game.

Figure 23: The HUD in Fallout 4 displaying many types of Interface Elements.

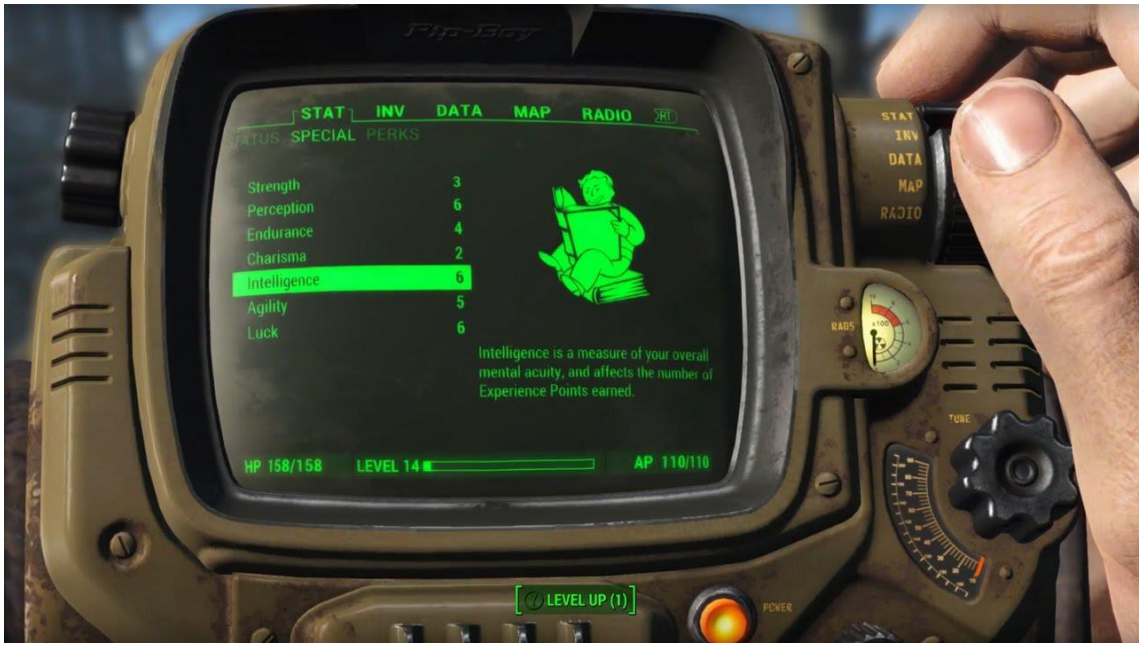

Figure 24: A Menu system in Fallout 4 represented in Diegetic form.

An example of diegetic interfaces that is often cited though related literature is Dead Space, a game that has a completely diegetic interface, where every element in the game belongs to the game's world. The health bar (Figure 25) is represented on the back of the main character and ammo is represented above the weapon when aimed, the in-game menus and navigation aids (Figure 26) are also a holographic projection provided by the character's suit.

Figure 25: Dead Space features a fully Diegetic Interface, the bar on the protagonist's back represents his overall health.

The game was conceived to be an immersive story-driven science fiction experience from the very beginning. The main goal of the studio was for it be as immersive as possible, an ideal that was pushed into all departments of the game's development, including the UI department to create the most immersive experience possible. And so, the UI team decided that all elements of the GUI would be kept diegetic to avoid clutter and also to keep the Player immersed, removing the "safe barrier" between the Player and the game world (Ignacio, 2013).

Figure 26: The Inventory system in Dead Space is also fully diegetic as it is projected as a hologram.

3. METHOD

To understand the relationship between Diegetic Interfaces and Player immersion and to properly evaluate if the implementation of Diegetic Interfaces impact usability, we must first address the fields of study related to the topic, for this, we have separated this investigation in two parts. Starting with research into the theoretical aspects regarding User Experience, its history, the importance of human-centred design, the emotional aspects of experiences and the definition of experience, a research into the evolution and history of UIs across the years, with an emphasis on the ones found in Videogames with various titles that exemplify the various types of interfaces with voices from both the industry and academia and finally, the definition of Diegesis from its origin to its context within UIs in games. This first part was important to both clarify important terms and to identify key contributions that aided us in answering the research question.

Following the theoretical and historical contextualization, we have conducted an analysis of the a diegetic interface, the methodology employed in this analysis was based on the work Of Vitorino & Serrano (2017), and consists of a combination of Semiotic Analysis, based on the work of Algirdas Julien Greimas and a Heuristic Evaluation based on the work of Desurvire & Wiberg (2009). This approach is qualitative in its nature, allowing us to understand how the interface is structured in order to create meaning, by becoming part of the discourse of a game's plot or universe. To Hassenzahl, (2010) "Experience is holistic. It comprises of perception, action, motivation, and cognition. It emerges from the simultaneous activation of those processes and integrates them into a meaningful, inseparable whole." With the addition of Schell's (2014:10) view that, "When people play games, they have an experience. It is this experience that the designer cares about. Without the experience, the game is worthless.", it is possible to understand games as an experience, which according to Hassenzahl, (2010) should be meaningful.

It is impossible for an individual to look at an object without ascribing a meaning to it, therefore, any type of information, especially visual information, is something that is not an object unto itself, but rather, the result of an individual and social interpretation by the part of the observer (Dias, 2016:395). To search for meaning in visual representations of information – namely the UI – this investigation resorted to

understand it as a form of text, which is visual in nature but carries a discourse nonetheless.

> (…) what does the verbal show about the Painting? How? This "what" of the painting that the semioticist wants to make visible are the structuring processes of the whole by seizing the pertinent units and disclosing the manner which these elements are arranged in its textural manifestation with the purpose of pointing out that a work of art's meaning is produced by its construction[1] (Oliveira, 1995:104).

To begin the analysis, first we separated the interface elements through their placement on-screen, afterwards, separated the previous elements into their subsets, focusing on their function. We then categorized the element according to its type based on the types proposed by Fagerholt & Lorentzon (2009). Afterwards, proceeded to perform a Semiotic Analysis of the Plane of Expression and its relationship with the corresponding Plane of Content. Finally, he have conducted a Heuristic Evaluation utilizing Desurvire & Wiberg's (2009) PLAY Heuristics, utilizing the heuristics found on Category 3, responsible for usability and game mechanics.

For the Object analysed in this Thesis, we opted for Metro: Last Light, a game that is lauded by its use of Diegetic Interface elements and immersive storytelling.

3.1 Discoursive Semiotics

According to Vitorino & Serrano (2017:235), "Semiotics seeks to determine what the text says, how and why it says, through an analysis in different forms of expressions[2]". Greimas' semiotic theory positions itself as the theory of the processes of signification, and not the science of the study of signs. It focuses itself on the generative process behind the creating of meaning (Greimas, 1976 as cited by Dias, 2016:396).

This discipline, which was heavily influenced by the works of Ferdinand de Saussure, developed into its own form of Semiotics, aimed specifically at Discourse Analysis alongside an original method proposed by Greimas. In addition to the

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[1] Mas o que o verbal mostra da pintura? Como? Esse o que da pintura que o semioticista quer tornar visível são os processos de estruturação de seu todo a partir da apreensão das unidades pertinentes e da evidenciação do modo como essas são arranjadas nasua manifestação textual com o propósito de assinalar que é em função da construção da obra que sua significação é produzida.

[2] A semiótica busca determinar o que o texto diz, como e para que diz, fazendo isso através de análise de textos em diferentes formas de expressão.

methodological support, an extensive terminological vocabulary is also presented, which is described in the postulate *Semiotics and Language: An Analytical Dictionary* (Greimas & Courtés, 2008). One of such terms is 'Text', and while it might seem unusual to refer to visual representations as such, our understanding is that:

> The term text is often taken as a synonym of discourse, […] Both terms – text and discourse – can be employed interchangeably to designate the semantic axis of non-linguistic semiotics : a ritual or a ballet can be considered as either texts or discourses[3] (Greimas & Courtés, 2008:460).

