

*UNIVERSITY OF OSLO*  
*Department of informatics*

*A deeper look into*  
*multi-touch gaming*

**Master thesis**  
60 credits

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# Abstract

In this article, I am looking at multi-touch tabletop games. I am looking for the best suited genre for multi-touch tabletops and at how multiplayer support should be done on these tabletops and what multiplayer format the technology best suits. I am looking into how user interfaces are best supported for playing games on a multi-touch tabletop. In looking for the answers to these questions, I am using user surveys, interviews, prototyping and workshop methods to gain perspective on the subjects. The article is showing how I, through these methods, came to the conclusion that the simplistic multi-user interaction genre holds the greatest gameplay value for multi-touch tabletops. And that a multi-user game brings players together and envelopes them in cooperative or competitive gameplay offers a social aspect that in turn goes beyond the game.

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# Glossary

## Technology glossary

**Single-Touch** a system that converts a touch at a time to control the mouse pointer.

**Multi-Touch** a system that generates multiple mouse pointers to handle multiple touches at the same time.

**Gesture** is a bodily created movement that is converted when passed through computer algorithms to a command.

**API** [Application Programming Interface] An interface used in computer programming languages which enables it to be used with other software libraries and applications.

**TUIO** [Tangible User Interface Object] is the technology that enables user interaction with a digital system through the manipulation of physical objects or direct touches.

**Latency** defines a wait delay. In multi-touch technology, this usually means the time it takes from a finger touches the table top, to the touch is noticed by the hardware, to the blob creation algorithms has created a blob and sent it to the current application and executed the command it represent. In gaming this usually means the time it takes from you send an action command to the action is completed on the host machine.

**Flow** is a euphoric state of concentration and involvement, often claimed to be one of the most enjoyable and valuable experiences one can have[1].

**Computer vision** is the technology that focuses on gaining information from a 3D scene and relies on complex assumptions.

**Image processing** is the process of gaining information from a 2D image and how to transform one image to another by pixel-wise operations without the need for assumptions.

**JME** [JMonkeyEngine] is a 3D java game engine.

**Lag** is a measure of the delay from an action is intended to when it is registered and completed by the system. It can also be the time between an action is registered to when it is completed, if the functions are slow.

## Game glossary

**Gameplay** relates to games how flow relates to multi-touch, the enjoyment you get from how the game is played.

**Genre** splits different type of games into categories with further subcategories for changes within genres.

**RPG** [Role-playing Game] is the game genre where you control one character through a game world and complete quests to fulfill a storyline.

**MMORPG** [massively multiplayer online role-playing game] is an RPG set in an online world with a social aspect added to the game.

**Action RPG** is an RPG with action based combat system, meaning you will have to choose where to shoot or hit, instead of toggling which monster to shoot.

**Strategy** is the game genre that introduces strategic planning to complete tasks.

**RTS** [Real Time Strategy] is a strategy game where you control multiple characters and buildings to overthrow an opponent. RTS games do not pause during battle and has a fluid gameplay.

**FPS** [First Player Shooter] is the game genre where you control a person with a gun, and hunt down enemies to complete an objective, may it be only to kill the other team, or to rescue hostages.

**GUI/UI** [Graphical User Interface] is the space where interaction between humans and machine occurs.

**HUD** [Heads up Display] is the way a game gives you information as part of the user interface.

**HP** [Hit Points] is the life energy of a character or unit.

**MP** [Mana Points] is the magical energy of a character or unit.

**Cooldown** is a time measure on how often an ability can be cast or action be done.

**Multi-user** means multiple people playing at the same time on the same device

**Multiplayer** defines multiple players playing simultaneously, together or against each other, on multiple, or a single game station.

**Singleplayer** defines a game where only 1 player is able to play at a time.

**Usability** means how easy something is to learn to use.

**Tick** a set time interval.

# 1. Introduction

Games are, and will always be a part of our society, in good and bad. Early discovery shows games being played 3000BC[2], and we still play them 5000 years later[3]. We started playing games with sticks and blocks of clay, and have over time come to play with keyboards, mice and hand held controller. The multi-touch era is here and I will look at how we can use multi-touch tabletops for playing games.

We have already seen great games developed for the iPhone and iPod, Angry Birds (which has sold over 6.5M units[4] on August 26th 2010, from when it was released December 10, 2009). Dungeon Hunter, which has had such success that the developers have moved their franchise from the iPhone over to the playstation3. We also have older games being remade for the iPhone, such as Monkey Island and Doom. Apples appstore received almost 60.000 game app uploads from July 2008 to January 2011[7].

1. Games come in different shapes and forms, most commonly known as game genres[9]; a popular game genre for the PC is the FPS, short for First Person Shooter. FPS games always have a few key gameplay elements in common with each other, while often trying to implement something new to make their game stand out of the crowd. The basic element of a FPS is that you look out through you characters eyes, and wield weapons of sorts. The main objective is to shoot your way through hordes of monsters or other players, while trying not to be hit yourself. It usually follows a story line where you complete tactical missions for each game level. Deus Ex[10] is a popular FPS game, while it borrows gameplay mechanics from the RPG (Role Playing Game) genre, such as monsters dropping items to upgrade your current strength or enabling you to render yourself invisible for a short period of time. Nicole Lazzaro from XEODesign writes in a study about why we play games that[16] “Adults in this study, enjoy filling their heads with thoughts and emotions unrelated to work or school, others enjoy the challenge and chance to test their abilities”

2. Multiplayer support is an important part in any game. Male subjects in particular often strengthen their social bonds with multiplayer games. The MMORPG game World of Warcraft is an extremely social game, where you run into other players in the game world of Azeroth. With its social gaming structure, Blizzard has 12million players subscribers that play WoW[14]. Games also take over social networks with games like Farmville, a java based social game that has reached over 64 million users[15].

Multiplayer support can be given through the use of separate devices linked together through the internet or a local area network. Multiplayer support can also be given on a single device through the use of newer consoles that usually offer 4player multi-user play with the use of separate controllers and a split TV screen.

3. How you interact with the game, and how the game responds to your actions is what defines how the gameplay is. If you are playing a FPS and you cannot move while shooting, or playing a driving game, and the breaks would automatically stop you dead in your tracks, the gameplay would be awful. In old platform games like Super Mario brothers 3 and Sonic the hedgehog, the games had to be designed with the controller in mind, enabling Mario to be able to do 11[11] actions, including attacking, jumping and picking up enemies with the use of 2 buttons. When I played the MMORPG Ultima Online[12] 5 years ago on my PC, I had to have over 60 keys bound on my keyboard to different actions to enable me to play competitively against other players. While the games are of uniquely different genres, the simplicity in Mario makes for a better design for a multi-touch tabletop game. Create 2 gestures for Mario, or 60 for Ultima Online.

This study plans to give a birds eye view of how the multi-touch technology can be used to play games. I am a firm believer of the fact that it's the gameplay that makes the game, not how it looks or sounds. Even though we have the technology to create grand 3D space wars with 1080p real time rendering, it would not be of any use unless it's actually fun and challenging[7] , difficult and rewarding[8] to play. To achieve this plan I will take a closer look into our 3 research questions.

## 1.1 Research questions

1. What game genres does multi-touch tabletop technology best cater to?
2. Multi-touch inherently means multi-user[5]. What is the most desired multiplayer format and what proves to work the best for multi-touch tabletops?
3. Multi-touch gaming provides all the input/output you need with the screen and multi-touch tracking technology. How does the current control standards and user interfaces from PCs and consoles transfer to multi-touch tabletops?

## 1.2 Project Breakdown

To answer these questions, I will do:

- User surveys, because this is a relatively new field with lack of available studies and articles to refer to and learn from.
- Interviews with some of the top gamers in the world to help determine how we should improve our way of gaming on the multi-touch technology.
- Gaming experience from my misspent youth, as I once saw myself as a hardcore gamer.
- Programming practice from my well spent youth, to prototype games for a multi-touch table.
- Workshops to try out, and get feedback on these multi-touch games

And I will look at how the standardized user interface for specific genres has to change to enable them for multi-touch tabletops.

## **1.3 Outline**

In chapter 2, I will look at previous work on the subject of multi-touch technology, multi-touch frameworks and games in general. In chapter 3, I will look at some methods that were used to figure out what prototype to make in chapter 4. Chapter 5 is dedicated to prototyping. Chapter 6 will show results and discussion in chapter 7. The conclusion of the article is in chapter 8 and future work comes in chapter 9.

## **2. Previous Work**

### **2.1 Introduction**

In this chapter, I will look at the relevant work done that contributes to this article. I will first get an overview of the different multi-touch technologies in order to understand what multi-touch does. I will then look at some different frameworks that use the multi-touch technologies and what they are good for. There has been done some good research on touch versus mouse that will come after, followed by general game design and user interface design for both PC/Console as well as multi-touch devices.

### **2.2 Multi-touch technology**

I shall start us off with a quote by Bill Buxton that reads “Everything is best for something and worst for something else”[17]. From the invention of the mouse, it took 30 years for it to reach its true potential.

