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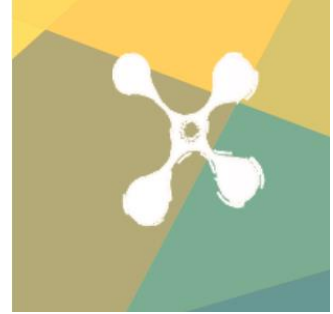


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AN INTEGRATED AND USER CENTERED PROCESS FOR GAME DEVELOPMENT

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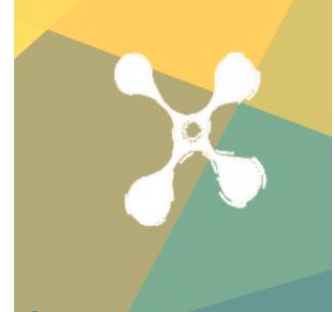
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UM PROCESSO INTEGRADO E CENTRADO NO USUÁRIO PARA O DESENVOLVIMENTO DE JOGOS

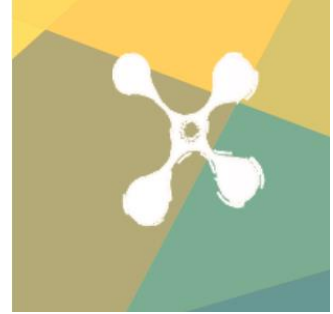
Resumo

Objetivo: Este artigo propõe um novo Processo de Desenvolvimento de Jogos focado na integração da equipe de desenvolvimento, em um design centrado no usuário, uma documentação única e em como fazer as coisas, não no que fazer.

Design/Metodologia/Abordagem: O desenvolvimento deste trabalho iniciou-se com uma revisão da literatura, pesquisa com os usuários para obter suas percepções de interfaces de jogos e uma investigação acerca do processo de desenvolvimento de jogos buscando entender como os usuários veem cada componente do jogo e como as organizações desenvolvem esses produtos. **Resultados:** O modelo proposto assim como as diretrizes apresentadas permitiram que todos os envolvidos acompanhem e compreendam as fases do processo, uma criteriosa análise de riscos e a engenharia de requisitos aplicada no modelo proposto, além de um maior envolvimento por parte do time de desenvolvimento acerca da experiência do jogo, resultando em um feedback extremamente positivo dos usuários.

Originalidade/Valor: Trazer o usuário para o centro do processo torna a pesquisa ainda mais relevante não apenas para o desenvolvimento de jogos, mas também para o meio acadêmico, oferecendo referências e incentivo para futuras pesquisas envolvendo processo de desenvolvimento de jogos, interface do usuário, usabilidade aplicada à esfera dos jogos digitais.

Palavra-chave: Desenvolvimento de Jogos, Interface do Usuário, Ciclo de Vida de Desenvolvimento de Jogos

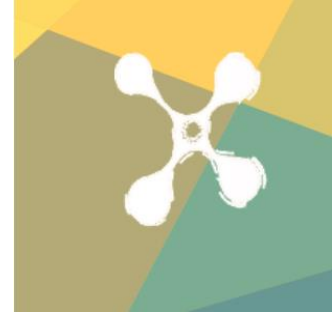


AN INTEGRATED AND USER CENTERED PROCESS FOR GAME DEVELOPMENT

Abstract

Goal: This paper proposes a new Game Development Process focused on the integration of the development team, in an user-centered design, an unique documentation and in how to do things, not in what to do. **Design∕Methodology∕Approach:** The development of this work began with a literature review, research with users to obtain their perceptions of game interfaces and an investigation about the game development process seeking to understand how users see each component of the game and how organizations develop these products. **Results:** The proposed model, as well as the guidelines presented, allowed everyone involved to follow and understand the phases of the process, a careful risk analysis and requirements engineering applied to the proposed model, in addition to a greater involvement on the part of the development team about the experience of the game, resulting in extremely positive feedback from users. **Originality∕Value:** Bringing the user to the center of the process makes research even more relevant not only for game development, but also for academia, offering references and incentives for future research involving game development process, user interface, usability applied to sphere of digital games.

Keywords: Game Development, User Interface, Game Development Life Cycle



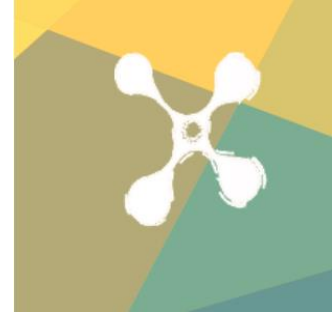
1. Introduction

The gaming industry is huge, moving billions of dollars every year around the world. According to new zoo Consulting, the sector's revenue forecast for 2021 was 180.3 billion dollars, +1.4% more than in 2020 (Wijman, 2021), in 2023, the expectation is that the industry will exceed 200 billion and reach, in 2024, the 218.7 billion dollars mark (Google for Games, 2021), which highlights the importance and power of industry in the world's entertainment.

In this way, is increasingly necessary that organizations that produces this kind of content look for efficient ways to produce and build their products as is game development has several peculiarities that leave its development much more complex than a conventional software development process.