The semiotic theory of Greimas is first characterized by the concept of a generative process of meaning, starting from the most simple and abstract to the most complex and concrete, and is composed of three levels, this is called the Plane of Content, where the main Discourse lies, and the Expression Plane, the externalization of the content.

It is important to note that, analysing verbal and non-verbal text through Discoursive Semiotics does not necessarily imply that it is necessary to observe each text in accordance to a previously constructed structure but rather, observe the possible articulations and constructions of meaning that, in the text, result in a determined structure (Castro & Portela, 2018).

3.1.1 Plane of Content. On the Fundamental Level, we find the basic semantics that constitute the foundation of the text's construction. It is here we find the semantic categories that order the text's content in a general and abstract fashion. This level is based on difference and opposition, in order to establish this opposition however, it is necessary the existence of common traits (Antonio, 2008).

Fiorin (2010:189) characterizes the fundamental levels as the most abstract and simple, where the text's meanings are represented by the semantical oppositions, whose terms are:

1. Determined by a living being's sensorial relationship with the content, which are considered attractive or Euphoric and repulsive or Dysphoric;
2. Negated or Affirmed by the elementary syntax operations;

[3] Com freqüência, o termo texto é tomado como sinônimo de discurso, […] Os dois termos - texto e discurso - podem ser empregados indiferentemente para designar o eixo sintagmático das semióticas não-lingüísticas : um ritual, um balé podem ser considerados como textos ou como discursos.

3. Represented visually by a logical relationship model called the Semiotic Square (Figure 27)

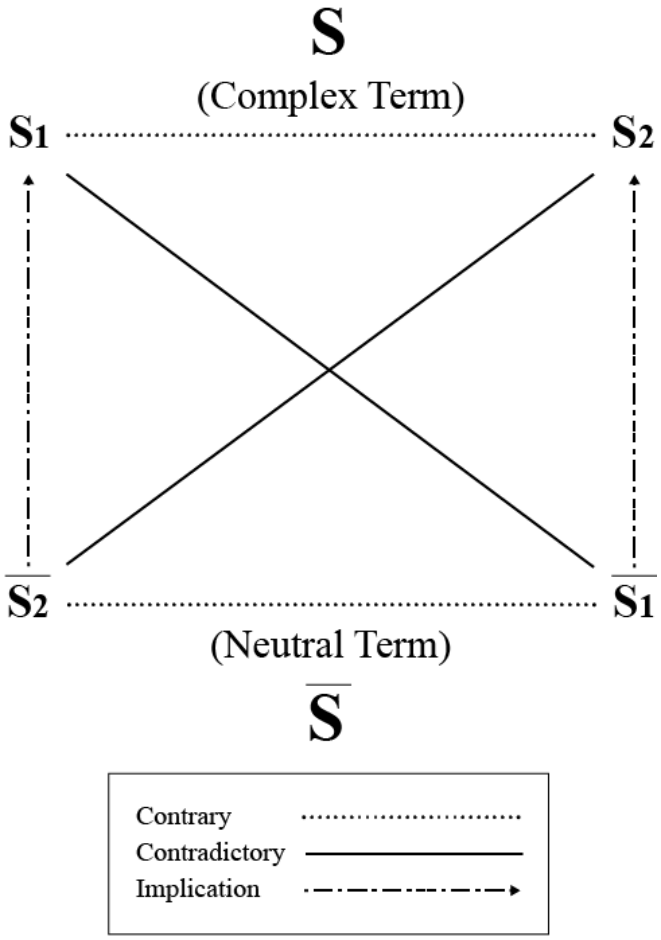

Figure 27: The Semiotic Square.
Adapted from (Greimas & Courtés, 2008)

Lara (2011) provides us with the example semantic oppositions of /humanity/ vs /divinity/, which also yields the contraries /not humanity/ and /not divinity/ (which are also contrary in comparison to each other). Besides the oppositional relationships, there also exists complementary relationships, such as the case of /humanity/ and /not divinity/, as well as /divinity/ and /not humanity/. The contrary terms /humanity/ and /divinity/ are then valued (positively or negatively) by placing them under Thymic Categories, either Euphoric of Dysphoric. Furthermore, the Thymic categories terms are also related to the Tensive category, Tension vs Relaxation, Euphoric terms correspond to the continuity of Relaxation, whereas Dysphoric terms relate to discontinuity, or tense separation. (Fiorin, 2010)

On the narrative level, the abstract values from the Fundamental become inscribed into objects, with which the observer can relate by Conjunction or

Disjunction. The texts in this level are structured by a Canonical Narrative Schema which comprises four phases, namely: Manipulation, Competence, Performance and Sanction. (Castro & Portela, 2018; Lara, 2011).

> A text´s narrative is the story of a subject in search of values. In order for the subject to have access to the values, they are inserted into objects. The objects, with their values, circulate among the subjects. Thus, when a subject earns or acquires a value, another subject must give this value or be deprived from it. The consequence of this is that the narrative unfolds and redefines itself as the story of two subjects interested in the same values and in search of these desired values. [4] (Fiorin, 2010:191)

Fiorin (2010) highlights that the conversion from the Fundamental Level to the Narrative Level can be synthetized in three key points:

1. The Introduction of the subject, replacing of the logical semantic oppositions and the occurrence of narrative transformations brought forth by the subject;
2. The fundamental semantic categories become values for the subject and are "embedded" in the objects with which the subject relates to;
3. The Tensive and Thymic categories are converted to Modalities that modify the actions and the modes of existence of the subject and its relationships with the values.

GENERATIVE PROCESS OF MEANING			
		Syntactic Component	**Semantic Component**
Semionarrative Structures	*Deep Level*	*Fundamental Syntax* Operations and Relations in the Semiotic Square	*Fundamental Semantics* Semantic investment in the Semiotic Square
	Surface	*Narrative Syntax*	*Narrative Semantics*

[4] A narrativa de um texto é a história de um sujeito em busca de valores. Para que o sujeito tenha acesso aos valores, são eles inseridos nos objetos. Os objetos, com seus valores, circulam entre os sujeitos. Dessa forma, quando um sujeito ganha ou adquire um valor, outro sujeito doa esse valor ou é dele privado. A consequência disso é que a narrativa se desdobra e se redefine como a história de dois sujeitos interessados nos mesmos valores e em busca desses valores desejados. (Fiorin, 2010:191)

	Level	Canonical Narrative Schema: Actants and Modalities	Semantic investment in the actants and modalities
Discoursive Structures		*Discoursive Syntax* Discursivization *Actorialization* *Temporalization* *Spatialization*	*Discoursive Semantics* Thematization Figurativization

Table 1: The Generative Trajectory of Meaning
Adapted from (Greimas & Courtés, 2008:209)

Lastly, on the Discursive level, the Subjects and Objects become Actors in the Discourse and the narrative begins to display the Time and Space categories, in order to transform the text into a communicative situation. The values previously embedded in objects become widespread as Themes - abstract elements which explain and instil reality – as well as Figures – or concrete elements that built the world simulacra and cover adjacent themes (Castro & Portela, 2018; Fiorin, 2010)

3.1.2 Plane of Expression. Constantly, the adage "A Picture is worth a thousand word" is evoked in order to state that in most occasions, images can represent, explain or convey complex ideas in a more efficient manner than in its written, descriptive form. As we delve further into the Semiotic Theory proposed by Greimas, we find heavy influences from Saussure and his conception of the Sign as a duality between Signifier and Signified. This dyadic – i.e. two sided – model was then revisited by Louis Hjelmslev, who renamed them into the two planes discussed in this section – the Signifier and Signified becomes the Plane of Expression and the Plane of Content respectively (Fontanille, 2006:6-11).

If, in a primary phase, the Semiotic Theory focuses its efforts in analysing the content of a text, then in a second phase that focus is transferred into the Plane of Expression, which if we refer to the Sausurrian model – i.e. the Signifier - constitutes the 'sound-image' component of a Sign. Hjelmslev however, understood that the Plane of Expression represents material culture and the physical materials of a medium – images, printed words, sounds or even physical performances (Chandler, 2017). Furthermore, Hjelmslev adds that: "There can be no content without an expression, or

expressionless content; neither can there be an expression without a content, or content-less expression" (as cited by Chandler, 2017:64).