As computers began to come alive in huge rooms with radio tubes, engineers have worked hard to make the technology better and the computers smaller. First there were simulations, then came the punched cards, keyboards[18], mouse[19], touch (1971) and then a technology to correctly register more than 1 concurrent touch. The multi-touch technology was born in 1982 when the University of Toronto started their research with frosted glass panels with a camera behind it. The first multi-touch monitor came in 1984, but the breakthrough occurred in 1991, when Pierre Wellner published his paper on his multi-touch desk. The paper spoke about multi-finger support and pinching motions[20].

Different companies continued Wellners work, but the cost of the technology were so expensive that it didn't hit the mainstream of users until 2006 when Jeff Han, the founder of Perceptive Pixel[21] suggested the FTIR-based low cost multi-touch equipment. He further implemented applications and techniques that greatly decreased research cost for the multi-touch technology. A year later, Microsoft proudly showed their Microsoft



surface table[22] at a The Wall Street Journal, May 30th 2007 and Apple released the iPhone in June 2007, springing the multi-touch research and interest forward.

In order to achieve multi-touch functionality, you need a program to run on your computer to detect where touches are happening. Community core vision is such a multi-touch blob detection program, it uses image processing to detect touches and convert them into blobs that are done through the use of one or multiple cameras with infrared light detection. The camera is modified to detect the infrared spectrum of light, and depending on the technology on the table, this is done in a few different ways that we will look at below. Community core vision works with any setup, as it only needs the image the hardware captures.

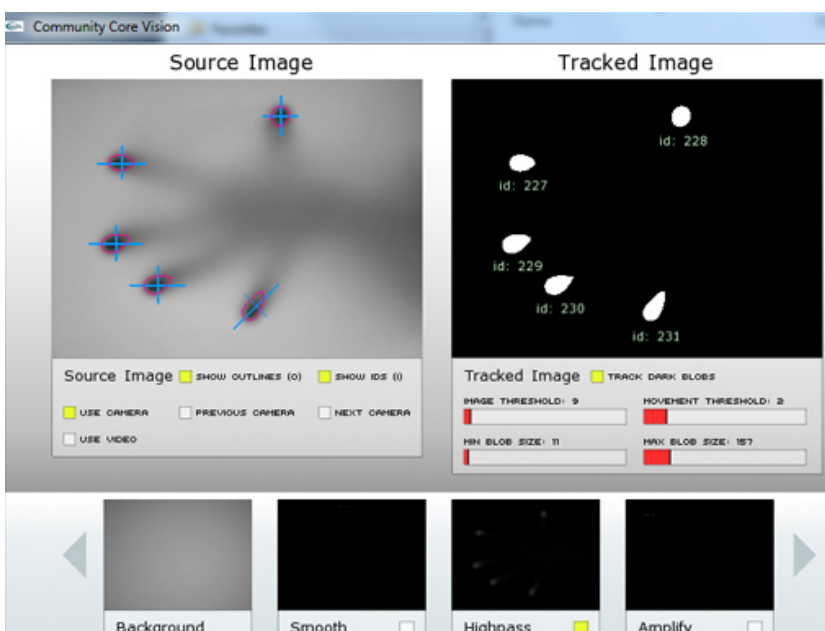


Figure 2.1: Community Core Vision user interface.

This is a screen capture from CCV, on the left is what the camera sees through fine tuning the brightness, gamma, shutter, dynamic backgrounds and more depending on how the light situation in the room is. On the right, you see how CCV converts the camera image into blobs. We will not look into all the different settings of how to get CCV to detect better blobs as it falls outside the scope of this article, but nuigroup has a great community with plenty of guides. The important part is that each blob gets a unique ID, and because of how CCV works, each frame from the camera updates the position of a blob, and lets it keep its ID. This helps to handle dragging of objects and handle gestures.

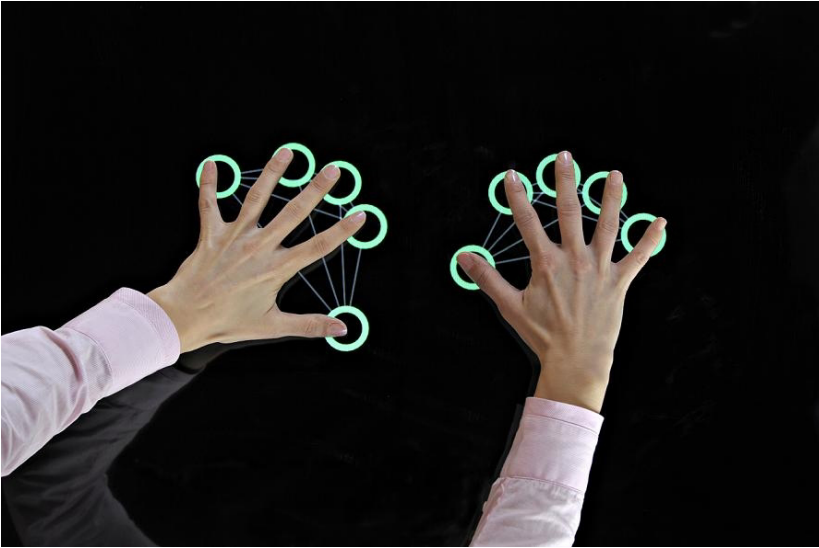


Figure 2.2: Blob tracking

### **FTIR (Frustrated Total Internal Reflection)**

FTIR is the technology to trap light when it enters the material at an angle of incidence greater than a specific angle [23]. Jeff Han [24] uses this technology to great effects using a piece of acrylic. When a user touches the acrylic panel, the infrared light becomes frustrated and the total internal reflection is no longer reflected at that specific spot.

To create such a surface, have infrared light diodes mounted at a slight angle into the piece of acrylic, so that the material becomes totally internally reflected. When you touch the surface you frustrate the spot you touch, scattering infrared light downwards. An infrared camera spots this frustration and can pinpoint the exact location of the frustration with the help of blob detecting software like CCV and send the touch data to an application for further instructions.

A silicone rubber layer is preferred on top of the acrylic surface, to reduce of pressure when attempting to achieve light frustration inside the acrylic. On top of these layers, add a projection surface, so that the projector can have a surface to project its image on.

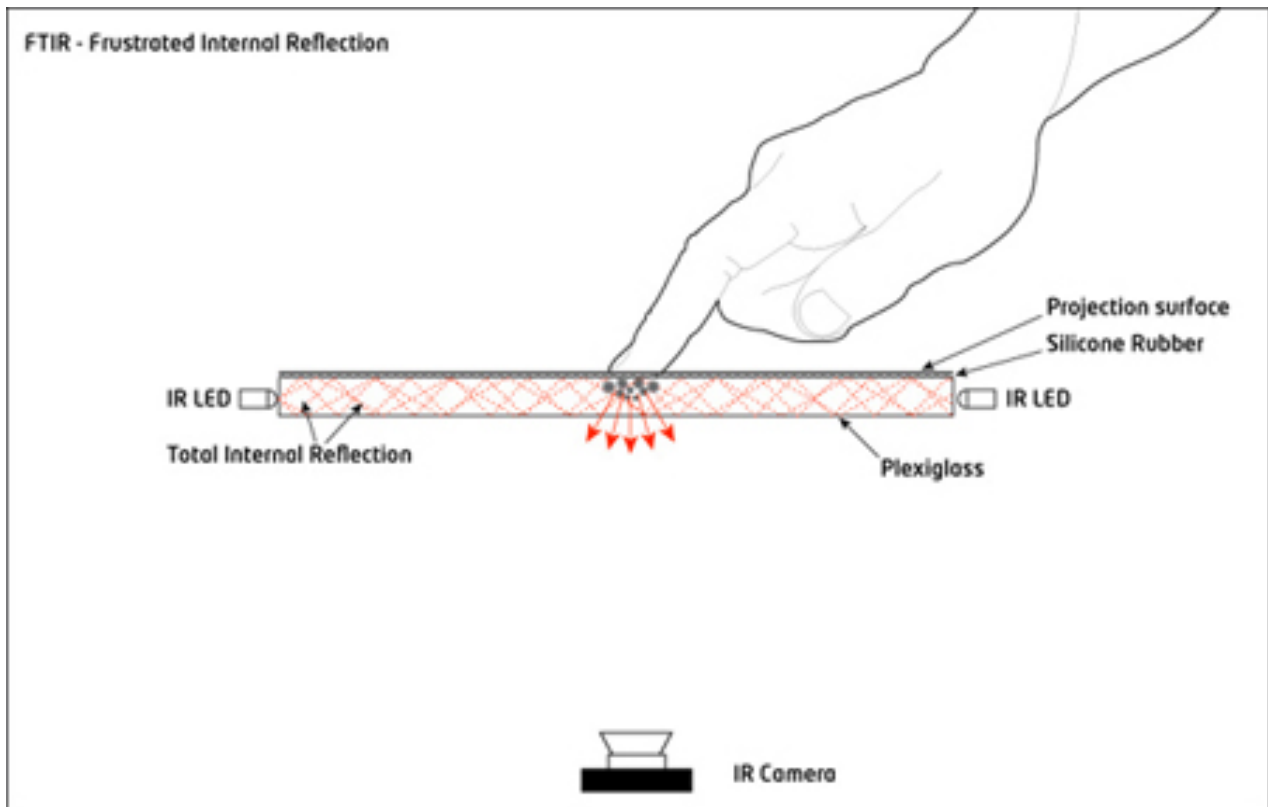


Figure 2.3: FTIR setup



Figure 2.4: FTIR

### DI (Diffused Illumination)

DI uses infrared light to light up a screen, composed of a sheet of glass or plexi glass with a diffuser material which can let some light through. A touch will be spotted by being greater illuminated than the screen itself, as light will pass through it[25].

