# Abstract

~~With the every rising popularity of games amongst people of all ages it was only a short time before they started to become more than a pastime. This project explore the possibility that video games could act as a medical intervention to help combat anxiety among children by creating an artefact that specifically targets them as the core demographic.~~

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# 1 Project Background

## 1.1 Introduction

This introduction will give a brief insight of the project and why video game based interventions are an interesting area of research in pediatric and how it can benefit both parties. This project aims to access all sections associated with this particular intervention ranging from specific mechanics, dynamics and aesthetics of game design and the general effect of dental anxiety among children.

Video games are enjoyed by millions all over the globe, progressing greatly since the days of pong and space invaders and act as a general distraction from everyday worries and concerns, they allow the player to become fully absorbed into the world so much so that the world around them starts to become faded and the perception of time becomes blurred (Jennett. E et al, 2008) so respectively the industry grows with it which makes it a suited candidate for these particular intervention.

Dental anxiety effect many people which can lead to irregular attendance, delays in seeking treatment or total avoidance completely. (Locker et al, 1996) This is seen as a severe problem amongst dental specialist and the lack of improper dental care can lead to problems later in life

## 1.2 Motivation

### 1.2.1 Fun over educational game design

Within early design stages the discussion was made to have the artefact more focused on fun rather than education, where the idea of educating the patients on the practices and harmlessness of dentistry the aim of the project is to simple act as a distraction tool to help them overcome their anxiety through experience. As it will be discussed later the theme of the artefact will have little to no relevance to dentistry other than a few subtle sub-text so to feel like a game fit for the environment. This was decided because the artefact needs to entice the player to want to play and thus become immersed in it, where educational games can be fun they’re much harder to become immersed in than a fully fleshed out universe.

### 1.2.2 The Environment

The environment for the artefact is just as important as the artefact itself, because the game will be played using a controller and view on a TV rest above them. This setup is important and should constantly be in mind when discussing the rest of the project, because of this theoretical setup of a dental environment it is impossible to recreate, given the time and resources. Yet it allows for much deeper game design as it will be played just like any other game except they’re in a the dentist. Even though this setup may be very specific and limited to certain dentist’s, it’s this idea of shaping and changing the environment to feel more comfortable for children that will ultimately make this project successful.

### 1.2.3 Justification and limitations of the Environment

If this project aimed on diversity of games used in dentistry to help combat anxiety, then it’s apparent that a mobile device would be the perfect candidate for this. To justify the decision to use the set-up described in (section 1.2.2) it’s important to eliminate why the more obvious decisions weren’t made. A mobile game would be fitting as it’s portable and requires little to no environmental change yet with all things considered it’s pretty limited.

# 2 Literature Review

## 2.1 Introduction

This sections aim is to review existing bodies of literature thoroughly and wisely in attempt to create a knowledgeable and coherent body of research. Everything within this section will help support further decisions made during the design and implementation stages of the artefact. It will cover topics ranging from dental anxiety to game design and all will identify the justifications and relation with one another in order to support the important of this research. First it’s important to know what dental anxiety is and how it can affect someone so that specific features can be applied to the artefact allowing for a more collective design.

## 2.2 Dental Anxiety and Phobia

The project is focussing on two major elements; Game Design and Dental Anxiety because of this it’s important that a thorough body of research is gathered for both subjects to ensure that the artefact is designed in such a way that collaborates with one another, this first section will focus on the study of general dental anxiety amongst all.

Dental anxiety in its simplest form is the fear of attending the dentist, for this project to be successful it’s important that the symptoms and effects of dental anxiety in general are explored thoroughly to better understand the target audience. A study by Chikkala. J et al (2015) explored the effects of dental anxiety amongst children from a variety of different backgrounds ranging from private schools to those at government ran Orphanages, they found that even though dental anxiety amongst children is generally poorly understood, the cause can be separated into 3 different mechanisms; Derived from an prior negative experience, Low understanding or negative influence of dentistry practices, as well as general anxiety or nervous personality traits. This is important to know because the game can only act as a distraction so typically it’s aimed to comfort those who are new to this treatment/operation and those who have general anxiety issues rather than children suffering from past trauma, it can be concluded that at its core the artefact only needs to be a game, it will not acts as a virtual therapist nor a way to teach people about dentistry or dental anxiety as an artefact that aims to only combat the effects of anxiety it’s clear that distraction and entertainment will be the two most important factors of this project.