Lara (2011) claims that, in the case of aesthetic texts – Poems, Ballet, Painting, etc. – the Plane of Expression doesn't limit itself to expressing content – Such as the case in utilitarian texts. Instead, it creates new relationships with the content, contributing to the global signification of the text.

> The Signifier or Plane of Expression has always been defined as instances of externalization of content, where the concrete qualities of language and the stimuli seized by our sensorial organs are manifested. When considering complex semiotic objects – theater, music, cinema, etc.- additional efforts in researching the synesthetic factors involved in this plane are necessary[5] (Lopes & Souza, 2018).

Before analysing the visual text it is important to note that, the Semiotic Analysis of strictly visual representations doesn't privilege neither the Plane of Content or the Plane of Expression, as the Dimensions – Also referred to as Plastic Formants – can also hold complementary relationships with one or more units within the Plane of Content (Oliveira, 1995).

> If, for example, I observe that the changes in a fruit's color may be put into relation with its degrees of ripeness, the changes will belong to the plane of expression, and the degrees of ripeness, to the plane of content (Fontanille, 2006:11).

Despite the numerous contributions to the relationship between the two planes, the lack of a Generative Trajectory for the Plane of Expressions proves to be a challenge yet to be overcome in order for a structured analysis of such plane. However, as Lara (2011) points out, Greimas may have provided an outline for a Generative Trajectory for the Plane of Expression in his book *De l'imperfection*.

Surface Level	**Form** (Eidetic Dimension)
Intermediary Level	**Colour**

[5] O significante ou o plano da expressão sempre foram definidos como instâncias de exteriorização do conteúdo, onde se manifestam as qualidades concretas das linguagens e os estímulos apreendidos por nossos órgãos sensoriais. Quanto mais complexo o objeto semiótico considerado (teatro, música, cinema etc.), mais devem ser investigado os fatores sinestésicos que atuam nesse plano.

	(Chromatic Dimension)
Deep Level	**Light**

Table 2: An outline for the Generative Trajectory of Meaning in the Plane of Expression
Adapted from (Lara, 2011).

This table shows that, both Forms and Colours depend on the presence of Light, without which they wouldn't have any effect on the observer, this is the main reason for its placement as a Deep Level structure. However, Light and Colour hold between each other an intimate relationship and as such, they should be placed under a Photochromatic Dimension, uniting both levels into one (Lara, 2011). Furthermore, if we refer to Greimas, (1984) we also find the Topological Dimension, which refers to the spatial properties of the Visual Text

To analyse the Plane of Expression in Visual Texts, we will employ the following Dimensions, with no specific hierarchy in mind.

Dimensions	**Terms**
Topological Dimension Spatial Properties	*high* vs *low;* *centre* vs *extremity;*
Eidetic Dimension Forms and Shapes	*circular* vs *rectilinear;* *uniform* vs *multiform;* *expanded* vs *contracted;* *angular* vs *rounded.*
Photochromatic Dimension Light and Colour	*light* vs *dark;* *monochromatic* vs *polychromatic;* *chromatic* vs *achromatic;* *opacity* vs *transparency;* *warm colours* vs *cool colours.*

Table 3: The Dimensions of the Plane of Expression
Adapted from (Greimas, 1984; Lara, 2011; Oliveira, 1995; Vitorino & Serrano, 2017).

3.2 Heuristic Evaluation

Despite this Thesis perspective of games as a medium through which storytelling can be achieved and, as Hassenzahl (2010) puts it, a mediator for experiences, they are still, nevertheless, software. As such, they're still bound to the principles of usability proposed by HCI studies. One of the methods proposed to analyse software in order to isolate usability issues is called heuristic evaluation.

Perhaps the most known examples of this type of evaluation is Nielsen's (1994) usability heuristics, which consists of 10 heuristics – or as Nielsen explains, broad rules of thumb – for evaluating UIs in a cheap and fast manner.

#	**Heuristic**
1	Visibility of system status
2	Match between system and the real world
3	User control and freedom
4	Consistency and standards
5	Error prevention
6	Recognition rather than recall
7	Flexibility and efficiency of use
8	Aesthetic and minimalist design
9	Help users recognize, diagnose, and recover from errors
10	Help and documentation

Table 4: Jakob Nielsen's Usability Heuristics
Adapted from (Nielsen, 1994).

For the purposes of this Thesis and in aiding us in answering the research question, we will rely on the work of Desurvire & Wiberg, (2009) where they claim that traditional heuristic evaluation fails to consider important concepts in Game Design, such as immersion, challenges and entertainment. Thus, a specific set of Heuristics for games is necessary, and they introduce the PLAY Heuristics as a possible solution.

The reason for choosing this method over the one proposed by Vitorino & Serrano (2017) is that the set of Heuristics it proposed was an earlier iteration of the PLAY Heuristics called HEP – Heuristics for Evaluating Playability. HEP was useful, but only in limited circumstances, PLAY however is a more recent iteration featuring up-to-date Game Design information from various triple-a game studios, as well as it taking into consideration that game design is both an Art and a Science (Desurvire & Wiberg, 2009: 558).

I. Category 1: Game Play
A. Heuristic: Enduring Play
A1. The players finds the game fun, with no repetitive or boring tasks; A2. The players should not experience being penalized repetitively for the same failure; A3. The players should not lose any hard won possessions; A4. Gameplay is long and enduring and keeps the players' interest; A5. Any fatigue or boredom was minimized by varying activities and pacing during the game play.
B. Heuristic: Challenge, Strategy and Pace
B1. Challenge, strategy and pace are in balance; B2. The game is paced to apply pressure without frustrating the players. The difficulty level varies so the players experience greater challenges as they develop mastery; B3. Easy to learn, harder to master; B4. Challenges are positive game experiences, rather than negative experiences, resulting in wanting to play more, rather than quitting; B5. AI is balanced with the players' play; B6. The AI is tough enough that the players have to try different tactics against it.
C. Heuristic: Consistency in Game World
C1. The game world reacts to the player and remembers their passage through it; C2. Changes the player make in the game world are persistent and noticeable if they back-track to where they have been before.
D. Heuristic: Goals

D1. The game goals are clear. The game provides clear goals, presents overriding goals early as well as short term goals throughout game play; D2. The skills needed to attain goals are taught early enough to play or use later, or right before the new skill is needed; D3. The game gives rewards that immerse the player more deeply in the game by increasing their capabilities, capacity or for example, expanding their ability to customize.
E. Heuristic: Variety of Players and Game Styles
E1. The game supports a variety of game styles; E2. The game is balanced with multiple ways to win; E3. The first ten minutes of play and player actions are painfully obvious and should result in immediate and positive feedback for all types of players; E4. The game had different AI settings so that it was challenging to all levels of players, whether novice or expert players.
F. Heuristic: Players Perception of Control
F1. Players feel in control; F2. The players have a sense of control and influence onto the game world.
II. Category 2: Coolness/Entertainment/Humor/Emotional Immersion
A. Heuristic: Emotional Connection
A1. There is an emotional connection between the player and the game world as well as with their "avatar."
B. Heuristic: Coolness/Entertainment
B1. The game offers something different in terms of attracting and retaining the players' interest.
C. Heuristic: Humour
C1. The game uses humour well.
D. Heuristic: Immersion