Rear DI uses light from behind the screen, while Front DI uses light from in front of the screen, blobs are spotted where infrared shadows appear. DI can also detect hover

and objects placed on the surface, since the light is no longer concentrated on the surface alone.

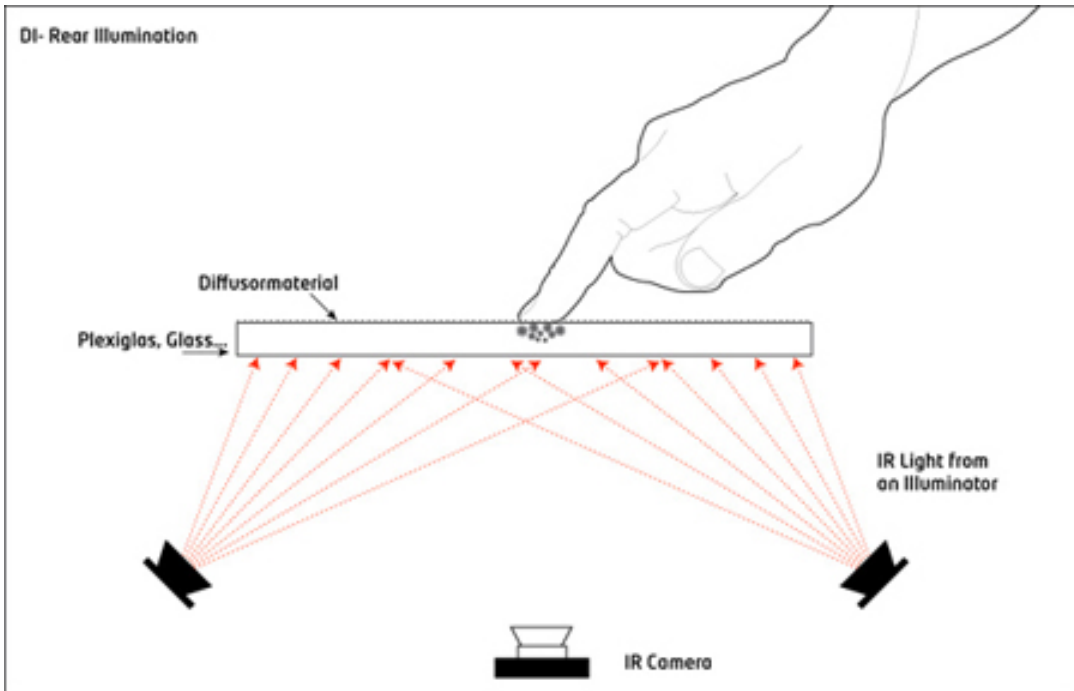


Figure 2.5: Rear DI setup

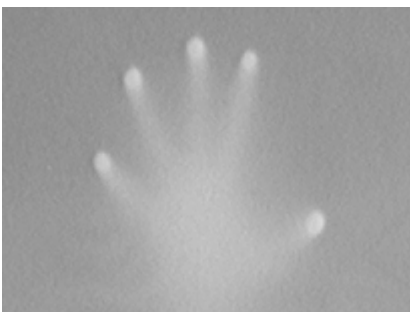


Figure 2.6: Rear DI [10]

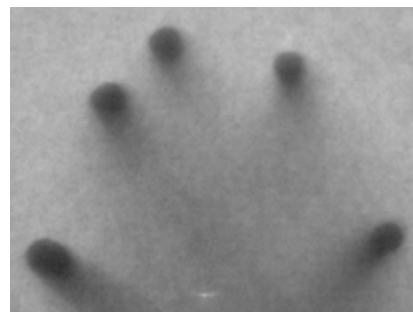


Figure 2.7: Front DI [10]

### DSI (Diffused Surface Illumination)

DSI uses an IR band like in a FTIR setup, but instead of a normal acrylic screen, you have to use an endlighten acrylic, which is the same as normal acrylic but has embedded microscopic metallic particles which send light out in front and behind the screen. In turn the functionality of the setup mimics DI in the sense that DSI can track hover objects. The blobs are lower contrast and are therefore harder to detect. [26]

## Capacitive touch screens

Capacitive touch screens are all glass screens with a small electrical current running across the screen. There are circuits located at the corner of the screen to measure the capacitance of touches.

The technology is expensive and can only be activated by a touch. A stylus or pen will not interrupt the electrical current and is therefore not useful in occupations where the handles wears gloves. Capacitive touch screens are designed for small screens and is difficult to scale to larger screens.

## LLP (Laser Light Plane)

LLP mounts lasers to illuminate a surface and track the blocking of laser by fingers to generate blobs. The more lasers the better, as 1 or 2 lasers might not be enough to spot fingers in the middle of 2 blocking fingers. [26]

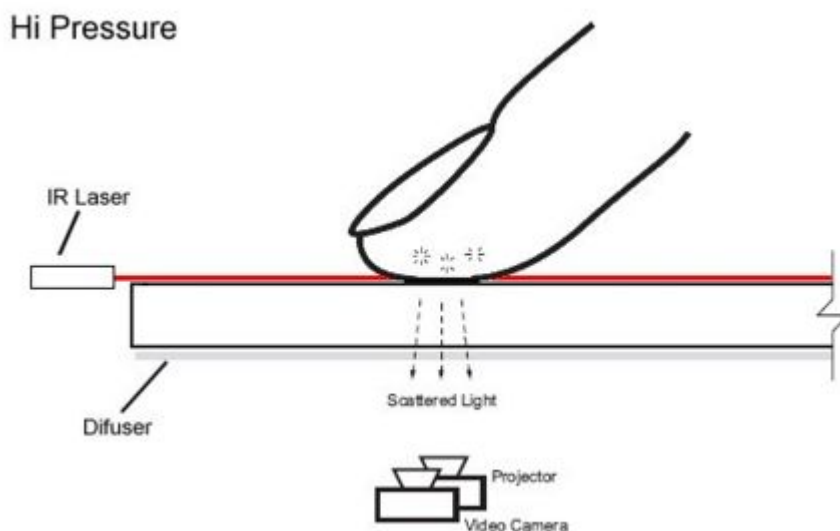


Figure 2.8: LLP

## LED-LP (LED Light Plane)

LED-LP has an IR led frame around, and just above, a surface to cover the entire surface. In the same way LLP does, but using a lot more IR LEDs than the amount of lasers[26].

## 2.3 Multi-touch Technology discussion

I have looked at the most popular different technologies to handle multi-touch interaction. We will now have a closer look at what technology is better suited for different situations. For small, mobile screens the capacitive touch screens are the way to go, because there usually is no room for a camera or projector.

For large tabletop installations, the task of choosing a suitable technology becomes difficult. The setup and calibration time are almost the same for FTIR and DI tables, while LLP and LED-LP can have a slightly higher setup time with the difficulty of getting the lasers / IR LEDs to cover the surface correctly.

FTIR does not offer any hover effect and is therefore good for installations where you want a touch to interact. DI on the other hand can be setup to allow touches some ways off the actual surface.

## 2.4 Multi-touch Frameworks

As with every technology, there is a bunch of ways to use it. This follows suit for multi-touch as well. There are a lot of frameworks under development, and some have had a couple of release candidates already. Since I come from a background of C, C++ and Java, this study will go through the most used frameworks readily available in these languages.

**Multi-touch for java MT4J**[27] is a java framework with great out of the box multi-touch features. MT4J is built of top of Processing[28], providing all native processing libraries.

**Multiplicity**[29] is a multi-touch framework in java, built on top of JMonkeyEngine[30], to get a native multi-touch feel to your JME games. JMonkeyEngine is a 3d java game engine with a large community. JME is a great framework for creating java games and multiplicity adds multi-touch functionality as well as native objects for 2d implementation and interaction.

**Openframeworks**[31] is a c++ framework for developing anything and everything, it is easy to learn and hard to master, as with any c++ based frameworks.

