

# Jetpack Project

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## ABSTRACT

This paper is based on an artefact, named Jetpack, which took the form of an interactive game where the user takes control of a manned jetpack in a 3D environment. The goal was to create an interactive artefact that would utilise the possibility of depth present on a 3D cinema screen, and to examine whether or not the added depth would result in a more immersive interactive experience for the user.

To better evaluate if the added depth indeed enhanced the user experience, a series of Opportunistic Evaluations were held to get a better understanding of the immersive properties of the 3D screen.

## INTRODUCTION

The Jetpack project was created as the exam project in a course named 3D interaction, taken at the University of Aarhus. The rules for the exam were that the resulting project had to include interactive use of a 3D cinema screen, and that the finished project had to be presented in front of the class and demonstrated to the examiners. As part of the course we had to design, build and test a prototype, as well as write a report about the design process and the user tests, to prove that our design used the 3D properties of the cinema screen, and that these properties actually helped enhance the interactive experience of the final artefact.

To this end, the immersion of the user was designed to focus around the game itself and not the Jetpack, as it was to function as a tool for interaction, thereby creating a perceptual illusion of nonmediation as defined by Lombard and Ditton (Ijsselstein, 2001). If the users felt that the Jetpack was cumbersome or unintuitive, then it would have taken away part of their focus from the game.

The project was created by three students working together to create the Jetpack project over a two month period. The game engine Unity was used to create the game, since this engine made it possible to receive information from multiple sources at the same time. This was used to receive user input via the constructed jetpack backpack.

We will now take a look at the goal of the original design process that resulted in the Jetpack idea. Afterwards the final design of the artefact will be presented and explained in detail. Then we take a look at how users actually interacted with the artefact. Lastly a short discussion about how we explored the

Jetpack's properties, will help create a better understanding of the artefact as a whole.

## GOAL

The goal of the design process was to create an Interactive 3D experience for the user, where the interaction between body and 3D environment created an opportunity to enjoy the game itself without disrupting the immersion.

Designing the Jetpack's textural, visual and interactive properties, also meant working with the theory of Tangible User Interfaces, to better insure the desired Connotations and Denotations in the users (Fishkin, 2004). Lastly the Jetpack game was planned out to be easy to learn yet hard to master, and took its inspiration from classical arcade games such as Donkey Kong. To have any chance of achieving this, our game would have to live up to several rules that are prevalent in classical Arcade games. Therefore these rules had to be examined and understood.

## Hypothesis

The Jetpack Project was created originally as an exam project, where the main rule for the exam was that the resulting project had to in some way use the possibilities of a 3D cinema screen. As a group we chose to take the assumption that we could create a more immersive experience for the user, by using the depth perspective of the 3D cinema screen, to create a video game that used a first person perspective, and the body of the user for navigation. Here the 3D cinema screen functions as a "Window-on-the-world" monitor based display, as defined by Paul Milgram (Milgram, 1994). Having the user use both their body as the controller, and giving them a first-person perspective, we thought would create a better immersive experience for the user, then if we had given the user an avatar in the game.

To figure out if the finished project lived up to these expectations, we therefore had to test the resulting game with and without the use of an avatar for the player, as well as see if we could create an interesting interaction experience that would support our game idea, and not work against the immersion we were trying to create.

## FINAL DESIGN

The final design took the form of the Jetpack game, where a user wearing the jetpack backpack, uses it to interact with the game running on the 3D cinema screen. The user stands approximately

three meters in front of the cinema screen, while wearing passive 3D glasses, to get the full 3D experience.



**Figure 1: User testing the Jetpack game.**

The game would start when the user pressed down on the two buttons placed on each handle protruding from the jetpack. This would activate the motor of the virtual jetpack in the game, and let the user navigate the game environment by tilting to a certain side while activating the jetpack. The user would then fly in the direction they themselves were pointing. This lets users change direction while flying, by simply tilting to a different side. Likewise breaking requires the user to lean backwards to exert force in the opposite direction. By letting the user control their movements inside the game with their own body movements, the interaction with the game became more intuitive than simply presenting them with a keyboard or joystick setup. This did however mean that the jetpack backpack itself had to be designed to help give users an intuitive understanding of some of the backpack's interactive possibilities.