D1. The game utilizes visceral, audio and visual content to further the players' immersion in the game.
III. Category 3: Usability & Game Mechanics
A. Heuristic: Documentation/Tutorial
A1. Player does not need to read the manual or documentation to play; A2. Player does not need to access the tutorial in order to play.
B. Heuristic: Status and Score
B1. Game controls are consistent within the game and follow standard conventions; B2. Status score Indicators are seamless, obvious, available and do not interfere with game play; B3. Controls are intuitive and mapped in a natural way; they are customizable and default to industry standard settings; B4. Consistency shortens the learning curve by following the trends set by the gaming industry to meet users' expectations. If no industry standard exists, perform usability/playability research to ascertain the best mapping for the majority of intended players.
C. Heuristic: Game Provides Feedback
C1. Game provides feedback and reacts in a consistent, immediate, challenging and exciting way to the players' actions; C2. Provide appropriate audio/visual/visceral feedback (music, sound effects, controller vibration).
D. Heuristic: Terminology
D1. The game goals are clear. The game provides clear goals, presents overriding goals early as well as short term goals throughout gameplay; D2. The skills needed to attain goals are taught early enough to play or use later, or right before the new skill is needed; D3. The game gives rewards that immerse the player more deeply in the game by increasing their capabilities, capacity or, for example, expanding their ability to customize.
E. Heuristic: Burden On Player
E1. The game does not put an unnecessary burden on the player;

E2. Player is given controls that are basic enough to learn quickly, yet expandable for advanced options for advanced players.
F. Heuristic: Screen Layout
F1. Screen layout is efficient, integrated, and visually pleasing; F2. The player experiences the user interface as consistent (in controller, colour, typographic, dialogue and user interface design); F3. The players experience the user interface/HUD as a part of the game; F4. Art is recognizable to the player and speaks to its function.
G. Heuristic: Navigation
G1. Navigation is consistent, logical and minimalist.
H. Heuristic: Error Prevention
H1. Player error is avoided; H2. Player interruption is supported, so that players can easily turn the game on and off and be able to save the games in different states; H3. Upon turning on the game, the player has enough information to begin play; H4. Players should be given context sensitive help while playing so that they are not stuck and need to rely on a manual for help; H5. All levels of players are able to play and get involved quickly and easily with.
I. Heuristic: Game Story Immersion
I.1 Game story encourages immersion (If game has story component).

Table 5: PLAY Heuristics
Adapted from (Desurvire & Wiberg, 2009)

4. ANALYSIS

4.1 About Metro: Last Light

Metro: Last Light is second instalment in a series of games developed by 4A Games and published by Deep Silver, released May 17th, 2013. The game is based around the book series Metro 2033 by the Russian author, Dmitriy Glukhovskiy. The game is set in a post-apocalyptic Moscow, following a Nuclear War that made the surface uninhabitable and forced the survivors to live in the Moscow Metro. Upon reception, the game was lauded for its atmosphere, world design, story and gameplay (Moriarty, 2013; VanOrd, 2013).

The game is classified as a singleplayer first-person shooter, and features stealth gameplay elements, enabling the Player to choose between direct combat or dispatching enemies quietly. The game features multiple difficulty settings. For the purposes of this Thesis we opted to play the game under Ranger Hardcore, which according to the text description aims to provide the most immersive experience of the game, removing all HUD elements. This choice was made in order to assess the impact of removing on-screen elements and if this way of playing the game has direct impact on usability and immersion. While a comparative analysis of playing the game with the HUD vs playing the game without the HUD was considered, we believe that by starting the game without the HUD it was possible to analyse the game under the perspective of someone who has never played the game.

4.1.1 Defining Interface Elements. The Interface in Metro – Last Light is very straightforward, from an early gameplay segment that features a prologue to the main story, we see two elements: *A Wristwatch* on the protagonist's left hand featuring a blue LED and a digital clock, *and a Gun.*

Figure 28: The first gameplay segment of Metro – Last Light

Following this opening sequence, the Player assumes control of the Protagonist, which proceeds to automatically take two items from his desk: *A Journal and a Lighter.*

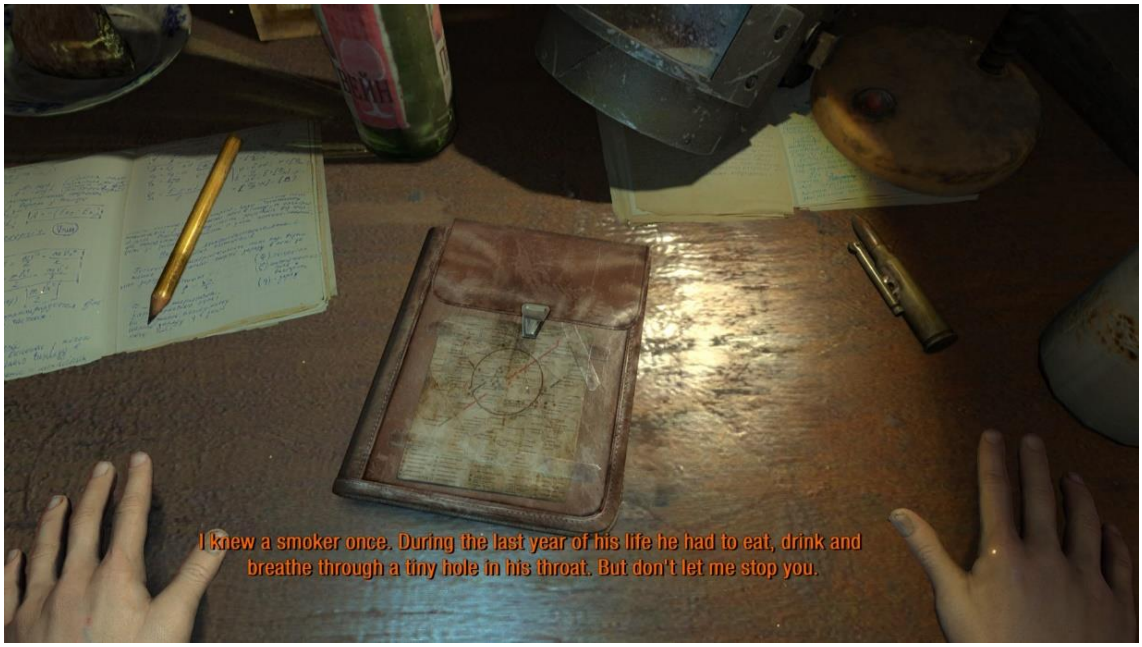

Figure 29: The Journal and Lighter are presented to the Player.

The Player is then left to wander around the environment freely, interacting with other characters who will give the Player exposition about the game world. As previously stated, the difficulty level under which the game was analysed does not feature a HUD.

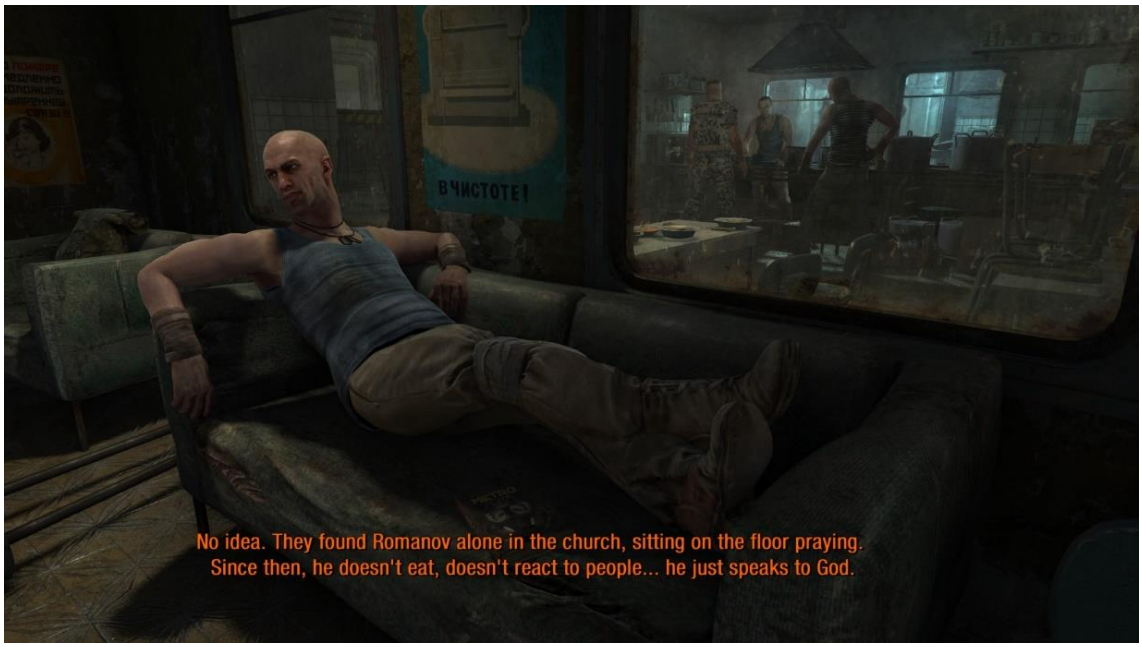

Figure 30: The Player's view as he explores his environment.