Developing a game is a multidisciplinary activity that involves countless professionals, such as programmers, writers, musicians, designers, managers, among others, who must simultaneously generate a functional and attractive product for the market. However, this raises some questions, like how to manage the work of so many different professionals at the same time? How to achieve efficient communication between the team, since everyone has different backgrounds, different visions and does not necessarily know about the other areas that make up a game? How can you constantly innovate in an industry that values the new? How do you respond to the increasingly frequent changes within a project in an extremely dynamic industry? And one of the main problems: how to build an accessible and intelligible interface for the user?

In its early days, the graphic interfaces were the big medium to access information in computers, systems and other networks. The interfaces are the medium between the user and the information, and in digital games the interface has the same role being responsible for the dialogue between user and game, allowing games to be accessible and intelligible for all possible users, transmitting the game experience (Johnson, 1997).



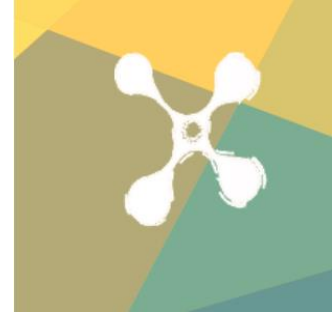
Once the interface is the medium, when the game has any kind of flaw relative to its diverse aspects is the interface that reflects and shows these flaws to the user. Even when a project is user-centered, because of its diversity of knowledge areas, it may be possible to some specific definitions taken that do not involve all the developing team, prejudice the final game experience.

All of these questions can generate a lot of problems for the project, and according to Petrillo (2009), some of the major problems encountered in the game development process involve scope, timing, technology, lack of documentation, and communication problems.

In order to mitigate these problems, development companies adopt practices and processes that help them develop their products faster, easier and cheaper. There are several development processes and methods in the literature, like Scrum. Despite the enormous advancement of these processes within the industry, there are still some questions: how to develop a good, user-centered interface that focuses on usability and can efficiently exploit the technology used in the project within such a so dynamic scenario? How to integrate and manage the professionals involved in the development? And how to have an efficient risk management within the project?

In order to answer these questions, this work proposes an integrated and user centered model for the game development, which focuses on the integration of professionals in all phases of the project, the efficient risk management and also the construction of an interface that is usual and that can exploit the full potential of the technology employed, investigating the relation of the interface with the user in the digital games sphere, and develop guidelines to contribute in the game development integrating every component of the game, to prevent potential flaws in the product.

2. Literature Review

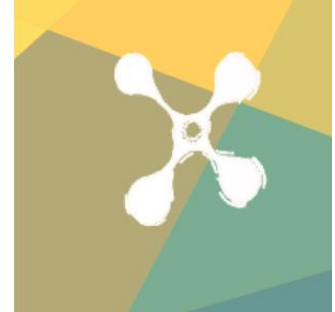


2.1. Game Components

The digital games were born as a new type of media, one which the entertainment is based on the interaction between human and screen. Many of the process and methods used in game development comes from other medias and areas such as television and cinema, for example, the use of storyboards, character, scenery and sound design. The game designer is the professional who builds the game from these processes to provide interaction (Cybis, Betiol, & Faust, 2017).

Schell (2008) defines the game design as the act of make decisions about how a game will be, its challenges, possible actions inside the game and other aspects. The game designers' goal is create an experience; the game itself is just the medium, like the relation between interface and information. This experience must be fun, challenging and immersive; one way to guarantee the quality of this experience is to balance the components of the game (Cybis et al., 2017).

As for Cybis et al. (2017) and Schell (2008) the components of a game are similar, first are needed a theme for the game that will guide the definitions of other aspects. Also, for Schell the components are listed based on its visibility to the user: (1) Mechanics: Are the rules and proceedings of the game, relates to the gameplay. The mechanics function as the base to the game and how the user will be able to accomplish the in-game goals. The mechanics are relatively close to the user once it allows most of the actions in the game; (2) Story: This component is the closer to other medias like cinema, television and books. The difference is the interactivity, and how far the user can interact with the story. There are a plurality of games and stories for games: linear, non-linear, with multiple endings and even no story at all. The unravel of it is determined by the user mostly, and like the mechanics the story is very close to the user due to the directly interaction with them; (3) Aesthetics: Is the visual language that the game is shown to the user. Is the closest component to the user, because of its tangibility. The definition of the aesthetics impacts and is impacted by the definition of other components



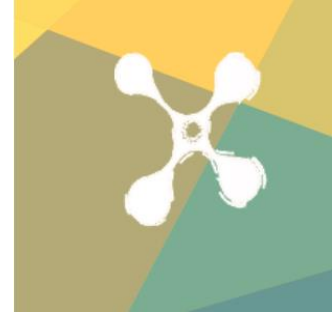
like the story, for example, because the aesthetics must be defined with the purpose to be the best visual form to tell the game narrative; (4) Technology: Are the means and materials that allows the game to be made, the choice of the technology implies in impossibilities and possibilities in other components. It's not about just computers and programming, but a medium; the diversity of technologies available opens to the game designers innovate in new ways to play (2008). This component because of its technical content is the less accessible to the user, it requires some knowledge that most users don't have.

Schell (2008) is emphasized the balance between the components, they are all essential to the game experience and their definitions don't follow a specific order due to the interactions between them all.

2.2. Usability and Gameplay

Different from work software which the usability assures the simplicity of actions to the user, meaning minimal effort to their realization, the games usability must assure that the games offer the tools to complete a task but in a challenging way without flaws or unplanned and unexpected challenges.