## 2.5 Single-touch vs multi-touch vs mouse

A collaborative study done by Mitsubishi electric research labs and the department of computer science at the university of Cambridge indicate that mouse input may be more appropriate for a single user working on tabletop tasks requiring only single-point interaction[35]. This is backed up by David Kieras at the University of Michigan who has come to the conclusion that if the user interface in a game is properly designed and set up, a mouse is as fast as pointing with the finger[33].

While the study at Mitsubishi electric research labs shows that selection with touch is a little faster than selection with mouse, the difference reduces when size and distance of the selectable user interface elements change. Study also shows participants being about twice as likely to commit a selection error using the touch-table (8.5%) than using the mouse (4.1%)[35].

In a study on direct-touch, bimanual and multifinger input show that targeting circles on a tabletop with more than 1 finger results in almost 15% increase of production, while it is over 50% faster than targeting with a mouse[34]. The study also shows that the miss rate increases by approximately 2% for each finger, starting at 7% with 1 finger, while using the mouse has a miss rate of 8,5%.

Kenrick Kin, Maneesha Agrawala and Tony DeRose concludes that single-touch is better than a normal mouse, and that there are no real improvements with multi-touch[34].

## 2.6 Evaluation of single-touch vs multi-touch vs mouse research

With so many similar research questions, you would assume that they would come up with a similar answer, but this does not seem to be the case. When I take into account how different people are, and how known they might be with either the mouse or touch, we can see how different research in the same field may have these large deviations.

To see how this would apply to games on multi-touch, a separate study would have to be conducted to have the right premises for concluding miss rate over accuracy. Unfortunately, this would have to be done in future work, as it falls outside the area of this article focusing more on how to play games on multi-touch devices.

## 2.7 General game design research

“Games must be fun. Satisfaction may come from accomplishing a difficult task, but enjoyment may also be derived from pure aesthetics or sidesplitting humor.” By Nicole Lazzaro and Kevin Keeker[37] who have researched what makes games fun. Their conclusion indicates that there are 4 different cornerstones which decides what emotion a gamer gets out of a game.

- **Hard fun** that focus on the games challenge, strategic thinking and problem solving. Hard fun generates emotion in frustration and personal triumph.
- **Easy fun** that focuses on intrigue and curiosity, players becomes immersed in games that absorb their complete attention. Easy fun generates emotion through wonder, awe and mystery.
- **Altered states** that focus on the internal experiences in reactor to the visceral, behavior, cognitive and social properties. Altered states generate emotion through internal sensations as excitement or relief.
- **The People Factor** who focus on the social aspect. The people factor generates emotion through amusement and gloating over the misfortune of your opponent.

Different game genres are based on different cornerstones, and when designing a game, one should try to keep it clear what cornerstone you are founding your game on. After the game is complete from the design and programming view, there needs to be a beta testing of the game before it is released. Microsoft game studio in Washington was established in 2000, employing a handful of game developers, psychologists and HCI specialists. Their play test group has tested more than 70 games with more than 10.000 participants[36].

Empirical evidence has shown that games can promote motivation, thereby causing players to become more intensely involved in a particular learning activity and ultimately allowing them to retain more knowledge[38] but this is unfortunately outside the scope of this article.



## 2.8 User interface research

David Kieras from the University of Michigan writes in his lecture paper about user interface design for games, that games should be difficult because the user is seeking the thrill of accomplishment[40]. Nicole Lazzaro and Kevin Keeker, agrees with this saying “Making something as simple as possible removes the very thing that characterize a game experience. In short, a 100% success rate eliminates most of the aspects that make a game fun”[41].

David Kieras goes on to explain the steps of developing a game, figuring out what the user needs to be able to do, then adding functionality that will help support the completion of the tasks, and not just a function to complete task as you would want in productivity software. XEODesign and Microsoft agrees with this saying “Like productivity applications, games require mastery of feature to achieve an objective”[41].

After you have your functions, choose an initial interface design and implement them. The user interface is the part of the screen dedicated to the interaction between the player and the computer. This space should be chosen with previous games in the same genre in mind, to improve the usability.

You then evaluate the usability of the design, correct the problems and repeat the process until there are no more problems to identify. The Sims went through 11 iterations with about 100 play testers[39] for their user interface. This might seem like many iterations when David Kieras quotes (Landauer 1995) that a median 50% improvement per iteration is expected.

David Kieras continues his lecture on some design error, explaining some errors being to open a new window or dialog for every aspect of a task, as this clutters the display. He goes on to say that you should keep all information for each decision on the screen as eye movement is extremely fast compared to bringing up additional screens for information. When designing the user interface, Keiras explains that icons work best when they closely resemble a concrete, familiar object associated with the task[40].

### **2.8.1 Fitts law**

Fitts law states that user interface elements that should be used often should be larger than elements that are used less frequently. Fitts law also states that menus should be placed to the edges to reduce errors.

### **2.8.2 Hicks law**

Hicks law says that the time it takes you to perform an action is related to how many options there are, dependent on how well you know the actions of course.

## **2.9 Multi-touch game design research**

Since multi-touch offers the introduction of easy multiplayer implementation both Jefferson Han, the pioneer of the FTIR technology and Thomas E. Hansen agrees that multi-user interaction is encouraged[42][43].

Nicole Lazzaro also agrees and writes “What surprised us most was the dramatic contrast in emotional displays between one vs. several people playing together”[44]. But designing multi-user games for a device that has no way of differentiating one player from another is no easy feat. DiamondTouch table developed at MERL (Mitsubishi electric research laboratories) uses front-projection and an array of antennas embedded in the touch surface where each antenna transmits a unique signal. Each user has a separate receiver, connected to the user capacitively, typically through the user’s chair. When a user touches the surface, antennas near the touch point detect an extremely small amount of signal through the user’s body to the receiver[45]. While DiamondTouch is onto something big here, there haven’t been any games developed for the DiamondTouch.

Another way to think about multi-users playing games is that you can make players cooperate, without differentiating their touches, or separating players to designated areas where they play.

## 2.10 Multi-touch user interface research

Mouse over help is a concept that works really well with a mouse, utilized by blizzard in their game World of Warcraft to great extent, having a hover help menu for almost every icon in the game[46]. This of course is not easy to achieve on a touch device, the 2 ways to do it is on a pressure device where a high pressure triggers an event while a low pressure activated a hover. Another way is by single pressing to get the hover help and then another click to execute. Both have terrible flow and will therefore be dismissed as possible user interface designs for multi-touch tabletop games.

As stated in the research chapter about single touch vs. multi-touch vs. mouse we see a high miss rate when elements are small and far away from each other. Thomas E. Hansen agrees with this statement[47] and writes “one approach to circumventing this issue, would be to simply design user interfaces so that all selectable elements are of a large enough size.”[48]. He also says that “This approach is too limiting for all but the very simplest applications”. When it comes to game genres we know from the PC/consoles, they are usually complex, and there needs to be a middle ground for the decision of size vs. distance between user interface elements.

Users seem to be stuck with the WIMP [51] human-computer interaction standard they have gotten so comfortable with on the windows operating systems. WIMP stands for Window, icon, menu, pointing device and is basically what Keiras say is a game design error, to open windows for every new bit of information. Schonings concludes that we should design applications for multi-touch that help users forget WIMP, as WIMP promotes single-touch.

Thomas Hansen writes on the use of virtual keyboards, “Even with full visual attention to the task, text entry on virtual keyboards is much more tedious and error prone than typing on a physical keyboard”[49] and concludes that the virtual keyboard should be excluded from any game unless the game is of such a nature that you can offer all attention to the typing of a sentence. When splitting stacks of items in a virtual game backpack, having a slider could offer much faster and better interaction then typing the number on a virtual keyboard. You could also implement a tiny numkey pad where inputs of numbers were essential.

## **2.11 Utilization of the technology**

There are applications designed for a multi-touch tabletop that would work the same way for a single-touch tabletop. You should always design with the technology in mind, to create applications that make use of the technology. The advantage of multi-touch is that it invites to multi-user applications, with its tracking of multiple points concurrently. But the technology isn't enough, there are other factors that depend on a successful multi-user application.

There is a great difference in designing an application for the iPhone rather than a multi-touch tabletop, or an interactive multi-touch wall. Cooperation and the way you touch have a greater focus on larger surfaces, because it's more intuitive to use hands and fingers, as long as the application is designed to support this.

Johannes Schonings writes that the size of the table also has a large impact on the flow and interaction. The flow and interaction is also dependant on the amount of users, their knowledge and their physical placement around the table[50].

## **2.12 Game Genres**

### **2.11.1 Introduction to game genres**

A game in a specific genre has to follow the rules set by past games in the same genre. This is similar to genres in movies, where when you start watching an action movie, you want there to be action, and you want the good guy to win. Almost all action movies are this way, and it makes it easy for the audience to pick out what they enjoy the most. For gaming, I will look at some genres that separate games from each other, and what they have in common. I am going to look at their gameplay, and dive deeper into some specific titles in each genre to compare to similar genres on other game stations. There will also be research and comparison to game genres for multi-touch devices, but since most multi-touch games are for the iPhone or iPad the comparisons won't be as good as they would have, if the games were for multi-touch tabletops.