Newton et al (2012) studies possible ways to help manage dental anxiety in patients undergoing treatment, the study research’s the varying levels of anxiety from low to Moderate to high and assess the potential interventions that may ease their anxiety, were this project will be purely aimed at children and their struggles with anxiety, Newton et al (2012)’s research focuses on anxiety sufferers of all ages and discusses that people suffering with moderate levels anxiety would benefit from preparatory information from the doctor and patients with high levels of anxiety may want to undergo relative analgesia. Therefore this review will only focus on the evaluation of low anxiety interventions for children, which predominately focuses on distraction and comforting in both the environment and during the treatment. A list of possible interventions that may help reduce anxiety in children are put forwards and though each one is important for the study of anxiety this review will focus on a selected few; Distraction, Enhancing sense of control and Cognitive Distraction. Newton et al (2012) discusses the idea of distraction within this dental environment and expresses that many forms of distraction have already been reported to have been used, such as the use of cartoons, audio-tape stories and even video games. “*Distraction techniques have been found to be as effective as relaxation-based techniques*” Newton et al (2012), in this study they says that Audio-tapes tend to be more efficient than video-tapes because it allows for the patient to close their eyes during the procedure, though it’s not impossible to create a game that allows the patient to close their eyes and could be done by creating a hand-held, vibration based game the artefact will remain visual so that it can immerse the player into the world and feel less like a tool and more like a game. Next is the enhancement of control, one example is the use of a stop button which allows the patient to communicate with the dentist whenever they may feel uneasy an study also done by Richardson et al (1999) who studied the efficiency of a stop button for patients undergoing stressful medical procedures and claims that just the idea can help ease their anxiety. This concept of a stop button can be introduced to a video game with ease as it will be, because the idea of a controller has already been decided the implementation of a stop button would only require the use of one of the buttons and some preliminary information that can be presented via the video game, this idea will allow the player to communicate to the dentist with a simple press of a button whether they’re in the middle of a level or on the menu this function needs to be accessible one-hundred percent of the time. Cognitive Distraction though like very similar to general distract this will be the most import part for this project, Newton et al describes cognitive distraction as less of a tool to occupy the patient and more of a way to get the patient thinking about something else entirely very similar to the idea of immersion a concept that will be explored later (See section 2.5) the idea of your mind being completely focused on something else, being absorbed into a world; a story, a universe is why this project will focus on an extensive artefact rather than a simple tool.

Considering everything from dental anxiety sufferers and ways to help combat it it’s clear that these types of interventions will not be an innovative new concept for this environment as it has been explored countless times before, but it’s the collaboration of this and game design which will bring to life this artefact, the artefact will not be a game played in a dentistry environment but a game made for it, hand crafted based on soul purposes, to aid with combating dental anxiety amongst adolescents by immersing them in a new world. Unfortunately immersion is a mere facet of the overall architecture of game design, though considered to be one of the most important (Brown and Cairns, 2004) it’s important that this artefact is crafted to the likes of the audience and thus the next sections will cover all the relevant areas of game design.

## 2.3 The Industry

This section will now start to focus on video games and how they are a common distraction for people all over the world which will support the use of video game interventions. The entertainment software association (*2015*) is a U.S association that deal with the business and public affairs side of the video game industry. They publish a report every year to demonstrate the statistical value of the video games industry amongst the American population, it is reported that over a hundred and fifty five million people in American alone played video games in 2015, forty two percentage of which play them for more than 3 hours a day. Though all figures aside it’s apparent that the video game industry continues to grow exponentially every year as proven by the ESA which makes them a perfect candidate for combating anxiety because of the way they’re already universally loved and played, it’s important to understand why videogames should be used in this project instead of any other medium.

## 2.4 Games as Distractions

Video games are prevalent and have already started becoming a form of medical intervention. Patel et al (2006) studied the effect of hand-held video games within a paediatric environment and showed that due to the support of video games their anxiety was severely reduced during the initial anaesthesia stage. Even though the artefact will not be hand held due to its potential interference with the treatment this study is a perfect example of this intervention, instead the artefact will be using a wireless controller connected up to a television that will display the game, this will allow for