For this assurance, the term usability in games slang refers to the means to accomplish a goal and the gameplay term refers to the challenge, and both contribute to the game experience, once the user won't be able to complete a gameplay goal without the usability that provides the information and tools to complete the goal. In digital games the fun factor doesn't exist if there's no challenge or obstacle to overcome, which demands a different approach in usability justifying the not much different concepts of usability and gameplay together. Going deeper into the goals proposed by a game, there are goals relative to the gameplay, corresponding to the creative environment and the fun factor; and instrumental goals that correspond more to the usability itself, to the tools: buttons, inputs, and the communication of this tools to the user (Cybis et al., 2017).



2.3. Interactivity

The interactive factor in a game comes from the communication between the player and what is happening on the game, in the screen. The game can respond in distinctive forms to the inputs of a user, but even with this communication games are not completely interactive, they also have moments when the player acts passively watching a scene, hearing dialogue or simply reading text. This is relative to the game narrative, and what it uses to communicate the story to the user.

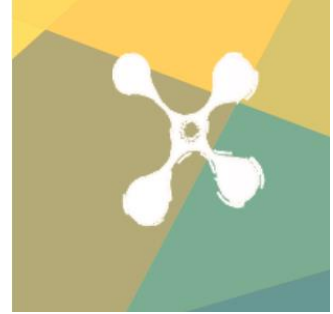
There are parts in a game that are interactive and there are parts that aren't, they're relative to the planned experience. For example, in first person shooter games, in which mostly skips a much deeper narrative over the gameplay, with emphases on the action and interaction, in the other hand there are graphic adventures which the narrative and the fictional aspect are more relevant and essential to achieve progress in the game (Cybis et al., 2017).

2.4. User Interface Conception

Looking at the development, the building of a user interface in a digital game becomes way easier under the knowledge of the interaction demanded by it. Knowing criteria to evaluate user interfaces helps too, beyond just being criteria these evaluation points can work as guidelines for any development, for example the heuristics by Nielsen (1990) and the ergonomic criteria developed by Bastien and Scapin (1993) listed below: (1) Guidance; (2) Workload; (3) Explicit control; (4) Adaptability; (5) Error management; (6) Consistency; (7) Significance of codes; (8) Compatibility.

Each of these criterions divides itself into sub-criterions that pull of any subjectivity of the user interface evaluation, giving straightforward results.

Cybis et al. (2017) follow distinct steps with different methods each. The first step consists in generating and organization of ideas, one method listed within this step is the brainstorming, as Brown (2020) describes the brainstorming is a structured form to break the structure,



because even being an informal method there are rules to follow and organize the ideas provided by the brainstorming.

The following step is the conception, based on the generation of ideas; in this step, there are methods to build fast prototypes to have a visualization of the tasks and environment where the software or game will be used. One of these methods is the storyboarding and comes from cinema in which are made graphical narratives for each scene, in the software sphere; the graphical narratives are made for each task involved.

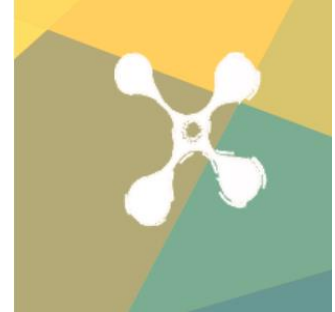
With storyboards already made for every task the next step is the modeling of the user interface. Within this step has three parts to be done: user roles, when is described the types of users and their roles, expectations and level of expertise, after that there are the task cases when is created a map with every task in the software and for each task are made a brief narrative indicating all the users' inputs and expectations and the system responsibilities and responses to these inputs.

By these task narratives is possible to determine what the interface must offer in every situation to provide the best response to the user's inputs. In the final modeling step is made a content map, with every screen of the system and the information on each screen. With this map done, is time to produce the first prototype, which can be considered a refine version of the ones made within the storyboarding process.

2.5. Game Development Process

According to Sommerville (2011), a software process development can be described like a set of associated activities and results that produces a software product at the end. Pressman (2005) defines software process development like a dialogue in which the knowledge that must become the software is brought together and embodied in the software”.

Sommerville defines four fundamental activities for software development process: (1) Software Specification: responsible for the definition of software and its constraints; (2)

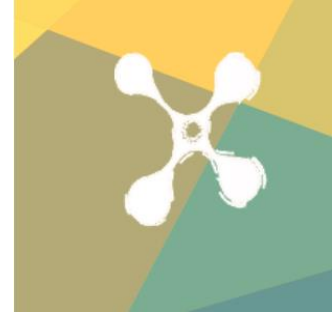


Software Design and Implementation: here, the software is produced according to specification; (3) Software Validation: software must be validated to guarantee that it is what the users expect; (4) Software Evolution: software must be improved to meet the new customer's needs. Still according to Sommerville, every software development process must have these four phases (2011).

Some examples of software development process are Waterfall, Spiral and RUP. Another kind of methodology for software development is called Agile. Pressman defines agile software development like a combination of a philosophy and some guidelines for development process (2005). The philosophy preaches customer satisfaction first, with small and frequent deliveries of usable product increments and simplicity.