## 2.11.2 Introduction to the Strategy genre

Strategy games can be divided into two main groups, RTS (Real Time Strategy) and Strategy (Like chess, where you take turns to perform actions). Both RTS and Strategy are valid game formats for the multi-touch architecture, but to use multi-touch for what it is, execution of several concurrent touches, I will look to RTS and further treat RTS as the strategy genre from now on.

The most common variation of strategy games for PC and console deals with a war, where there is a winner and a loser, contrary to the strategy game chess, where it can pay off to play for a draw if you start as black.

In a normal starting phase of a strategy game, you start out with a few workers and a main building. The main building offers you the function to produce more workers and is also the place your workers can work to earn money. The workers are the essential building blocks of any strategy game, how well you manage to control the flow of workers, often decide early on whether you are going to win or lose the war. You can command workers to use their earned money to produce additional buildings which may produce warriors or technology that can help you win the war. In most strategy games all the workers and warriors has to be fed in some way, so while a worker might eat 1 meal a day, a warrior might have to eat 2 or 3 times. The cost to feed a unit will further be call supply.



Figure 2.9: Starcraft 2



Figure 2.10: Warcraft 3

Early in the strategy game's genre developers set a limit on how much supply one could have. Stronger fighters often use more supply and cost more than the weaker warriors and workers, but also ate more. Finding the balance between how many workers you want making money, versus how many warriors you want for destroying the opponent is a constant issue in the strategy any individual war. In most games, a worker can attack, but they are a lot more fragile than the weakest warrior in battle. Typically in a strategy game you can have a maximum of 200 supply, which means you can have 50 workers (1 supply each), 50 weaker warriors(1 supply each) and 50 stronger warriors (2 supply each), which might not always be the best strategic case, but it illustrates the point.



Figure 2.11: Starcraft 2

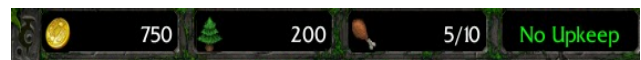


Figure 2.12: Warcraft 3

The warrior buildings in a strategy game is important, but it is important to learn when to use the money to make large amounts of warriors, called macroing, and when to spend money on improving the economy further, called economical, making more workers or build more workstations or warrior training facilities.

In 1994 when Blizzard released Warcraft 1, Orcs vs. Human[52], the standard for how strategy games were played on the PC was set. Variations have come since then, and few of these have been an improvement and managed to come up with something new that has been necessary. In Warcraft 1 you start with a main building, 4 workers, a farm, providing some food, and a gold mine. The gold mine had room for four workers at a time. The remaining workers produced had to be set to either build up your town, or cut timber in order to produce buildings. Warcraft 1 also had a tech system where you would need some building in order for another buildings to be built, or warriors that need technology only more advanced buildings can produce. Almost every strategy games since then has kept with this tech system.

With the tech tree players can develop fine tuned timed pushes. A timed-push is a term that has come up over time, when players have found exactly what to produce and in what order from, workers, building, or warriors to the point where the have a special attack force early on. As an example, as the breed Protoss in StarCraft 2[53], which is the latest strategy game from Blizzard [27 July 2010], you can play a three stalkers timing push. A stalker is a warrior type that costs 125 minerals and 50 gas, which is considered costly in

earlygame. The stalker uses 2 supply and can fire a laser beam at an enemy unit from some distance from your opponent.

You start with 6 workers, a main base, 50 minerals and 8 mineral patches, where your workers can work to gather minerals. There are also two gas fields next to the main building where you can build mines and collect the gas. You begin to build workers until you have 9, then one produce a supply building to increase the supply by 8 and send out a worker to find out where your opponent is on the map. When you have 10 workers you build a gateway which is the building for creating warriors, and instantly send the worker back to work on retrieving minerals. Continue to produce workers until you have 13 workers. Build a mine at a gas field. Build another worker and send him to gather more minerals. When you have 14 workers, the gateway is finished, and you can build the Cybernetics Core building as part of the tech tree. The Cybernetics Core is a tech needed to build Stalkers at the gateway. The mine will finish almost simultaneously as the Cybernetics core started construction, so you send in three of the 14 workers to get gas and build another worker. When the 15th worker is done, you send him to produces a gateway before proceeding to gather minerals. Create another supply building when you reach 100 minerals. When the Cybernetics Core is done, you have to wait a brief moment for the last 15 minerals, so you have enough minerals and gas to produces a stalker at the first gateway. You then build another worker when you reach 50 minerals and send him to get minerals. At this point you are stuck at 18/18 supply, meaning you cannot create more units until the supply building finishes a couple seconds later. After the stalker is finished the second gateway should be done and you should have roughly 250 minerals and 100gas that you spend to produce two stalkers, one in each of the gateway. Then you continue to produce a lot of workers with all your incoming money, as well as remembering to build supply buildings whenever necessary. In a few cases, these 3 stalkers gets to the opponent before the opponent has a large enough army to stand against the attack and lose the match after roughly 6 minutes. This is also called a rush or a "cheese"[54] which is a fast, high risk, attack.

These 3 stalkers can also meet an army of opponents' base, and it then becomes important to micro, which is the task of moving the unit under fire away from the fight, while the other 2 continue to shoot, so all your units will take the least possible damage while the opponent takes the most.

To defend against a cheese, you need to utilize a 4th game mechanic called scouting; scouting is the art of exploring the enemy base to see what your opponent is

building. This is usually done by sending one of your cheap workers to run into the enemy base, risking his life for the greater good. If a fast 2 gate 3stalker build is scouted early on, a Terran, which is a second race in Starcraft2, might react with a hard counter going for fast marauders with concussive shells. These Terran marauders will completely overpower the 3 stalkers and the Terran will be in a great lead after the initial battle.

To be among the best in strategy games, you have to have a good control on the economy, micro, macro and scouting elements in the game.

All of today's strategy games have a mini-map, this is a small map that comes with the HUD, short for Heads up display, that shows you where warriors are on your map, and if there are any opposing warriors in the vicinity.



Figure 2.13: Starcraft 2



Figure 2.14: Warcraft 3

The fog of war is the term used to describe the uncertainty in situation awareness, most used in military operations, translated into video games by providing units with a field of vision, and as they walk around, they temporarily remove the fog of.

### **Research on previous strategy games for pc / console**

Herzog Zwei set the bar in 1989 for how RTS games were to evolve into the future[55]. The title was released for sega genesis and featured strategic real-time army movements and attacks. After its success, the genre exploded into popularity and Dune II was released as the RTS game that set the standard for the PC in 1992[56].

Now, most strategy games are played the same way on your PC, you select, move, attack and build basically the same way. The most common variations are in the units, where you can either control 20 separate units, or group them together into 1 ball that



attack together. Newer games let the size and strength of a unit decide how much space it will take on the map. All strategy games that are produced these days, except the latest command and Conquer: Tiberian Twilight, have production of a base, and the goal of the game to crush your opponent's base or make them forfeit as part of a grand siege or economical advantage where your opponent knows that he cannot win.

Command and Conquer: Tiberian Twilight[57] has 1 of 3 optional base stations that produce a fixed set number of warriors on a fixed interval, leaving you to only micro.

To build a building you click on a worker and then the building you want to produce and where it should be. In some older strategy games you had a menu with buildings and could just place them without the need for a worker. In some of the older games, a worker rushed to the building to construct it, while on other games, the building constructed itself.



Figure 2.15: Starcraft 2



Figure 2.16: Warcraft 3

All current strategy games have the ability to group units, usually with a keyboard shortcut where you hold down ctrl and press a number like ctrl+1 or 2. At any time one can recall this selection with the corresponding number like 1 or 2. You choose units by clicking on them, or click and hold while you drag the mouse to create a rectangle over the area where your units are. In the newer strategy games, you can also double click on a type of unit to target all similar units on your screen.

In almost all current strategy games you have an overview over all the units that are currently selected. And you can use the view to target the weakest unit, to micro him back, or to target a group of stronger units to flank the defenders. This also helps you single out special units that may have abilities for change the tide of battle. These unit abilities may be anything from teleportation, heavy attacks with a cooldown, or immobilizing effects to slow down or stop enemy units.

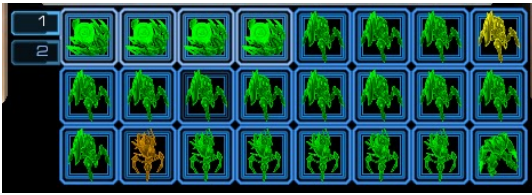


Figure 2.17: Starcraft 2



Figure 2.18: Warcraft 3

### Research on the earlier strategy game for the iPhone

iPhone is not often thought of as multi-touch because the device screen is so small that it does not allow for many concurrent fingers on the screen simultaneously. This didn't stop developers from producing great strategy games for the device.