## 2.5 Immersion

Immersion is a way to analyse how much a player is invested in the overall game experience and is critical to making a successfully game, it is a common term used by gamers, designers and researchers alike. Brown and Cairn (2004) who studied this idea of immersion, found that immersion is quantitative and broke it into three separate levels; engagement, engrossment and total immersion. Studying and analysing these points of immersion will help craft a robust understanding of them to help better predict the immersion level of the artefact. The first and lowest level is engagement, this level is described to act as a barrier which can only be broken based on the player preference” if they do not like a certain style of game they will not even try to engage with it.” (Brown and Cairn, 2004) as it is with any game it cannot appeal to all and can completely take you out of the experience if it focuses on a genre that doesn’t appeal to the player, unfortunately like most mediums the game industry is fully of unique minded individuals and is very rare if at all that a game will appeal to everyone, which is why the artefact will focus around a genre that is already well established rather than venturing off into designing a new innovative concept. Engagement also requires the gamer to invest time into learning the mechanics and controls, if a games happens to have controls that don’t satisfies the players preference or are generally awkward this could take them out of the experience or cause frustration.

The second level is labelled engrossment and is said to hinge on the overall game construction. “There are lots of games that are still loads of fun, but lack that semi-mystical quality of good construction.” (Brown and Cairn, 2004) To achieve this level a player must feel as if all of the game mechanics have started to merge together into the overall experience and the controls of the game become second nature, it is said that this is the point off immersion that the player starts to become immersed, they begin to be less aware of their surroundings and the concept of time becomes blurred. This is the state the project needs to achieve, because of this idea of Cognitive distraction mentioned prior (See section 2.2) engrossing the patient in the game will hopefully distract them from any dentistry taking place, the artefact will attempt to achieve this by having a series of platforming mechanics that allows the player to tackle a goal in multiple ways.

The last level of immersion is Total Immersion, Total Immersion is achieved by completely braking the barriers of atmosphere and empathy, the state where the player totally closes themselves off from the world around them and becomes fully involved with the game. It is as said that total immersion is the point where the player actually starts manipulating their surroundings to match the games atmospheres, this has said to be done by turning off the lights while playing a horror game or simply wearing a headset to fully immerse themselves in the sound.

“You just forget about the things around you and you’re focused on what you’re doing in the game” (Brown and Cairn, 2004)

Due to the nature of dental anxiety sufferers within a dental environment, achieving total immersion may not be possible but immersion can definitely be achieved. The artefact will attempt to achieve empathy and atmosphere through story and characters hence the decision to create an adventure game but this level of engrossment will be the aim for the project.

Jennett et al furthers this study of Immersion by Appling three factors that associates with immersion; Flow, Cognitive Absorption and presents

## 2.6 Flow

Flow has been described as the process of optimal experience, from a physiological stand point flow is the measure of happiness, the concept of flow was initially introduced by Mihaly Csikszentmihalyi, yet this idea of flow can be easily translated into game theory. For a project that aims to distract children it’s important that the game relives stress rather than enhances it so it’s important to achieve the right balance of flow.

## 2.7 Theme

“Sounds easy, but what is a theme? The theme is what your game is about. It is the idea that ties your entire game together — the idea that all the elements must support.” (Schell, 2008), Theme is important, it’s important for consistency and style. Schell (2008) discusses the art of creating video games and has written a comprehensive section of theme, it starts by addressing the utility and effectiveness of a single themed video game how this simple concept of a theme can help create this aesthetic and consistency that is pivotal to a well-designed game. Schell states that identifying the theme early can help drive and inspire the development cycle forward and act as a catalyst for furthering the gameplay elements. The artefact must have a theme that appeals to children’s

# 3 Tools References

## 3.1 Documentation Tools

### 3.1.1 Microsoft Word 2013

## 3.2 Artefact Creation Tools

### 3.2.1 Game Maker Studios

The two decisions for the game engine were GameMaker:Studio and Unity 3D, though alternately GameMaker:Studio was chosen for several reason; first GameMaker:Studio specialises in 2D game design which the artefact will focus on. And due to the nature of GML it is easier to create much denser games in a short amount of time than any other engine meaning that a much more expansive game can be built within the given duration. “Making games development 80 percent faster than coding for native languages.” (*YoYoGames. 2016*), because of the friendly nature of game maker it makes it much quicker to work with than Unity but less versatile.

### 3.2.2 Game Maker Language

Game Maker Language (GML) is the native coding language for Game Maker Studio, it will be used instead of Game Makers built in drag and drop programming this is because of the cleanliness and additional functionality that GML supports though drag and drop is useful for anyone starting with game maker

### 3.2.3 Unity 3D Engine

The

## 3.3 Asset Tools

### 3.3.1 Adobe Photoshop

Adobe Photoshop will be the software used to create all of the sprites and background assets for the games graphics, Photoshop is a diverse programs specifically used to crafting images and graphics alike, it comes with an entire toolset that allows for the creation of small pixel like sprites and larger more simple backgrounds. “Create anything you can imagine. Anywhere you are.” (*Adobe, 2016*) Adobe Photoshop will be used over Microsoft’s paint because of the simplicity of Microsoft paint it doesn’t allow for tools such as layers, gradients and transparent backgrounds which can make all the difference when drawing game based sprites.