Develop a game is very different from a traditional software development, since it interacts with other factors such as mechanics, aesthetics, soundtrack, etc., in order to create an attractive and fun experience for the user. Because of that, it generates a range of new possibilities of failure, which can generate countless problems, such as delays, scope changes, divergent budget and so on. A lot of works, such as Callele et al. (2005), Ramadan & Widyani (2013), Aleem et al. (2016), Kanode & Haddad (2009) and Murphy-Hill et al. (2014) deal with the theme, establishing guides and process models for this, that fit the needs of game development in the best possible way.

Game development cycle can be splitted into 4 major phases: pre-production, production, testing and post-production, each one responsible for a step, from the beginning to the end of the process. (1) Pre-production is the first one of this cycle, being responsible for defining aspects of design, history, soundtrack, mechanical and etc., in addition to project planning; (2) The next stage, production, is responsible for the production the part, in other words, is responsible for build the product (3) the next phase is a testing phase, comprising unit and user tests, as well as ergonomic and usability analyzes; and (4) the last phase, post-

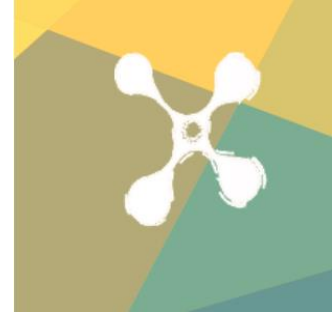


production, is responsible for the final documentation and product launch (Ramadan & Widyani, 2013).

As previously stated, game development is different from the traditional process, because it has many peculiarities and also because it is a multidisciplinary process. Since it has seen this, Kanode & Haddad enumerate some challenges in game development also points out some solutions provided by Software Engineering to solve these problems: (1) Diverse Assets: Optimize tools and pipeline for integrating assets into the game; (2) Project Scope: Apply requirements engineering and risk management when translating the GDD to the project scope. Consult with the teams involved so that the project scope is realistic. Consider time needed for game exploration and feature creep; (3) Game Publishing: Develop deeper communications between the publisher and the development house. Publishers need to be clear with their requirements. Developers need to keep the publisher informed of project progress; (4) Project Management: Invest in managerial training with an emphasis on project management practices; (5) Team Organization: Evaluate potential process methods based on team organization and corporate culture. Encourage an attitude of the team as a whole and less importance on individuals; (6) Development Process: Understand current process and the problems with it. Identify processes that will benefit the project; and (7) Third-Party Technology: Apply risk management to selection of third-party technology to identify which, if any, components would work best for the current project, and for future projects (2009).

After reviewing more than 150 releases of various companies and projects, Washburn, Sathiyarayanan, Nagappan, Zimmermann, & Bird (2016) defined some best practices within the game development process and also some of the biggest common problems within process.

How best practices, Washburn et al. (2016) points user-centered design, that captures the interests of the player, the development of the full story, even if it is draft, in the first steps of the development process, a well-done planning in the early stages of process, prototype



development, iterative development process, specialized and motivated professionals and team integration.

As failure points, Washburn et al. points to the lack of integration between development times, poor planning budgets, lack of planning and expectations that are not at all realistic in the planning phase (2016).

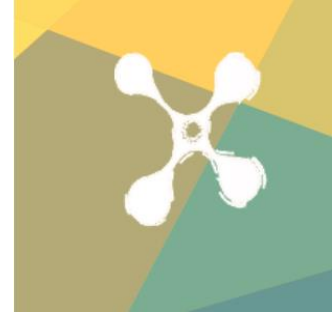
Based on these reports, the objective of this work is to develop a development process that meets these recommendations, always focusing on the integration of the development team, in an user-centered design, an unique documentation and in how to do things, not in what to do.

3. Methodology

With the literature review and their explored knowledge, the next thing to be made in the present paper is the investigation and research about user's game interfaces perceptions and game development process. The purpose on researching about these perceptions is to understand how they see each game component and how the organizations develop these products. The best way to uncover these perceptions is, based in Gil (2008), through surveys. Surveys can extract from users: knowledge, beliefs, feelings, values, principles, interests, expectations, aspirations, fears, behaviors; measuring and quantifying this information.

The users and development team perceptions allied to the literature review will serve as a base to build the proposed development process and its guidelines; the building will follow an analysis of the data collected from users relating to the information provided by the literature review.

To evaluate the usage guidelines, they will be applied into a game concept, focused into the components describe by Schell (2008) and the interface conception described by Cybis et al. (2017), following every step that is defined into the literature review. The concept will be showcased to a group of users and surveyed about their perceptions, each question



punctuating the guidelines use. The evaluation of the proposed model will be done in future work.

As described, after the literature review around the themes already exposed, it was made a survey to collect the user perceptions about the games components as described by and how organizations perform the game development process. The tool chosen to apply the survey was the Google Forms, because it could reach a larger number of users and it could be applied online. For the development model, the sample were of 2 organizations. The low number of organizations due to the low number of game companies in the country region that the research was conducted.

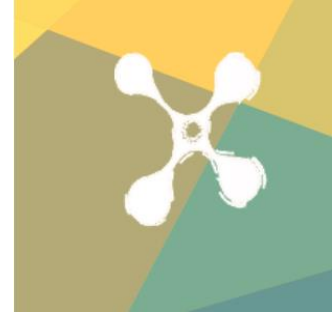
4. Results and Discussions

4.1. Survey Results

4.1.1. Users Game Interfaces Perceptions

The sample collected for the guidelines were of 52 responses, from different groups of players, they are part of organized game groups or not, and students from de academic environment.