Lost Empire is a game that copies a mixture of Warcraft 1 and Warcraft 3, it functions in very similar way as you would on a PC game. The game features a mini-map, you can drag around the map, manage 1 or more units by either dragging the mouse to create a rectangle or two fingers on a and b to create a rectangular selection field over the board. The game has a tech tree and different units.

Lost Empire also has magic casting units, these do not work so well in the game, since the magic must be used through a menu that pause the game. This stops the flow, and it can be used as a pause function in stressful situations, which is not what you would want in an action game. Multi-player will not work with this feature as it would pause for both. If it didn't pause the game you would not have been able to see what was happening on the screen, as the menu covers most of what one can see of the map.

The game supports dual tapping on a unit to select all units of the same type nearby, which also is perfectly normal and common for PC strategy games.

The problem for RTS games on touch devices are the ability to multitask. There is not enough space on an iPhone to implement every UI element needed to support a pc version. The other problems with the touch based RTS genre are the lack of commands able to be given to the device to support movement and attack. Starfront, a Starcraft lookalike game for the iPhone and iPad has the ability to draw a box around units to select them, and a single click on anywhere to move/attack there, similar to an 'a' click command for the PC. This results in direct engagement in combat if an enemy is in the close area. The basic right click, 'm' click command to move a unit without it attacking is enabled by the tap-and-hold gesture for the touch device. This removes the micro element from the

game since there will always be a 1 second delay on every micro command, resulting in the unit in heavy distress to die before the command is completed.

### **Research on the earlier strategy game for multi-touch tables**

R.U.S.E. by Ubisoft[58] is a strategy game designed for windows, PS3 and Xbox360. It features support for multi-touch screens and Playstation Move. R.U.S.E. follows a military storyline with tanks, marine enforcements and planes. The game is heavily based on strategy thinking as you use decoys and ruses to trick and trap enemy units. R.U.S.E. lacks the micro insensitivity that most strategy games has, making R.U.S.E. a game equally playable as single touch, as you don't need more than 1 command at a time.



Figure 2.19: RUSE screenshot[58]

There have also been ports from multi-touch to PC games, where touches control the mouse. This was done for Warcraft III to great effect by PQLabs' iTable[59], where you control everything as you would with a mouse, but multi-touch gestures for the right click of the mouse was to have 1 finger on the table, at a random location and pressing with another finger to simulate the area of right click. Panning and zooming was also done with these multi-touch gestures, and moving the camera was done by dragging the screen with your hand.

### **Comparison**

In a RTS game, you will need to be able to attack, micro and retreat while macroing with efficient actions. As we saw in the Starfront game, a press initiates an attack while a press

and hold initiates a retreat, this wastes time and becomes a frustration. A double tap as retreat will need to have a delay of around 100ms wait from a single tap to a double tap, resulting in 100ms delay attacks. This is also not very functional as it decreases speed in the same way. A tap with 2 fingers to simulate a retreat might work a little better, but fast micro on close proximity may result in the technology mistaking an attack and a target-unit command as a retreat command. The research on 2finger tap is beyond the scope of this article but may provide interesting results in the future development of multi-touch tabletop strategy games.

Nina Schiff from the University of Cape Town wrote in her article on multi-touch gesture-based gaming that using gestural controls where it is appropriate to use then, may create a more enjoyable experience for the player over normal menu interaction[60]. The lack of gestural interaction in any previously developed games for a multi-touch device makes it difficult to compare to a PC game where you always use your mouse and keyboard.

Pierre Benz, also from the University of Cape Town writes in his article about gesture-based interaction for games on multi-touch devices that his prototype strategy game were rated the best when performed with gestures. He also concludes that players became more immersed in the game when playing with a direct manipulation interface[61].



Figure 2.20: Starcraft 2

### 2.11.3 Introduction to First Person Shooter

The first FPS game came in 1973, it was named Maze War[1] and set the standard for the genre.

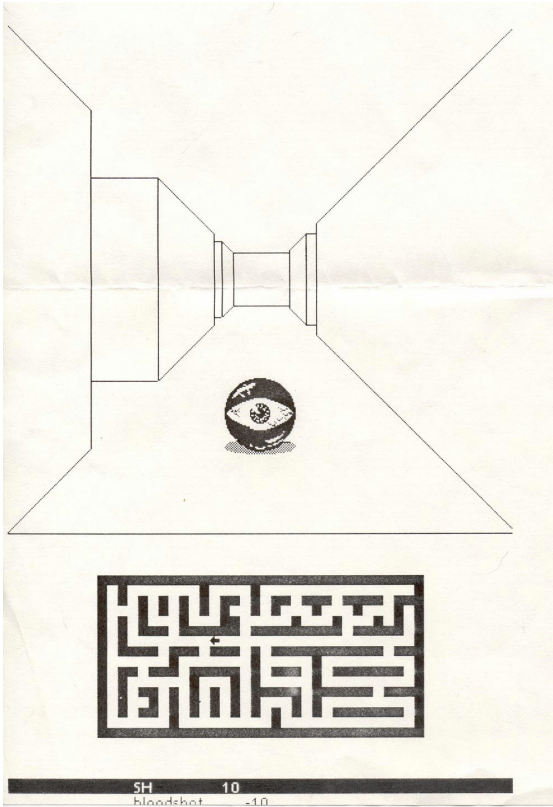


Figure 2.21: Maze War[62]

The idea behind FPS games revolves around the gamer looking through the eyes of the character you are handling. You use guns and shoot different types of projectiles at opponents. This genre has changed very little over the years, except for the graphics, which of course got better and better as the processing power became greater. You have health points that either regenerate, has to be healed or stay static in which case dodging bullets becomes very important. FPS games also feature ammunition with different guns, and the object of the game is to blast your way through hordes of monsters or players to achieve a goal. The gameplay is often similar from one game to the next, with the corsair handled by the mouse, and the movement of your character handled by the keyboard. Switching of weapons can in most games be bound to whatever key on your keyboard, or to any buttons on the mouse, if you own a mouse with multiple buttons that is. The genre

often takes you through multiple levels with monsters becoming increasingly difficult, and the weapons you wield increasingly powerful.



Figure 2.22: Doooms BFG borrowed from <http://www.chippedhip.com/>

FPS games has in recent years enveloped the RPG genre to accommodate a deeper experience for the player. In an FPS RPG blend, you often have levels and can customize weapons or stats with points gained from levelups. These FPS games are based on multiplayer experience and balanced with multiplayer in mind. Joining a lobby with your friends or a pack of random players offers multiple game modes. Multiplayer game modes range from Capture the flag, domination to deathmatches and more.

### **Capture the flag**

Capture the flag is a multiplayer game mode that teams the participants up equally and has them battle out with the goal to grab the enemy flag and carry it back to your own flag. Some FPS games allow players to shoot while carrying the flag, while you have to rely on your teammates for cover in others. CTF often offers winning conditions on time and or flag captures.

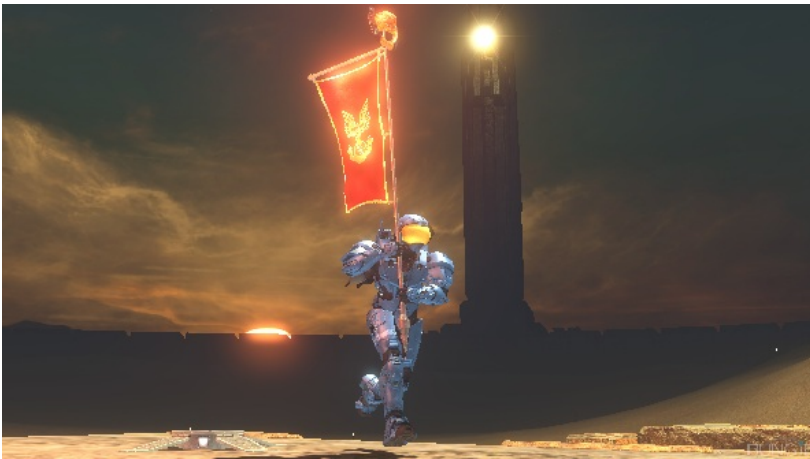


Figure 2.23: Halo Reach capture the flag game mode[63]

### Domination

Domination is a game mode where you take an objective and hold it against the opposing team, every second or tick, gain points. Domination offers winning conditions based on time or point score.



Figure 2.24: Canalzone domination game mode[64]

### Deathmatch

Deathmatch, or team deathmatch is a popular game mode to play when joining an online multiplayer game. The game mode pits 2 teams against each other and the winning

condition is based on a max set kill, or a time limit, where the winning team has the most kills.



Figure 2.25: Modern warfare 2 team deathmatch game mode[65]

### **Research on FPS games for the PC**

We can take 1 game, and it will hold true for the whole genre, doom. The game starts you off with a gun, and as you progress through the increasingly difficult levels, you achieve greater weapons and battle your way through the game. The game in its early development stage only supported the keyboard, but as the players became better with their programming skills, they created the mouse support for doom[66]. As it is now, every FPS games use the mouse and keyboard, typically with movement bound to the wasd setup. You change weapons with the number keys, but all these settings are readily available for keybinds from a menu option.