Upon reaching the Armory, the Player is presented with the *Gas Mask*, as well as receiving his guns, which he can test in a shooting range.

Figure 31: The Gas Mask is presented to the Player.

So far, we have established four distinct items which play important roles in the game's mechanics and gameplay, which we will refer to as.

- Gun;
- Watch;
- Gas Mask;

- Journal and Lighter.

There are other interface elements which are responsible for specific game mechanics, such as a Battery system which the Player must use in order to recharge its flashlight, however this system is only used occasionally and thus, we have opted not to analyse it and instead focus on the more prominent and common elements.

By pressing the right mouse button, the Gun's sights become centred in the screen, allowing for more accuracy, we can then identify that the Gun element has two distinct behaviours: *Hipfire Mode* and *Aim Mode.*

As it was previously established, the Player also possesses a Watch, featuring an *LED* and a *Clock*, these two elements inform the Player of two distinct aspects of gameplay, which will be discussed further in their own sections.

4.1.2 Element Analysis: Gun. The Gun is the protagonist's primary form of defence against enemies, either monsters or human. The Player comes across various types of guns through the game, but for the purposes of this Thesis we will not analyse each individual gun, instead, we will look at all weapons simply as a means through which the Player kills enemies.

The gun takes up the lower right portion of the Player's perspective in its Hipfire Mode, differently from other First-Person Shooters however, there is a distinct lack of crosshair in order for the Player to aim.

Figure 32: Gun viewed from Hipfire Mode.

Figure 33: Gun viewed from Aim Mode

4.1.2.1 Element Classification. As there is no barrier between the Player and the game world and the weapon is fully contextualized through the in-game narrative, this element is considered a fully Diegetic element, the scope shown while in Aim Mode is also fully Diegetic, since the scope can always be seen placed upon the gun model – unless there is no scope attached.

4.1.2.2 Semiotic Analysis. Starting from the Plane of Expression, the element's two different modes are related to the Topological Dimension, by the means of the oppositional relationship /centre/ vs /extremity/, which are related to the terms /accuracy/ vs /inaccuracy/ found the Discoursive Level of the Plane of Content, establishing semi-symbolic relationship.

While in Aim Mode, the scope can assume various configurations depending on which scope the Player has equipped however in all of them – except for guns without scopes – we find representations of the Eidetic Dimension through the terms /circular/ vs /rectilinear/ by either a dot in the centre of the scope or crosses. The scope's central dot also manifests the /opacity/ vs /transparency/ and /high saturation/ vs /low saturation/ terms in the Photochromatic Dimension of the Plane of Expression.

Player movement creates the fundamental opposition /static/ vs /dynamic/ while in Hipfire Mode, however, there is no manifestation of such relationship in the Element's Expression. When a Player manages to kill an enemy, the /victory/ vs /defeat/

terms emerges in the Discoursive Plane, leading to the Fundamental opposition of /life/ vs /death/.

4.1.2.3 Heuristic Evaluation. Despite a lack of hints and pop-ups to aid the Player in learning the game's control scheme, the Player does not need to read the manual or documentation in order to play the game, as the game's controls are mapped according to industry standards seen in other First-Person Shooters. The Player receives the proper auditory and visual feedback when he fires the gun, albeit not from the interface but rather as the form of muzzle flash and sounds from the gun. The screen layout is efficient and integrated, following the standard placement of the gun on the lower-right side and cantering when the Player enters Aim Mode. As a Diegetic element, the Player experiences the interface as part of the game, encouraging immersion in the game world.

Despite the element fitting favourably under a considerable number of heuristics, it is also important to note the ones in which it has failed. Due to the fact that the game possesses no HUD, there is no way for the Player to check how much ammunition he has left in total, it is only possible to see how many rounds there are on the current magazine, which may prove to be a challenge for new Players to the series, putting an additional burden to the Player.

4.1.2.4 Overview. Some of the aspects in which the element fails in the usability evaluation section seems to reinforce others, the lack of an ammo indicator can prove to be an additional challenge for the Player, encouraging him to explore the world in search of more ammo, this element also adds to the survival element proposed by the game's narrative, the Fundamental /life/ vs /death/ opposition is also applied to the Protagonist's relationship with the world he inhabits, reinforcing the themes proposed in the game's discourse. Following the information gathered during the element's analysis, we have constructed a table for visualizing the element classification, the semiotic analysis of the plane of content and the plane of expression and lastly, the usability heuristics.

Analysis Results: Gun	
Element Classification	Diegetic
Plane of Content:	Discoursive Level accuracy vs inaccuracy victory vs defeat
	Fundamental Level life vs death static vs dynamic
Plane of Expression:	Topological Dimension centre vs extremity
	Eidetic Dimension circular vs rectilinear
	Photochromatic Dimension opacity vs transparency high saturation vs low saturation
Usability Heuristics;	A1,A2, B3, C2, F1, F3, I1[6]

Table 6: Analysis Results: Gun

6

- A1. Player does not need to read the manual or documentation to play;
- A2. Player does not need to access the tutorial in order to play;
- B3. Controls are intuitive, and mapped in a natural way; they are customizable and default to industry standard settings;
- C2. Provide appropriate audio/visual/visceral feedback (music, sound effects, controller vibration);
- F1. Screen layout is efficient, integrated, and visually pleasing;
- F3. The players experience the user interface/HUD as a part of the game;
- I.1 Game story encourages immersion (If game has story component).

4.1.3 Element Analysis: Watch. The Watch is the one element which is consistently visible through the game with no changes in appearance, its purpose is to provide the Player with two distinct status information: The current oxygen filter's duration and the protagonist's visibility to enemies, represented by a pair of the red glowing numbers on the watch and a blue led indicator, respectively.

Figure 34: While close to a light source, the lit LED indicates that the Player is visible.

Figure 35: In a dark area, the LED become unlit, indicating that the Player is not visible to enemies.

Figure 36: While exploring the surface or in irradiated areas where the Player must use a gas mask, the numbers on the watch represent the current oxygen filter's duration.

4.1.3.1 Element Classification. Once again, the element assumes a Diegetic representation, the Watch is placed in the Protagonist's left wrist and is contextualized as part of the game's art and narrative.

4.1.3.2 Semiotic Analysis. On the Plane of Expression, the LED indicator manifests characteristics from the Photochromatic Dimension, by the oppositions /light/ vs /dark/ and /chromatic/ vs /achromatic/, they relate to the /visible/ vs /invisible/ oppositions on the Discoursive level, which lead to the /conflict/ vs /calm/ Fundamental terms, which can be found in the Plane of Content, establishing a semi-symbolic relationship.

The clock's numbers also assume the /light/ vs /dark/ and /chromatic/ vs /achromatic/ in the Photochromatic Dimension of the Plane of Expression. On the Plane of Content. As the numbers are displayed on what seems to be a Nixie Tube, we find the /analogue/ vs /digital/ and /decline/ vs /progress/ terms on the Discoursive level, leading us to the Fundamental opposition /culture/ vs /nature/.

The numbers on the watch continuously decline until the Player replaces his oxygen filters, if he fails to do so, he will die. We find the /full/ vs /empty/ Discoursive Terms, leading us to the /life/ vs /death/ Fundamental opposition. While these oppositions are not represented on the current element's Plane of Expression, they appear on the *Gas Mask* element.