The first question from the survey asked them about their age group to provide demographical data about them. 65.4% of the users are in the age group of 18-24 years old, 32.7% are in the 25-35 years old group and 1.9% is in the above 35 years old group. The next question was about their gender with 80.8% of the responses from men and 19.2% from woman. The following question asked how often they play video games, 48.1% of the users plays every day, 36.5% plays a few times during the week, 7.7% plays once in the month and 7.7% plays less than once in a month.



The main question in the survey was about the relevancy of game components to the users, they were requested to punctuate each component with a value between 1 and 5, 1 being irrelevant to them and 5 being very relevant. In addition to the four components already described was inserted the component user interface to know how much the users cares about the user interface. As shown in the Fig. 2 the most relevant components are the story, mechanics and aesthetics, the user interface received good notes, and the technology was the least relevant to them. The results match with the [6] description of the components based on their proximity to the user, once the story, mechanics and aesthetics are much tangible to the user than the technology.

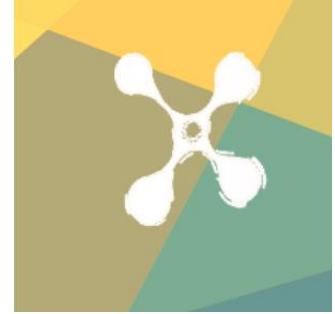
4.1.2. Game Development Process

For the development model, the sample were of 2 organizations. The low number of organizations due to the low number of game companies in the country region that the research was conducted. The organizations differ principally in the size, one is a medium organization, the other one is a startup incubated in an university.

The survey focus principally in the game development process and how the interactions between the teams and team members occur. It contains 15 questions that comprehends the entire development process and the artifacts generated.

Both organizations use their own scrum-based methodology, dividing the development process into pre-production, production and post-production phases. The pre-production phase is responsible for the theme definition, game design, scope and planning. The production phase is responsible for concept arts, development and tests. The last phase, post-production phase, is responsible for the final tests, bug reports, marketing and launch.

Again, both organizations have a lack of documentation, generating just a Game Design Document (GDD) that is used like unique guide for development. Both of organizations don't have a dev process that focus on team integration, dividing designers and programmers.



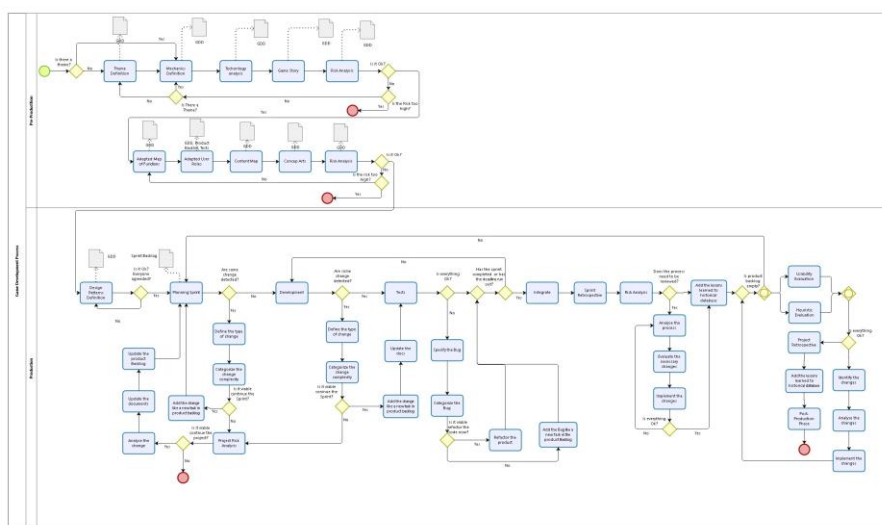
Tests are automatic just in the medium organization, the startup tests their code just with feeling. Both of the organizations don't have a lessons learned procedure and both don't have an appropriate requirement engineering.

The last question of the survey concerns the integration of professionals (designers, programmers, musicians, etc.) and also the documentation generated by the process. Both organizations said that they would use a process that focus on integrate the professionals and generate a unique documentation for all the involved professionals.

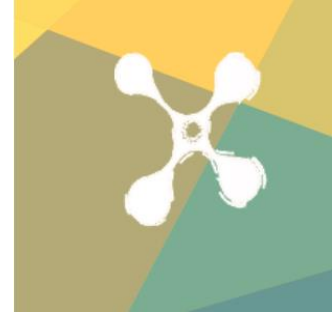
4.2. Proposed Model

The proposed model contemplates only the first 3 stages of development process, Pre-Production, Production and Testing, which are the ones that most need the interaction of the team. The proposed model was made to be iterative and incremental, in order to improve the speed of development, but, above all, to bring all actors involved in the process closer.

Figure 1 – Proposed model



Source: Authors (2020)



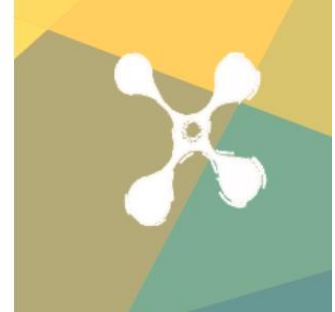
4.2.1. Pre-Production

The Pre-Production phase is a creative part of the game, where all creative aspects are defined, such as theme, history, mechanical, technology and so on. Here also a careful risk analysis is done to identify whether or not the project can move forward, generating a unique documentation to all professionals. In this phase, the whole process is accompanied by the entire team so that everyone can receive the information directly from the source and can show their views on the project, so it is possible to identify possible scope and technology failures early on, such as: mechanics that do not fit the chosen technology.