### **Research on FPS games for multi-touch.**

We will again look at NOVA[67], as it sums up most of the FPS games on iOS. You steer your character with the typical D-pad, while rotating your viewpoint by dragging over finger over the screen.





Figure 2.26: NOVA screenshot[67]

You shoot your weapon by pressing a shoot button, as illustrated at the bottom right of the screenshot. You change weapons with a weapon menu, as shown in the upper right corner, and throw grenades with the use of a grenade button, located under the weapon changing.

Doom resurrection is another FPS game that offers aiming by using the accelerometer instead of dragging your finger over to screen to aim. Doom is rather a simulator FPS as you do not control the movement, the game is scripted in where you move at all time. You have a dodge button at the bottom of your screen that allows you to dodge incoming missile attacks, and if an enemy gets close to you and grabs you to basically feed on your flesh, you have to shake the device to get free.

### **Comparison**

The type of game is very similar, the only difference is that moving, aiming and shooting can all be done simultaneously on the pc or console, but aiming and shooting in NOVA is much more difficult. Aiming and shooting on doom resurrection is a lot easier since you don't have to use D-pads to control movement, and aim with tilting your device.

### **Conclusion**

FPS games still has a way to go in fine tuning the control set for it to be as functional as FPS games on the pc or console. The gameplay and joy of a touch based FPS game can still outdo the difficult aspects of playing the game.

## 2.11.4 Introduction to Role Playing Games

A Role Playing Game is all about becoming the character you are controlling, to live his life and to choose how to spend it. A RPG is often set in a world where you find hardships and have to struggle to help yourself and those around you to a better life. An RPG game often holds interesting NPC characters you can talk to, and help with their problems, and as a RPG player, you should care like your character would care, meaning you shouldn't help Mrs. Cambridge find her cat if you don't like cats, but rather help Mr. Stewart find his magic smiths hammer if you are into that sort of stuff.

The RPG genre has evolved over the years, going from the basic 5 NPC towns with their quick quest assignments, to the broader, "you are now in a game the size of the world with equally many people who can talk gossip and share small secrets and also offer you a quest or 2 for small fortunes and experience". The early RPG games, are now thought of as their own genre named Hack and Slash, basically because there weren't enough people invested in making games to create a huge NPC community, but generating random monsters with the same abilities as their twin was easy. So they would generate a map, generate a lot of monsters and have you find the exit to the level you were on. When you finally found the exit, you had to battle your way through another level, with harder monsters dropping better loot.

In any RPG, you have control over what you character wears, what he says in conversations, what spells or martial arts he specializes in and where he goes. Every modern RPG also features the hotbar with customizable spells or abilities.

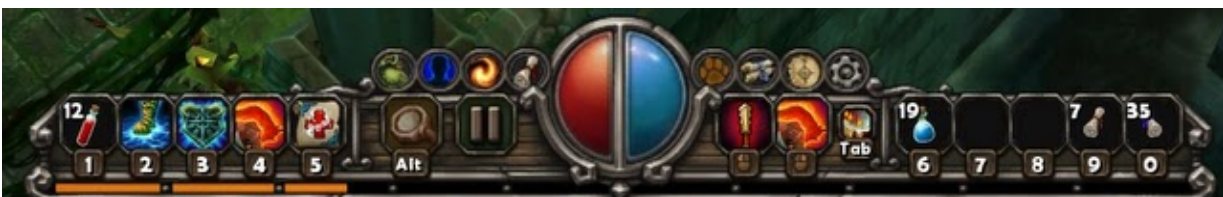


Figure 2.27: Torchlight features almost all UI elements at the hotbar area



Figure 2.28: NeverWinter Nights 2 has the more normal hotbar

You usually see your character in a third person view, with the camera located behind and above the character. You are also able, in most RPGs, to change this viewpoint to a close camera view, or out through the eyes of your character as in an FPS game.

Every early RPG had an endgame, a way to complete the game, a way to victory. Later development and better understanding of human hoarding needs made game developers rethink their strategy. Now, almost every RPG games has a last boss, if you would call it that, but he would still just be a boss, and after he was dead, you would be able to continue your adventures, backtrack and complete smaller side quests, or just sit in the local tavern and chug down a beer with your NPC buddy.

As the memory and hard drives gain better technology, so too does the RPG worlds try to utilize it. Skyrim, the next big game coming from Bethesda Game studios, the 5th title in the Elder scrolls line, will feature a 16 square miles (41 square kilometers) world. Skyrim will be filled with around 150 dungeons and dragons will roam the 7 distinct environmental areas.[68]

### **Research on RPG games for the pc/console**

The Diablo franchise from Blizzard entertainment is one of the classics to make research on, they have from the start paved the way for how RPGs have been developed. Diablo gives you the ability to bind spells to both left and right mouse button, but will move with both buttons unless you have your cursor over a monster when you click. You can also trigger your left and right mouse abilities by holding down shift and pressing anywhere on the screen, a great functionality for killing packs of monsters, not moving into them after one dies.

Dungeon Siege III is a hack'n'slash game in the way that there is no open world, you follow a straight path with optional side quests. Dungeon Siege III is also a role-playing game because of the huge amount of NPCs around to give you quests, and help make a better bond within your group by replying heroic or nicely to dialogs. The greatest way Dungeon Siege III is a roleplaygame more then a hack and slash game is when you inspect a corpse by pressing 'e' close to them. The whole game pauses and gives you time to read through what horrors the corpse has gone through. In a hack and slash game, this would ruin the whole flow of the game, where you might intend to interact with

something else in the midst of battle, but coming close to a corpse while pressing 'e', stopping battle completely.

Dragon Age is a tactical RPG where you have the option to pause the game to rethink your strategy. You may also fight without pausing, offering you the choice of how you wish to play.

Arx fatalis attempted at a gesture based spell casting system, having you draw intricate symbols with your mouse to summon magical powers.

World of Warcraft is the most well-known MMORPG to date, with 12million subscribers. It took the best parts of previous MMOs and put it into a new package with great cartoony graphics. There are too many features in WoW to name, but the select few would be the hotkey system, and the immense world with quest hubs and dungeons. The feel of the game is brilliant and caters to new players as well as hardcore gamers.

Heavy rain for the PS3 is an Action RPG with a controlled cinematic combat system. A combat sequence might begin, and the screen will show the X symbol from the controller, if you press the button quick enough, your character attacks in the cinematic battle, but if you fail to press X in time, or hit another button, your character will be dealt the blow instead. This type of combat system is a fast paced turn based combat system, much like blitz chess, where players have a set time before they have to make a move.

### **Research on RPG games for multi-touch**

Most RPG games for multi-touch devices are ports of old Nintendo games, Zelda was a huge hit when it came to the iPhone, and many fans played through the game again on their phone. Gameloft created Dungeon Hunter, a hack and slash semi-RPG game with a clear linear storyline to gain great praise among the iPhone community. The one mistake game developers make for multi-touch games are that instead of utilizing the fingers individually, they used the D-pad[69]. You also mostly have to click on the monster of choice to attack, making the whole feel of a multi-touch game, based on keyboard-wasd + mouse-index-finger.

Order and chaos, for the iOs and android, is an MMORPG, which in turn is basically multiplayer RPG games. The game is beautifully designed, closely relating to any MMORPG you would play on the pc. There is a rotational hotbar instead of the normal vertical hotbar you see on computers, this is to allow the right thumb to flick through spells and abilities. To allow users to quickly use less common abilities, not necessarily bound to the rotating hotbar, you have a drawer that can be opened just above it to show the rest of

the spells for faster using. The left thumb controls a d-pad for character movement, and any touch to the background rotates the camera around your character. The game feels much the same as dungeon hunters, which comes to no surprise when you know that both games come from Gameloft, seemingly the frontrunner when it comes to iOs games.



Figure 2.29: Order and chaos

Infinity Edge is an Action RPG game where you venture through a world only to find foe after foe to battle. You wield a sword and a shield, and as the battle starts, you enter the combat mode and the setting change. You can either chose to swipe in different motions to attack in different ways, or with for your opponent to start battle by attacking in different ways. If you are quick enough to swipe in the counter position, you parry or block the incoming attack, letting you retaliate to score a blow instead. This genre of battle fits the touch devices very good, but it still does not take into consideration that it is a multi-touch device.

ReacTable Role Gaming (RRG)[70] is an RPG game for multi-touch tabletops, it uses tangible fiducial blocks to control base movement and options. It has a fun gameplay where you continually build up movement points to move your character through a standard RPG maze. Combat mode was solved in pausing the game and using tactical strategy to attack with gestures. The game is fully functional and works like you would want Dungeons and Dragons to work on a multi-touch tabletop.



Figure 2.30: RRG

### Comparison

If you look away from the fact that your finger is basically a mouse, and that you move your character the same way you would with the keyboard, they are the same games.