## 1 The Jetpack

The Jetpack is constructed primarily out of wood sheets, venting pipes and plastic jugs, which were constructed and painted to conceal the internal electronic components, as well as complete the illusion of the jetpack for the sake of the user's immersion (Greenfield, 2006).



**Figure 2: The finished jetpack after painting.**

When designing the jetpack backpack, we as designers had the opportunity to shape the artefact in such a way, that the user would have a natural understanding of some of the properties of the artefact (Kirkpatrick, 2009). Because of this, choices had to be made about the materials, the look, as well as the weight of the finished artefact, to ensure user understanding of the possibilities of the finished jetpack backpack (Rogers, Muller, 2005).

The jetpack was therefore constructed to create the illusion of being made of metal. This was achieved by using a technique of painting called dry brushing to create a worn metal look, as well as thick glue, painted to look like welding, to reinforce the idea of a metal item. These small details ensure that the overall look of the Jetpack backpack itself, helps reinforce the illusion of the real world properties of this joystick.

The internal components consist of a wireless mouse for button pressing input, as well as a Nintendo Wii Remote that functions as a gyroscope, and makes it possible to receive information about how much the jetpack is tilting to a certain side.

The two rods protruding from the jetpack both have a red arcade button on the end, that the user must press simultaneously to activate the jets on the jetpack inside the game. This way both of the user's hands are engaged as well as serving as a form of a dead man's switch in regards to the rules of the virtual world. Keeping the user's hands engaged while playing the game, was done to better insure that the user would use this part of her body as well, thereby trying to create a sort of full body immersion in regards to the actual interaction. By giving the user as much relevant interaction and information about the game world as possible, it was hypothesised that the user would achieve a better immersion (Jennett, 2009). In the paper "*Investigating Computer Game Immersion and the Component Real World Dissociation*" the authors argued that players would experience a higher level of immersion while playing a good game, as opposed to a bad game. A good game being loosely defined as a being able to give the user interesting and relevant feedback to the actual interaction. Therefore keeping the user's entire body engaged, in a relevant fashion, would help create a more immersive experience.

When combined these inputs from the user, enables her to interact with the Jetpack game, while wearing the jetpack, by tilting themselves, back, forth or sideways, while pressing the two buttons that activates the jetpack motor in the game. This allows the user to navigate the 3D world of the Jetpack game, while maintaining their immersion in the game through the input device in the form of the jetpack. The wireless mouse and the Wii Remote that make up the internal components here lets the jetpack send information to the computer running the game in Unity.

## 2 The Game

Choosing classic arcade games and the documentary *The King of Kong* as our main sources of inspiration, we arrived at the idea of creating a modern arcade game, based on the concept that a game should be simple to learn, yet hard to master (Halskov, 2010).

The game itself is based on the idea of putting the user into the harness of a jetpack, which then lets the user traverse a virtual 3D world, using her own body and its tilt as the main form of interaction.



**Figure 3: Shows paint detail and the fake welding.**

One of the early decisions about the game that was taken by the group, was about whether or not the user should have an avatar to represent her in the virtual world, or if the 3D screen that the project was based on, would achieve a better level of immersion if the user felt that she was inside of the game. The group decided not to include an avatar for the user after a series of concept tests, that were held early in the process, made it clear that a better immersion in the game could be achieved by letting the user feel that she was inside of the game and looking out through her own eyes. This did however mean that some of the movement precision of a normal 3D platformer was given up in an attempt to create a more immersive experience. An example of a game that mixes the idea of using both a partly hidden avatar, and not having an avatar at all, is the game *Mirrors Edge*, where the user has to traverse levels at a breakneck speed, while enjoying a first person perspective. Here the avatar is partly hidden, and only the limbs are shown during the levels, thereby creating the illusion of the avatars limbs, being the users limbs inside the game.

The Jetpack game consists of three different levels each build on a slight variation of the overall jetpack theme. To traverse a level, the user must collect fuel for the jetpack while navigating the level and reaching the goal which is placed at the end of each level. Players are awarded a score on completing a level based on the time spend as well as the amount of fuel picked up. The fuel consumption and traversing of the game world make out part of the rules that enable the game to take place, since a game without rules could be considered pointless, or a sandbox game, where users create their own rules (Salen, Zimmerman, 2004). The rules were planned out to be relatively simple, if you run out of fuel or fall down then you die and must start over. To help users learn the rules of game, the first platform that a user can land on in the first level, is equipped with fuel, so that the user is shown the rules of the game gradually (Salen, Zimmerman, 2005).