Here, the proposed model presents some guidelines too, that focus on improve the process of develop the game design and promote a user-centered design. As was shown the relevancy of the certain components in the perspective of the user is really based on their proximity to the user. Closer aspects were better punctuated than the technology which is less close to the users due to their complexity. Despite the user perspective is known that every component is essential to the game experience, the perception collected by the survey don't denies this fact, just reinforce a question about visibility.

For the guideline's development, it was though about the ergonomic criteria by Bastien & Scapin (1993) and how they function for evaluation and how they work as guidelines as well, their use is constrictive, and with this in mind the developed guidelines should be more open and more subjective, with the main purpose to put the team behind games development to dialogue and discuss about how the components can relate to the user and the environment. With this goal in mind, the logical path to create the guidelines is through layers, the first are the components with the basic structure of a game, the second is the user itself, and the third is the external environment.

The first guideline developed was the Engagement, in this guideline the thinking is centered in how the components works together to provide the best game experience possible. (1)



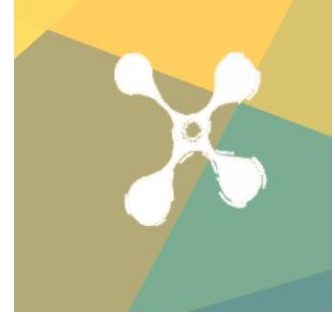
Engagement: Applied in the early concepts in the game development to provide verification on how the components relate to each other and how they work together. The developer must think as the user questioning himself: The components engage me, the mechanics are according with the technology chosen, if these questions answers be negative some changes in the components are needed to achieve balance between them and engage the user.

The interdependence between the components and their balance is the most important aspect in the first guideline, even when one component can mask other component flaws chose to let this happen is an erroneous decision to make. The guideline about Engagement is for the developer to reflect about the game thinking if he was the user.

The second guideline reflects in how the game transmits the experience to the user. (2) Experience: The questions made in this guideline are about how the game translates the experience to the user through its interface. The meanings used are effective to the user, the controls and interface reiterates the engagement, the user can be empathic with the story, the user can experience the components in a unified form. The questions in this guideline references to more formal elements in the game as the interface, controls, colors, typography.

The perception of the user is unified, they hardly divide the experience in components, the experience is the components working altogether. The division of the components happens when one of them fails. Is in this second guideline that most of the game's problems can be resolved with adjustments in these formal elements.

While the first guideline is in the central layer of components and the second one is in the user layer, the last one is in the external layer, the environment. (3) Exterior: In this guideline the questions made are: how the game standout between other games, the controls and imagery follows the established conventions, is the game accessible. These questions are made to provide adjustments related to usability and ergonomics like the inputs map, control handling These aspects must follow established conventions and offer configurations for accessibility purposes.



In addition to this, the model proposes some adapted documentation which contributes to the generation of a single document for all involved and all phases of the process. Some documents generated in this phase that make part of adapted GDD are: adapted role map, content map, conceptual arts, and adapted user roles are also finalized and delivered here. Analyzing the documentation generated by both, designers and programmers, it is possible to perceive quite similarity between some documents. Therefore, with the objective of generating a unique documentation, that integrated the team and facilitated the understanding by all, the function map was merged with the use case diagram and the user roles with the user stories, both from Software Engineering.

After the completion of these steps and the approval of the entire team, the last step of this phase is a new risk analysis to define the continuity of the project.

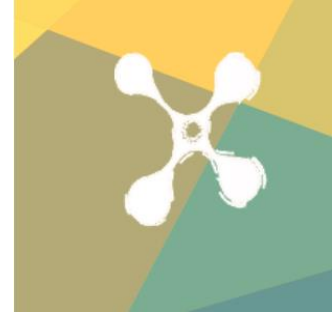
4.2.2. Production

The next phase comprises the Production phase, where the team starts to build the game. This phase is managed using scrum, and using concepts of spiral methodology, mainly in the risk analysis and also in knowledge management.

The mainly goal here is to solve the (2), (4), (5) and (6) points raised by Kanode & Haddad (2009). (2) talks about project scope and the proposed model deals with it by using a solid and frequent risk assessment, taken from the spiral methodology, promoting team integration and using agile methodologies for process control and the quickly identification of scope changes.

(4) talks about Project Management and the proposed model structure a new process with focus on the team interaction and in a solid planning, covering the three firsts phases of the Game Development Life Cycle.

The next point, (5), talk about the team organization. This point is solved using scrum as a dev process base. The scrum gives us an extremely adaptive process that preaches the self-



organization of teams as well as a constant integration of all the members, idea that is shared by the agile methodologies and the proposed model.

The last point covered is (6), that talk about Development Process. Here, the proposed model proposes an iterative, adaptative and complete dev process to the organization, focused in how to do things and not in what we have to do.

4.2.3. Testing

The last phase of the development process covered by the model is the testing phase. This phase is integrated into the development phase, with unit tests and usability and heuristics tests at the end of each iteration, but also has a process exclusively dedicated to the tests.