### 3.3.2 Microsoft Paint

Even though Adobe Photoshop will be used a majority of the time, Microsoft paint isn’t out of the picture, Microsoft paint offers one thing that adobe Photoshop doesn’t, the ability to quickly and easily re-size your canvas as well as easy copy and paste functionality. Though Paint won’t be used for any sprites it is a useful tool for cropping screenshots for display in the document or artefact. Microsoft’s paint will be used over all else because of how accessible it is with any windows operating system.

## 3.4 Backup/Source Control Tools

### 3.4.1 GitHub

The project will be using get hub for both source control and backup, Github is a web-based repository that allows the user to host projects and share them with anyone around the world or just store them as private. In addition Github comes with a desktop app that allows for easy uploads and reverts of your project making it easy to undo any major mistakes to the project. Github will be used over other repository based software such as bitbucket because of familiarities with the interface and accessibility with the application makes GitHub the viable option in this circumstance.

“GitHub is how people build software. With a community of more than 14 million people, developers can discover, use, and contribute to over 35 million projects using a powerful collaborative development workflow.” (Github, 2016)

# 4 Game Design

## 4.1 Mechanics

### 4.1.1 Familiarities in modern games

When creating a game in a scenario like dentistry, it’s important that the learning curve is shallow yet the game remains interesting and somewhat challenging, because you want your player to be able to pick up the controller and have fun straight away without spending hours learning how to play. This is why a majority of the mechanics in the game are based around popular games of our times such as New Super Mario Bros. U (Nintendo EAD, 2012), the aim isn’t to create the next innovative game but to design a game that can hold the attention of a children during their dental treatment. The game will be a simple platformer consisting of mainly familiar mechanics with a few new ones to keep it captivating.

### 4.1.2 Save and load Feature

The artefact will feature a load and save feature which will allow the dentist to save the ID of that patient which will store the patient’s game data. This means the game can be continued from the last visit allowing the player to continue the adventure into unknown areas of the game, this keeps the game from becoming tired after a single sitting and with any luck would give the patient something to look forward to during their next visit.

## 4.2 Dynamics

### 4.2.1 Adventure game

The game will consist of a linear sets of levels that ultimately leads to a new world with new enemies and new scenery like seen in Sonic the Hedgehog (Sonic Team, 1991) and Crash Bandicoot (Naughty Dog, 1996). This concept is important simply because arcade style games such as geometry wars (Bizarre Creations, 2003) are built in a way that can be challenging which in turn creates its own progression, this means that by nature they can be frustrating which may build on the stress of the patient. An adventure game would allow the game to go at a much steadier pace allowing them to take their time with any level, this means that the game will be a lot less stressful yet the equilibrium of flow remains, giving the game it’s challenge through platforming puzzles and higher levels which by that point the patient would be acquainted with the mechanics.

### 4.2.2 Controller Support

The artefact will focus around controller support, this is due to the familiarity and comfortability of the controller while undergoing treatment.

### 4.2.3 Communication via the Game

The game will contain a feature that allows the patient to communicate via the game, the feature will be able to be activated at any point during the game, whether they’re in the middle of the level or at the menu, Newton et al (2012) states that enhancing the sense of control for the patient has positive effect on peoples anxiety, Stop buttons have been a widely used concept in dental treatment for some time and have proven their effectiveness. This concept will be presented and explained to the patient via the characters in the game as an attempt to detract any negative denotations that may follow as well as this idea of relatability with these character should be less intimidating for children making them more included to use it if needs be.

This stop button or communication will be accessed by holding the back button, it will feature around a three to five second delay supported by visual influence for several reasons; first is that this game must support dentists as well as patients, it should never be a hindrance for the dentist unless it needs be, having this delay will prevent any accidental presses of this button and should hopefully only be activated if the patient intended to. Secondly by using images that were shown during the introduction to this feature it should act as a cognitive response mechanism that reminds the player what the button does if they happened to have forgotten just so it doesn’t act as an inconvenience to the dentist.