4.1.3.3 Heuristic Evaluation. The watch speaks to its function to the Player, making it easy for a new Player to understand the information being conveyed without having to read a manual or play a tutorial, as the game introduces the Player to the watch's functionality through specific in-game sections. The watch beautifully performs as both an indicator of the Player's visibility and the current air filter's duration, providing visual as well as auditory feedback - in the form of a beeping sound when the filter is running out – it does not lack any sort of feedback and thus, does not place a burden upon the Player. The watch is placed on the lower centre portion of the screen, where the Player can easily see looking by simply looking down during shooting portions. As a Diegetic element, it encourages the Player to immerse itself into the game's narrative.

4.1.3.4 Overview. It is apparent that the watch is not hindered by the any lack of feedback from its function, its positioning in the lower-centre of the screen attests to its importance in providing the Player with crucial feedback regarding two game mechanics, Stealth and Oxygen. Not only does it provide feedback, it is also implemented into the game world in a realistic fashion, reinforcing the Player's sense of immersion and conveying the themes and figures found in the game's discourse. In addition - as we'll see in the next chapter – we find that while specific Diegetic elements do not express their contents visually, the content can be expressed in other elements.

Analysis Results: Watch	
Element Classification	Diegetic
Plane of Content:	Discoursive Level visible vs invisible analogue vs digital decline vs progress full vs empty
	Fundamental Level life vs death culture vs nature conflict vs calm
Plane of Expression:	Photochromatic Dimension light vs dark chromatic vs achromatic
Usability Heuristics:	A1,A2, B2,C2,E1,F1,F3,F4,H5,I1[7]

Table 7: Analysis Results: Watch

7

- A1. Player does not need to read the manual or documentation to play;
- A2. Player does not need to access the tutorial in order to play;
- B2. Status score Indicators are seamless, obvious, available and do not interfere with game play;
- C2. Provide appropriate audio/visual/visceral feedback (music, sound effects, controller vibration);
- E1. The game does not put an unnecessary burden on the player;
- F1. Screen layout is efficient, integrated, and visually pleasing;
- F3. The players experience the user interface/HUD as a part of the game;
- F4. Art is recognizable to the player and speaks to its function;
- H5. All levels of players are able to play and get involved quickly and easily with tutorials, and/or progressive or adjustable difficulty levels.
- I.1 Game story encourages immersion (If game has story component).

4.1.4 Element Analysis: Gas Mask. The Gas Mask is responsible for protecting the Protagonist against irradiated and toxic gases often found while exploring the world's surface, it is a constant reminder to the Player that in the game's world is a dangerous place. The mask however, is not impervious to being damaged, as the Player receives damage from enemies, the mask begins to crack, decreasing the durability of oxygen filters. The mask can also become obstructed by dirt or liquids from the environment which the Player to clear his view.

Figure 37: Masks in various conditions and filters are found across the game.

Figure 38: As the protagonist dons the gas mask, he syncs the clock in his watch, displaying the filter duration.

Figure 39: The mask's condition is reflected by the cracks around the edges of the screen

Figure 40: Dirt or water from the environment can block the Player's view.

Figure 41: The mask can be wiped by the Player's command.

Figure 42: As the Filter's duration depletes, condensation starts building around on the mask.

4.1.4.1 Element Classification. As the mask belongs to the game world but is not represented in the 3D Geometry, we consider it to be a Meta-Representation.

4.1.4.2 Semiotic Analysis. As explained previously, the Gas Mask is responsible for allowing the Protagonist to survive in the outside world. As the filter's durability depletes, humidity starts condensation on the inside of the mask, partially obstructing the Player's view as well as serving as feedback on how much oxygen he has left, this leads to the /opacity/ vs /transparency/oppositions Photochromatic Dimension of the Plane of Expression and the /centre/ vs /extremity/ oppositions on the Topological Dimension, the manifestations are related to the /full/ vs /empty/ terms on the Discoursive Level, which leads once again to a /life/ vs /death/ opposition in the Fundamental Level, the same terms found on the Analysis of the Watch elements, finally creating a semi-symbolic relationship.

The cracks displayed on the Mask inform the Player of the mask's integrity. The mask can eventually break, and the filters duration will be severely shortened. We find once again the /opacity/ vs /transparency/ opposition on the Photochromatic Dimension, as well as /uniform/ vs /multiform/ on the Eidetic Dimension. On the Discoursive level we find the /functional/ vs /broken/ oppositions, leading once again to the /life/ vs /death/ oppositions in the Fundamental Level of the Plane of Content.

As the mask becomes dirty, we once again find on the Plane of Expression the /opacity/ vs /transparency/ terms on the Photochromatic Dimension. Relating to the Plane of Content, we find the /clean/ vs /dirty/ Discoursive terms, relating to the /culture/ vs /nature/ Fundamental oppositions.

4.1.4.3 Heuristic Evaluation. The Mask element is primarily responsible for providing the Player with feedback in regard to the game mechanic imbued into the Mask itself, it does so in a way that immerses the Player in the game world, adding additional layers of immersion by making so the mask becomes dirty, as well as having limited durability, creating an additional challenge for the Player and incentivizing a non-confrontational approach to gameplay. The mask is placed as an overlay on the Protagonists perspective and despite not being diegetic, it belongs to the game's narrative and is contextualized by exposition provided by NPCs, where they inform the Player to put on the mask when approaching hazardous environments.

Despite having a clear function, new Players might find difficult to remember the mapping related to the mask's functions, specially the key responsible for replacing the filter or the key for wiping dirt off the mask. While playing the game, we found

ourselves having to constantly pausing the game to consult the mappings related to said functions, experienced Players however might not have this issue.

4.1.4.4 Overview. The Mask is responsible for immersing the Player further into the game world, both by the means of the game mechanic itself as well as the feedback it provides. However, the mask has three different keys responsible for distinct functions, and as the mechanics are not transversal to the First-Person Shooter genre – unlike the ones found in the Gun – remembering the mapping can prove to be challenging.

The lack of an indication of how many filters there are available can also prove to be a potential hurdle to be overcome by casual Players, however, this can also be an incentive for exploration and resource scavenging.

One of the most curious aspects of this analysis is that the Mask shares common traits from the Plane of Content as the Watch, as they are both involved in the same mechanics, however the element responsible for Expressing the content is the Mask.

Analysis Results: Gas Mask	
Element Classification	Meta-Representation
Plane of Content:	Discoursive Level full vs empty functional vs broken clean vs dirty
	Fundamental Level life vs death culture vs nature
Plane of Expression:	Topological Dimension centre vs extremity
	Eidetic Dimension uniform vs multiform
	Photochromatic Dimension opacity vs transparency
Usability Heuristics:	B2,C1,C2,F1,F2,F3,F4,I1[8]

Table 8: Analysis Results: Gas Mask

8

- B2. Status score Indicators are seamless, obvious, available and do not interfere with game play;
- C1. Game provides feedback and reacts in a consistent, immediate, challenging and exciting way to the players' actions;
- C2. Provide appropriate audio/visual/visceral feedback (music, sound effects, controller vibration);
- F1. Screen layout is efficient, integrated, and visually pleasing;
- F2. The player experiences the user interface as consistent (in controller, color, typographic, dialogue and user interface design);
- F3. The players experience the user interface/HUD as a part of the game;
- F4. Art is recognizable to the player and speaks to its function;
- I.1 Game story encourages immersion (If game has story component).

4.1.5 Element Analysis: Journal and Lighter. The Journal and Lighter are a set of two complementary elements, being the Journal the Player's primary indicator of the current mission objective, as well as pointing the Player to the objective's direction, the Lighter is used to illuminate the Journal in dimly lit locations as well as a source of fire which can be used to clear cobwebs.