At the end of development, the final tests of usability and Heuristics are made, being analyzed by users and specialists. The evaluation of both is taken into account for the final evaluation of the product delivered, and if the product has failures, these will be defined as the entries in the product backlog and then the team would make the necessary changes.

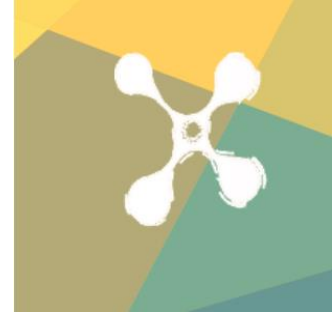
This phase is responsible for refining the product for the post-production phase, only enabling a product for the release when it is already completely validated and free of bugs.

4.3. Applying and verifying the design guidelines

To verify and validate the developed design guidelines, they were applied to a game concept, and besides the guidelines the building of this game concept used methods already showcased by the literature review, related to the game components, and interface conception as well.

4.3.1. Defining the Components

For the game conception, first were the definition of a theme, the theme will guide the rest of the game conception. The game theme was the subversion of the post-apocalyptic tropes,



presenting the opposite of that. Instead of a dark color palette and scenery there will be in this game concept colorful environments with references to cartoons and real-world locations presents in a mood board, a panel with figures, pictures and colors from other medias to define the color palette and overall atmosphere of the aesthetics (Fischer & Skaletsky, 2009). After the mood board phase, and having the aesthetics defined, were made several concept arts.

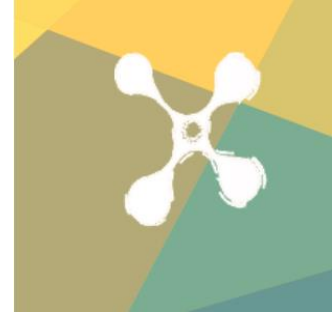
The next decision was what medium the game could be realized, which technology could be used. This game concept was designed to be an app for smartphones and television together, meaning the gameplay involves two screens. The television being the main screen and the smartphone being the controller. This choice was made thinking in how most users already owns a smartphone and television, wouldn't be necessary acquire another equipment to play the game.

The game mechanics were designed using the storyboarding method, simulating the user environment, and actions and already giving a fast prototype to the game's user interface.

The game itself would be easily describe as an adventure with role playing games elements and turn based battles using the match 3 mechanics. The main mechanics are provided by the match 3 genre, when the user combines pieces of the same color to achieve attacks and other actions.

The definition of the games story was made thinking on how it could break some of the basic game's conventions about story: multiple endings. Instead of giving the player different endings based on their in-game decisions and actions, the game would offer multiple beginnings based on the user character choice. Johnson (1997) defines a method called pearl necklace, in which the story moments of the game are passive with cut scenes, audio or text, intercalated to gameplay moments.

The characters were designed following a cartoonish style, and using very known methods like the model sheet, that provides the base for any other artist who may work with the game.



From the model sheets, there were made the first art works (Fig.2) for the characters and with the story it was written the synopsis for the main story.

4.3.2. Modeling the User Interface

With the basic components already defined the following step into this process is the prototyping the game concept user interface. The prototyping follows the process described by Cybis et al. (2017), with the adapted user roles definitions, adapted task cases map, the content map and at lastly the prototype, which in this case will be screenshots and concepts closest to the final product could be.

Figure 2 – *One of the games characters' artwork Note.*

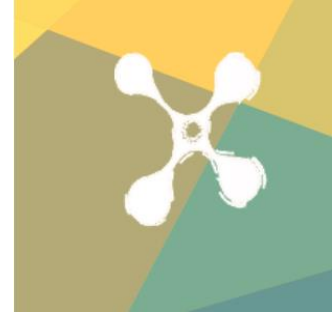


Source: Authors (2020)

The user roles were defined based on the tasks that will be requested to them, use local, the participants involved and the types of users based on their experience. Each type of user could be reacting in a distinctive way to the tasks requested.

In conjunction to the user roles with the tasks that will be in the game, was built an adapted task cases map with all the tasks in the game like a user history.

These narratives indicate the demands for the user interface, what tools must be in the user interface to attend to the users' intentions and needs. With these demands listed, was made an update in user role document with all the information and options in the game's screens, from the title screen to the battle's screens. As explored in the storyboarding phase,



the game uses a virtual directional in the smartphone screen as the main tool for the in-game actions.

Before the game prototype was made, the questions proposed by the guidelines (Engagement, experience and exterior) to provide the dialogue intended by the guidelines and resulted as well in changes improving the prototype.

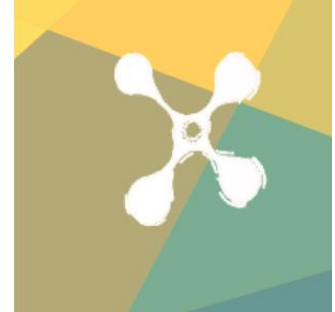
The game revolves around this virtual directional with all other options arranged around with quick access from this directional and the user should use only one hand. The main screen on the television shows of the status from characters, enemies and the game environment, while the smartphone focuses mostly on the tools for interaction, like the virtual directional and other buttons.