## 4.3 Aesthetics

# 5 Methodology and Implementation

The aim of this project to create an artefact that inherits these previously discussed concepts which will help immerse players while undergoing dental treatment. Every design decision made will have had this idea in mind. This section will be broken down into every iteration of the artefacts implementation stage, it will discuss and evaluate what decisions were made and why to help support this intervention. It will follow the design section closely (*See section 4*) but dive more in depth about how it was achieved through these iterations and what features were changed, removed or added. Each iteration is purely arbitrary in workflow and duration as this is following the waterfall methodology and not scrum which focuses on set sprint times and tasks for each iteration.

## 5.1 Iteration 0.1

The aim of the first iteration was to focus on constructing all of the mechanics for the game with little to no coherence, like stated before the artefact will be a platformer and thus borrow mechanics from popular games of the same genre, but is still important that the game holds its own identity and introduces a few new mechanics that keeps it interesting. This parallel will hopefully create this pick up and play experience.

It had been during the development stage that the decision to use the Gamer maker: Studio engine over the Unity Engine had been established, the concluding was made based on this idea of a 2D platformer, were Unity can achieve both 3D games and 2D just as Game maker: Studios can, it’s apparent that the scope of the project will much easier to achieve and polish with Game Maker as it excels at making 2D games and has an interface and coding language (GMC) that is much easier to grasp and master.

The first task was creating the basic functionality of the platforming mechanics using simple block based sprites as place holder art, it’s important to implement these features before getting caught up in the aesthetics of the game, as it makes any adaption to the game player that much more smoother. The core platforming mechanics will be the first thing that is implemented, as with any platformer it’s the obstacles and level design that ultimately drives the challenge. The game will feature mechanics such as; jumping, double jumping, wall sliding, wall jumping and some means of attack all of which feature in the popular video game franchise Super Mario (1985) a franchise that still uses the same core platforming mechanics today as they did back in 1985.

Because of Game maker’s in-built controller support it was simple to get everything working on a Xbox-one controller, it was important to make sure that the button to action layout felt comfortable, familiar and fluent as the controller will be the only means of play for the patient and thus it must feel native to game. *For more information on this see section 4.2.2*

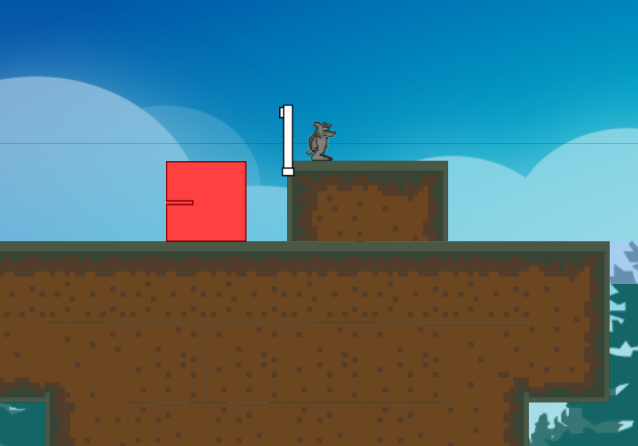
|  |  |
| --- | --- |
| A | Jump |
| B | Drop Item |
| X | Fire Staff |
| Y | Pick-up Item |
| Left-Stick | Move left, right or fall through platform |
| RT | Aim Staff |

***Fig A***: A table displaying the current set-up for the Xbox-one controller

As development continued and the basic mechanics of the game were implemented, the process of animating began. “*Modern Games are full of characters that need to seem alive. The very word “animation” means “to give life.”*” (*Schell, 2008*) Once you start creating your world it becomes easier to understand what works and what doesn’t and now that the fundamental mechanics are implemented, the creation of the graphics can begin and help bring the world to life. Early production the theme seemed apparent, the artefact will focus around an idea that inherits a series of popular themes such as; science-fiction, wizards and an anthropomorphic animal protagonist just like characters from other popular children’s games such as the Sonic the hedgehog series (Sega, 1991), this was done as an attempt to create an entirely new universe in which to become immersed in.



***Fig A***: The original sprite atlas for the main character



***Fig A***: A very early screenshot of the game

In (Fig A) the artefact was playable and functioned correctly, but wasn’t at a state where it could be classed as a game, even with the addition of obstacles it still some core gameplay mechanics.

## 5.2 Iteration 0.2

## 5.3 Iteration 0.3

# 6 Testing

# 7 Evaluation

# 8 Conclusion

# 9 Appendices

# 10 References

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