The main difference between the three levels lies in the different difficulties presented by the individual level designs. The progression in difficulty allows for a manageable learning curve for the users.

## USER TESTING

To evaluate whether or not the design choices regarding materials and game design had been successful, a series of Opportunistic Evaluations were held to get a better understanding of how actual users interacted with the finished artefact, and if the addition of the 3D screen's depth actually did give users a more immersive experience (Rogers, 2011). To this purpose users were both observed and later questioned about their experiences.

First the users were asked to test the finished game using the jetpack backpack, but without the aid of the screen's 3D capabilities. They tested the three different levels of the game and had a chance to talk about what they thought about it. Afterwards users were again asked to try the game, this time using a 3D version of the game that required the user to wear passive 3D glasses. Lastly the users were interviewed about the different versions of the game to find out if the addition of the 3D depth had had an impact on their game play experience. These interviews were held to see how users reacted to the different versions of the game, and to better understand how the different versions of the game, as well as different forms of interaction, either improved or removed game immersion based on the earlier hypothesis.

The users were observed, during the test, to better evaluate their interaction and experience, while at the same time allowing us to better understand their point of view during the interview afterwards. Initially most users chose to test how the jetpack behaved as a controller by activating the jetpack in small controlled bursts. This way they could see how much fuel was consumed during flight, as well as get a feeling for how jetpack manoeuvred. The users that didn't choose to test the jetpack slowly, often ended up pressing and holding the thrust buttons compressed, resulting in the jetpack taking off and remaining airborne until they ran out of fuel.

After the initial trial run, the users chose to gently try and maneuver towards the first available fuel source, and once there they repeated the procedure, thereby trying to navigate the level from one visible fuel source to the next. Some users chose to stick to this form of navigation throughout their interactions with the game, while a select few decided to experiment and try to find a more strait path towards the finish line. One user decided to try and see if he could reach the finish line without picking up any fuel at all. This user seemed to have noticed that the longer the activation buttons remained compressed, the more speed would be generated. This was due to the way the jetpack had been programmed to add force to the players avatar, without ever reaching a maximum setting. Here the user had found a different way to play the game, but not necessarily one that broke the game. The reason for this was that this new approach to the game might not have been planned from a design standpoint, but it did prove to be extremely hard to pull off for the users. After the initial user had tried the idea a few times, a few of the others wanted to give this new approach a try as well, but in the end only one of the users was able to actually reach the goal. Interestingly enough it was the same user that initially had the idea. This could mean that this user was more determined to make it work, or that this user was simply more

used to playing video games, and therefore had a better understanding of the rules and limitations of the Jetpack game.

## DISCUSSION

The users agreed that the game was more immersive when using 3D to enhance the depth experience, as well as giving the users a better understanding of how far they had to fly to reach a certain point.

Most users didn't complete all the levels but everyone agreed that the game seemed "fair" as far as their interaction and movements were concerned. One user managed to gain enough proficiency at the game, to try and complete one of the levels picking up as little fuel as possible.

During the interviews it became apparent that the users didn't focus on the Jetpack itself once they had it on, and after just a few tries most of them didn't even consider their interaction though it. They simply played the game.

## RESULTS

The addition of the 3D depth allowed the users to traverse the games levels more precisely, however they agreed that the game would also functioned without the added depth, just not let the user navigate as precisely. Therefore the addition of the added 3D depth, using the 3D cinema screen resulted in a better experience for the users, since they felt that it improved their control in the game. Likewise the interaction though the use of the jetpack, made the game experience more immersive for the users, since they felt that they where controlling the jetpack directly thought their movements.

## RELATED WORK

When working with the term *immersion*, in regards to game design, it can be a good idea to take a closer look at Emily Brown and Paul Cairns article "*A grounded investigation of game immersion*", to get a better understanding of the definitions of *immersion* as a term, as well as getting insight into how the users of games can experience immersion in different ways.

When designing a game where some form of input device is required then Graeme Kirkpatrick's work in *Controller, Hand, Screen: Aesthetic Form in the Computer Game*, focuses on the user interaction though different types of controllers, and specificity how and what the design of a controller can contribute to the experience of a given game.

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