4.3.3. Verifying the Guidelines

Once the prototype was ready and refined after the use of the guidelines, there as a showcase of the concept to a group of users, which also answered the earlier survey about game components perceptions. After the showcase, the users had de opportunity to answer another survey about the guidelines use in the game concept, the questions were designed to extract information about the guidelines, and the tool used was Google Forms too, but this time the survey link was shared only with the users that saw the showcase.

The sample was smaller due to physical limitations, with 21 users seeing the showcase and answering the survey. Inside the group of users were players with all the types of experience and all being part of the academic community. The survey was chosen again to quantify the results and as a fast and simple form to validate the user opinions about the game and guidelines use.

The first question in the survey was intended to investigate if the game could stand out between other games by its experience as a whole. This question relates to all guidelines, but



especially the third about the exterior. 76.8% of the users said that the game stand out and 23.2% said no.

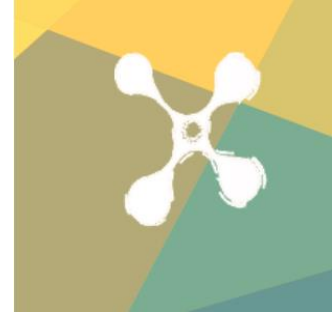
The next question was about the second guideline, the experience, the users were asked if they could feel empathic to the game characters story, and the gameplay as well. The results were similar to the past question with 76.2% of users said that they can relate to the game and 23.8% said no.

The third question in the survey asked about the mechanics directly, asking the users about the mix of genres by the game. This question was one of the most important, because if the results are negative that means the game won't be fun to play, and the main goal is to be fun. 57.1% of users said the mechanics are good and stand out, while 28.6% said that the mechanics were excellent, creative and innovative, 9.5% disliked the mechanics and said that were boring, with no interest in playing the game.

The following question asked about the platform that the game would be released, as a smartphone and television app, and 47% of the users considered the platform good, and 42.9% considered excellent because most of users already have a smartphone and television, and 9.5% considered the platform bad, because the use of two screens was dull.

By these questions is possible to analysis the engagement and experience guidelines, the next questions were about the usability and ergonomics, involving the third guideline of exterior. The users were asked about the established conventions in the game concept, if the controls and imagery (icons etc.) were intelligible and known and 95.2% of the users said yes while the rest said no.

The last question in the survey was about accessibility, the users were asked if the game could be played by the multiple types of users. The game was designed to be played with one hand only, and needing less effort as possible, that reflects in the users answers with 76.2% of them said that the game was accessible and 23.8% said is not.



The answers pointed by the survey, shows the relevancy of using the guidelines in the game concept, the reception from the users was very positive and they noted the union of the game components and they felt engaged, wanting to play the game. The user interface received positive feedback collaborating to the translation of the game experience to the user and being accessible too.

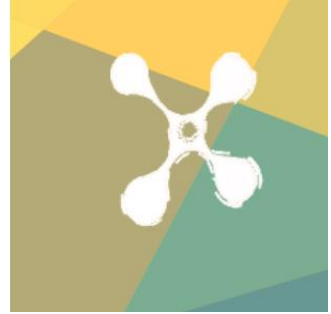
The final approval comes from the users seeing the game as innovative and standing out from other games. This extremely positive feedback to the game concept proves the benefits from the guidelines use in game development, once they impacted in most of game decisions.

5. Conclusions

The understanding of game development process, usability, and the interactive questions that the game sphere covers, and the methods within the user interface conception process resulted in the guidelines and the model proposed in this paper.

The proposed model focuses on how to things, not in what to do and proposes an integrated development process that connects all the professionals involved in the development process. Therefore, the proposed model provides a complete process that covers the three first steps of the game development and some adapted documentation that allows everyone involved to follow and understand all phases of the process. Another point to highlight is the careful risk analysis and the requirements engineering applied in the proposed model.

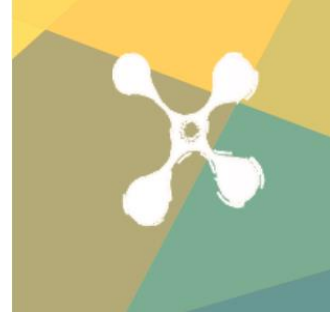
Regarding the Guidelines, the choice to make only three guidelines, wider guidelines, happened because of the existing heuristics and ergonomics criteria; they constrict and left no subjection when used for evaluation and as guidelines. The presented guidelines are supposed to stimulate the developers to talk and involve the whole developing team in every decision, opening more dialogues about what the game experience should be. Applying the guidelines to the game concept resulted in extremely positive feedback from the users that saw the showcase and besides the validation of the guidelines use, it was also very satisfying



to see how the literature review and the methods implied in every process like the mood boards and storyboard could be used to benefit the development.

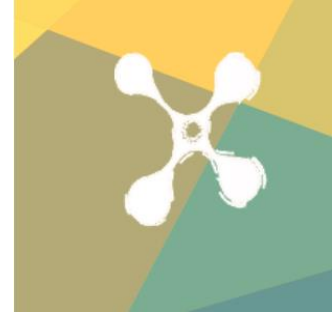
The research not only is relevant to the game development, but to the academic environment as well, offering references and incentive to future researches involving game development process, user interface, usability applied to the digital games sphere.

As future work is intended to test the complete development process applied to the development of a real game at all stages.



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