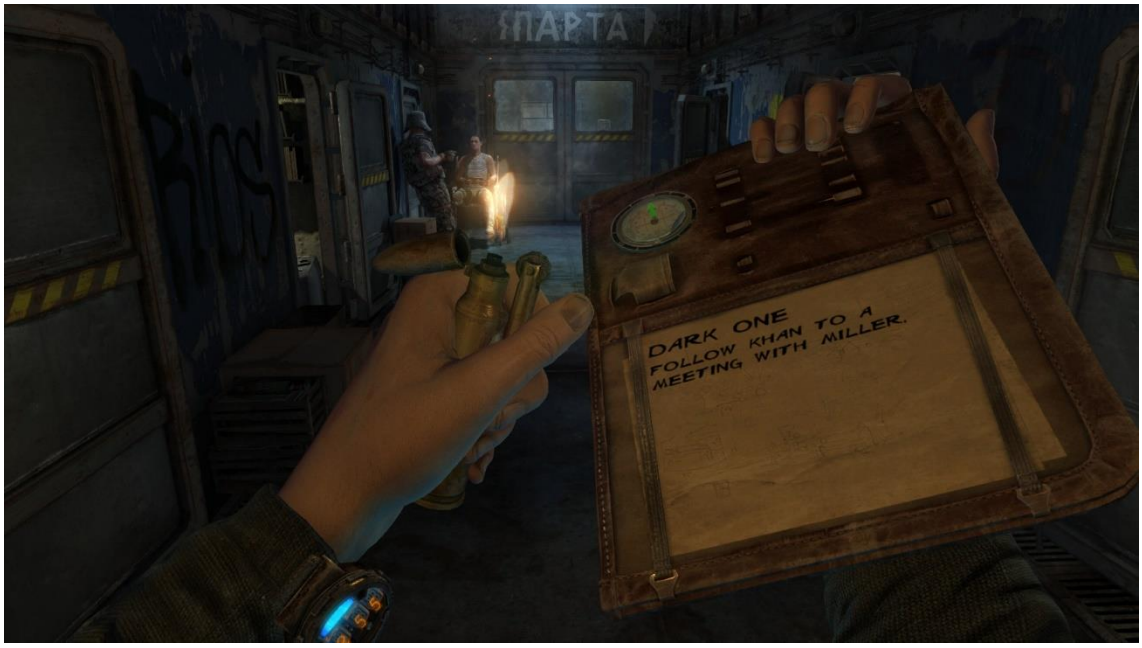

Figure 43: The Journal displays the current objectives and a compass on the upper section of the journal points the Player towards it.

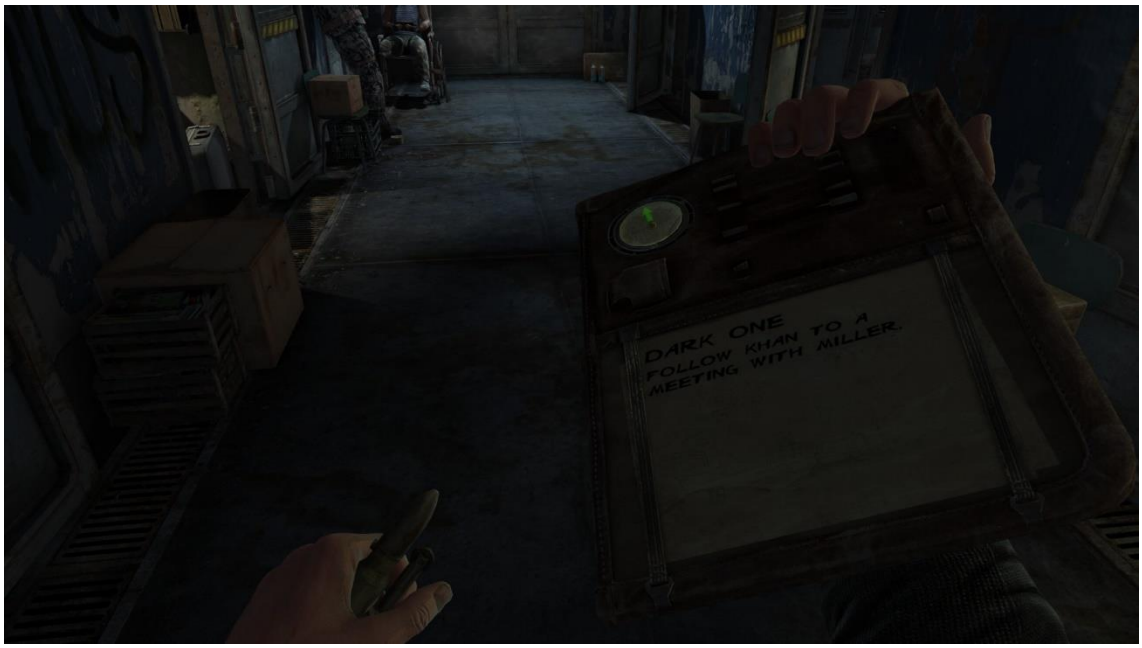

Figure 44: The Journal behaves according to the game's lighting and the Player must use the Lighter in order to see his current objectives in dark areas.

4.1.5.1 Element Classification. Both elements belong the game's narrative and are represented spatially, making them Diegetic elements.

4.1.5.2 Semiotic Analysis. On the Journal's Plane of Expression, we find that the Journal is composed of multiples shapes, namely the notepad itself in which the objectives are displayed as well as a compass on the top-left corner of the Journal, leading us to the /uniform/ vs /multiform/ terms on the Eidetic Dimension. The compass possesses a distinct green arrow pointing towards the objective and once again we find the /chromatic/ vs /achromatic/ terms from the Photochromatic Dimension.

The compass is complementary to Objective Description presented in the notepad, pointing the Player towards his goal. Thus, we find the /accuracy/ vs /inaccuracy/ Discoursive terms, leading to a /victory/ vs /defeat/ Fundamental opposition, composed by a Narrative where the protagonist must use the compass to accurately pinpoint the location of the current objective, in order to succeed in fulfilling said goal, where Victory is a Euphoric term and Defeat is a Dysphoric term.

The Lighter manifests the /light/ vs /dark/ Terms on the Photochromatic dimension, leading to the /visible/ vs /invisible/ Discoursive Terms on the Plane of Content, leading us once again to the /victory/ vs /defeat/, if we were to analyse the Thymic category found within the terms, we could consider /visible/ as Euphoric and /invisible/ Dysphoric. This is evident when we analyse the Narrative, where the Protagonist must use the compass in order to succeed in fulfilling his goal of navigating the World, however, in order to see the compass in dark areas the Player must use the Lighter.

By analysing the overall visual aesthetic of the Journal and Lighter we find once again the /analogue/ vs /digital/ Discoursive Terms, suggested by the fact that the Notepad is hand-written by the Protagonist himself as a reminder of his current goals. In a world where technological advancement has come to a halt, this serves as a reminder to the Player that the game's world is a bleak and barren world where humanity strives to survive, and once again we find the /nature/ vs /culture/ Fundamental opposition.

4.1.5.3 Heuristic Evaluation. The Journal is introduced to the Player during the opening sequence of the game through a short cutscene, this creates awareness of the existence of the item early on and so the Player does not need to consult any manual or play through at tutorial to learn how to use it.

The Journal also suffers from a similar issue found in the gas mask, that is the lack of on-screen indication of the key mapped to display the Journal, once again we deem that this issue will only occur the first time the Player needs to consult the information and as Players progress through the game the mapping is memorized.

The item is represented visually as a clipboard in which the current objective is listed and updates automatically as the objective changes, the compass also provides constant feedback should the Player feel lost navigating the game, removing any burden from the Player of having to guess the current goal.

The Journal, like other items available to the Player are presented at the centre of the screen and conforms to the aesthetics of the game and is presented as part of the game's narrative. Due to the choice of utilizing an analogue device – in this case, paper place atop of a clipboard – with a typeface that imitates handwritten text it encourages Player immersion in the world presented by the game.

4.1.5.4 Overview. The Journal in its essence is an objective list with a compass similar to the ones found in other games, however, it behaves as an item that is part of the game's world. The main form of exposition of the protagonist's thoughts are presented in the form of journal entries featuring the same typeface found in the objective list. This leads us to believe that that typeface is indeed written by the protagonist. The journal – beyond serving its function as a form of feedback – is an attempt to reinforce the connection between the Player and the protagonist and in this sense it performs amazingly. This is not a list that pops up when the Player hits the mapped key, it is an artefact belonging to the protagonist inscribed with its own hand. While in early sections of the game the Player might feel confused due to the lack of on-screen displays informing the mapped key, we consider it to be easily memorisable and there is no detriment to the overall usability.

Analysis Results: Journal and Lighter	
Element Classification	Diegetic
Plane of Content:	Discoursive Level accuracy vs inaccuracy victory vs defeat visible vs invisible analogue vs digital
	Fundamental Level victory vs defeat static vs dynamic nature vs culture
Plane of Expression:	Eidetic Dimension uniform vs multiform
	Photochromatic Dimension light vs dark chromatic vs achromatic
Usability Heuristics;	A1,A2,B3,C1,C2,D1,E1,F2,F3,F4,I1[9]

Table 9: Analysis Results: Journal and Lighter

9

- A1. Player does not need to read the manual or documentation to play;
- A2. Player does not need to access the tutorial in order to play;
- B3. Controls are intuitive, and mapped in a natural way; they are customizable and default to industry standard settings;
- C1. Game provides feedback and reacts in a consistent, immediate, challenging and exciting way to the players' actions;
- C2. Provide appropriate audio/visual/visceral feedback (music, sound effects, controller vibration);
- D1. The game utilizes visceral, audio and visual content to further the players' immersion in the game;
- E1. The game does not put an unnecessary burden on the player;
- F2. The player experiences the user interface as consistent (in controller, color, typographic, dialogue and user interface design);
- F3. The players experience the user interface/HUD as a part of the game;
- F4. Art is recognizable to the player and speaks to its function;
- I.1 Game story encourages immersion (If game has story component).

4.2 Analysis Discussion

It was possible to notice during the Analysis some of the common Themes of the Game and its use of visuals to convey its Discourse, Metro: Last Light is a game about a decaying society, where Humanity's last remnants struggle to survive the desolate world left by a Nuclear War. The sense of helplessness is reinforced to the Player by the game's mechanics such as the Gas Mask mechanics, where the Player must scavenge the ruins of Moscow in search of filters in order to survive and complete his Objectives. Overarching Themes such as the technological stagnation, the unrelenting and uninhabitable overworld as well as the constant threat of exposure to enemies are clearly reflected in the game's Diegetic Interface and in this sense, we could say that Metro: Last Light excels at its use of Diegesis to reinforce the Player's immersion.

However, that is not to say that this implementation is without fault. During the Analysis it was possible to understand that, while traditional First-Person Shooters mechanics did not require any type of instruction to the Player, such as movements, aiming and shooting, the game's specific mechanics such as the Gas Mask and Journal and Compass.

The Gas Mask is perhaps the worst offender for usability, although the mechanic itself is very easy to understand and gives the Player feedback regarding various statuses, it suffers primarily due to it having 3 keys responsible for distinct functions – Replace Filter, Clean Mask and Remove Mask - and as the mechanics are not transversal to the First-Person Shooter genre, unlike the ones found in the Gun, remembering the mapping can prove to be challenging. The lack of an indication of how many filters there are available can also prove to be a potential hurdle to be overcome by casual Players, however, this can also be an incentive for exploration and resource scavenging.

One of Metro: Last Light's strongest points is its constant use of feedback to indicate the Player's current status, such as the use of Meta-Perception UI in the form of condensation in the mask, providing an indication that the Player's Oxygen Filter is about to expire or the LED Display on the watch which signalizes if the Player is visible to enemies.

It is clear that, although the game might suffer significantly on usability while being played without the HUD, if the Player manages to memorize the key mappings

this can prove to be an immersive story-driven experience, where the Player is put in the shoes of a survivor in the post-apocalyptic underground of Moscow's metro system, with gameplay mechanics, UI and visual storytelling that reflect the care given to it.

5. DISCUSSION

Reviewing the main question that we proposed to answer, **how do Diegetic Interfaces impact player immersion and what is the usability impact of their implementation?**

Considering immersion as a subjective aspect composed of various factors such as the gameplay mechanics, story and narrative as well as beauty and aesthetics as proposed by Lemarchand (2012), with similar claims regarding Experiences in the broader sense by Hassenzahl (2010), we found that the Diegetic Interface in Metro: Last Light not only reinforced Player immersion through storytelling, but also impacted usability in a very small scale. We believe this to be due to the emotional investment by the Player, brought about by the game's narrative, impacting the Player's perception of usability, although there were no instructions or tutorials teaching new players how to play the game, we found that during heuristic evaluation there was no significant difficulty in playing the game, this is related to the Aesthetic-Usability Effect described by Norman, (2005:17), where he cites several studies showing that objects with pleasing aesthetics were perceived to be more intuitive than it's less appealing counterparts.

We found that by representing interface elements within the tri-dimensional space and contextualized within the game's narrative, new relationships were formed between the Player and the game world. The Interface assumes the form of tools employed by the protagonist, in many cases contextualized through the themes as is the case of the Journal, which while during normal gameplay shows the current objective but also serves as the game's main form of exposition to the silent protagonist's thoughts, where he exposes his opinions regarding his surrounding, other characters present in the story as well as his own resentments about his past doings.

Alongside with the methodological contribution, this research also provided an overview of the evolution of interfaces in videogames, some of the key terms used when discussing videogames UI and their origins, while also providing insights from veterans from the videogame industry, their concerns, opinions, reminiscences about past games as well as predictions about the future of the industry. This overview was useful for mapping the related fields of study for researching into game UI, one of the most consistent and important pieces of information we have gathered is that in games usability is not as important as previously thought for designing UIs, one must also consider the Player's investment in the story, the visual appeal of the game and also its

gameplay, of course that is not to say that usability plays no role in the gameplay, however, by moving away from a purely usability based approach to analysing the game's UI – specifically the one found in Metro: Last Light which consists primarily of Diegetic elements – it was possible to consider not only the interface's effectiveness in conveying the game's status', but rather approach it under a holistic perspective, considering its choice of forms and colours to convey its discourse, as well as considering the usability impact of such choices.

With these considerations taken, we believe that we have succeeded in answering the research question that drove this investigation, however, as a suggestion for future researchers, we make the following considerations:

We firmly believe that for future research, the use of Discursive Semiotics will prove to be a useful tool for analysing such relationships, and hope that this investigation will lead to further studies in the use of the Interface as an auxiliary tool in world-building in Videogames. Vitorino & Serrano's (2017) contribution to this research cannot be understated and as suggested by the authors, we also believe that Discursive Semiotics is a useful tool for analysing interfaces in videogames, especially Diegetic Interfaces. While Discoursive Semiotics, as the name suggest, focuses on Discourse Analysis, it is also a useful tool for analysing the narrative and visual aspects of digital media, by utilizing the Plastic Semiotics proposed by Oliveira, (1995) it was possible to textualize the Plane of Expression of the UI, which enabled us to analyse the Plane of Content, where the game's Discourse lies. This was what enabled us to Understand how Diegetic Interfaces differ from the traditional HUD, whereas the HUD is an outside element, not belonging to the narrative and serving purely a functional purpose, Diegetic interfaces in Metro: Last Light performed in both a functional element as well as a narrative element, strengthening the connection between the Player and the Protagonist.

While utilizing the Plastic Formants for the Plane of Expression, we found that although they were of great assistance, a set of specific Plastic Formants for Videogames could be of great interest for future researchers, primarily due to the dynamic nature of the visuals found in games. Some of the terms suggested by Oliveira, (1995) were concerned with aspects which were related to the analysis of paintings – e.g. the brushstroke texture and gesture – which are not adequate for this case. As such, we suggest that the Plane of Expression be expanded upon by the creation of

Dimensions which allow for more accurate descriptions of the expressive qualities found within videogame art.

We also suggest that future researchers who use the method proposed by this investigation consider conducting the heuristic evaluation with a greater sample size, and consider evaluating with multiple ranges of players, from expert to novices, to assess the usability impact with greater accuracy.

This insight into the relationship between interfaces and immersion was only possible by considering interfaces as much more than a functional element found in games, we hope that the perspective established by this investigation, as well as the theoretical and methodological frameworks will aid future research into game UI, immersion and storytelling.

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