The RPG genre on multi-touch works great, the only flaw is that multi-touch functionality has not been implemented in a good way in any games yet. You have the functionality with multi-touch devices to use the D-pad while attacking, or changing spells while running away from an aggressive opponent, which is a good thing to be able to do at the same time.

Looting monsters is one of the more time consuming tasks on a touch device, where you would on the PC hold down shift and right click on all monsters in close proximity, to get all the loot, you need to target each of the dead monsters in turn to get up a menu with items and press another button to get the loot. Rift for the PC has added the functionality to loot multiple close proximity mobs with one auto loot command, which greatly improves the old system, and is a necessary improvement to any touch RPG.

Infinity Edge vs. Heavy rain is both action RPG games with similar gameplay. The difference is that you must swipe in the right directions, instead of pressing the right button, a good way to turn add flow to a game.

RRG offers multiple players the chance to play simultaneously as created through different fiducial elements. This takes advantage from the multi-touch technology and is in a huge step towards multi-touch multi-user gameplay standards.



Figure 2.31: Diablo 2



Figure 2.32: NeverWinter Night 2

### **2.11.5 Introduction to the multi-touch tabletop games**

After going through all the different genres we are used to be playing on the PC or consoles, seeing how they should be played on a multi-touch device, I started looking for games designed for multi-touch tabletops, screen sizes larger than 28". We will take a closer look at the most popular multi-touch tabletop games.

#### **Multi-touch tabletop games**

"Multi-touch inherently means multi-user" – Jesserson Han.

"What surprised us most was the dramatic contrast in emotional displays between one vs. several people playing together. Players in groups emote more frequently and with more intensity than those who play on their own." – Nicole Lazzaro

Most of the games in table1 was found through youtube, and a few were found through multi-touch framework examples. 1 of the following were found through a bachelor thesis.

The table shows 13 games, each one unique in it self, and even though they are unique, they still share the basic multi-touch functionalities, multi-user support. The table lists the games with first the name and link to where the demo video is located. Players are the number of players the game was designed for, which can be either 2, 4 or X. X players means that the game is designed to work with any number of players and can work equally well for 1 to unlimited numbers, as long as there is room around the table. ST/MT is to show whether or not the game was designed to support multi-touch gestures for each player. A good example to showcase this is to take 2 examples from the list. One game provides an attack gesture to be like throwing a ball. The other game attacks with the bow and arrow type gesture, where you shoot in a straight line between your 2 fingers.

The description is a very short overview of what the game is like, how the interaction is, or what kind of game it is.



<b>Name and Link</b>	<b>Players</b>	<b>ST/MT</b>	<b>Description</b>
Multi-Balls - Multi-touch multiplayer game <a href="http://www.youtube.com/watch?v=1yoRX89llsw">http://www.youtube.com/watch?v=1yoRX89llsw</a>	4	ST	Shoot balls with swiping motion
Multi Touch Space Wars Game <a href="http://www.youtube.com/watch?v=U2NIZV8xqnY">http://www.youtube.com/watch?v=U2NIZV8xqnY</a>	2	MT	Space wars game with swiping attacks
MT4j - Open Source Java Multi-touch Framework Applications <a href="http://www.youtube.com/watch?v=YW5c3IKPj7E">http://www.youtube.com/watch?v=YW5c3IKPj7E</a>	X	MT	Ubongo board game simulation
multi touch screen for games <a href="http://www.youtube.com/watch?v=R_h3vlikGIE">http://www.youtube.com/watch?v=R_h3vlikGIE</a>	X	MT	Puzzle game
Molecule based Multi-Touchscreen game <a href="http://www.youtube.com/watch?v=jHHYItY5aWQ">http://www.youtube.com/watch?v=jHHYItY5aWQ</a>	X	ST	Collect atoms and build molecules
Microsoft Surface Games Pack <a href="http://www.youtube.com/watch?v=RYDa0FzyBDY">http://www.youtube.com/watch?v=RYDa0FzyBDY</a>	2	ST	Board games from Microsoft surface
Microsoft Surface Games #1 <a href="http://www.youtube.com/watch?v=3pldDhlxX6s">http://www.youtube.com/watch?v=3pldDhlxX6s</a>	2	ST	Strategy domination game
Firefly: The first game for Microsoft Surface <a href="http://www.youtube.com/watch?v=JFapl4PxL9Q">http://www.youtube.com/watch?v=JFapl4PxL9Q</a>	4	MT	Create fireflies to trap insects in enclosures
Finally, a good use for multi-touch <a href="http://www.youtube.com/watch?v=fwZ2Oe6hOxo">http://www.youtube.com/watch?v=fwZ2Oe6hOxo</a>	X	MT	Missile to your fingers to stop paratroopers
Oculusia: Multi-touch gaming <a href="http://www.youtube.com/watch?v=njKTJLr5J8g">http://www.youtube.com/watch?v=njKTJLr5J8g</a>	4	MT	Coop to shoot spores at a boss
Slider: A Dynamic Multiplayer Game <a href="http://www.youtube.com/watch?v=Fqi5l-LwA5w">http://www.youtube.com/watch?v=Fqi5l-LwA5w</a>	2	MT	Tangible fiducial air hockey
Watouch Multi touch interactive game project <a href="http://www.youtube.com/watch?v=EXEi8H9tNZQ">http://www.youtube.com/watch?v=EXEi8H9tNZQ</a>	2	MT	Shoot the opponents base to win
People playing a Duck Game <a href="http://www.youtube.com/watch?v=Md07ZISi7XM">http://www.youtube.com/watch?v=Md07ZISi7XM</a>	X	MT	Trying to capture ducks
Interactive Multi-touch Music Multiplayer Game <a href="http://www.youtube.com/watch?v=UT18X_ekvic">http://www.youtube.com/watch?v=UT18X_ekvic</a>	4	ST	Requires you to use simultaneous ST.

Big production companies have been so focused on attempting to create what we already know. In a way this concept of creating the comfortable has clouded our view of accepting new technology as it is. We can create games that almost looks like it does on a PC or console, and with the use of a D-pad and/or other good UI elements, plays almost like a PC or console.

Games designed in a simple, yet efficient way, that you play with other people, may provide greater emotional efficiency than playing the game as a single player.

The developers of the games in table1 has focused on what we can invent with the help of a new technology. And the developers has had focus on bringing people together in a more interactive way with multi-touch tabletops.

As we see from the table, we see innovative designing, students and developers trying to find the best use of multi-touch gaming, and all ending up at the same place. Easy, often single-touch, controls for each player, with more players being able to control different bases/characters simultaneously.

### **Deeper look into the games**

Oculusia is a 4 player game with multi-touch functionality to support shooting projectiles in a straight line between your 2 fingers. Each player controls a side of the table. The object of the game is to block the enemy boss' projectiles from hitting the side by moving a panel to intercept the projectiles.



Figure 2.33: Oculusia

Interactive multi-touch music multiplayer game is a multi-user dance dance revolution type game for a tabletop. The 4 players in the game each has one of table sides as their play

area. In the middle of the table is a boss, dancing and dealing damage, and each of your characters trying to attack him. The object of the game is to tap you designated playarea fields as they light up, in beat with the music playing. On a perfect hit, your character deals damage to the boss in the center.



Figure 2.34: Interactive Multitouch Music Multiplayer Game

## **3. Methods**

### **3.1 Introduction**

Starting out on a subject with a small amount of published material is a scary journey to embark upon. To make it less scary, good methods can help immensely. Below I will talk about methods that have been of help to me, and a little about why they were used.

### **3.2 User survey**

User surveys are a great way to find out what the population wants, and in the game development, what gamers would want to play, and how they would want to play it. A user survey can be used to confirm previous research in a closely related study or to get additional information. The user survey can be completed by either stopping random people on the street, gather a meeting or sending out invitations to participants online. By using online user surveys, you can offer a better experience to the participants with the use of visual graphics. An online user survey also helps the surveyor in his task of collecting and comparing data acquired.

The questions in a user survey are predefined, but you may chose to question the participants on additional information if they so chose to give. Through the use of user surveys, you can gather large amounts of data and it fits well for design processes.

### **3.3 Workshop**

Workshop is a gathering of multiple participants to work together and figure out solutions. When it comes to game workshops, testing of a prototype is preferable, where you interview or survey the participants on their experience with the prototype and new directions to take the game. A workshop is often very useful, as designers and developers tend to create content for what they see as important or good. Games should go through many workshops in the form of beta testing phases to fine-tune the gameplay and content to the majority of the participants.

## **3.4 Interview**

Interviews is the act of asking questions and receiving answers. Being active in the area of interviewing experienced people, relevant for your task is important in figuring out what has been done and what will work and what has been proven to not work. Interviews are more time consuming than a user survey, but it usually offer richer, more precise data. Interviews are an important part of a workshop, where you get feedback from what has been conducted.

## **3.5 Prototype**

Prototyping is a way of trying ideas to see how they work out in a functional space. There are different types of prototypes. Low fidelity prototypes are what we call alpha builds when it comes to games. They are often only the skeleton of what the complete game will be, with low quality textures, missing content and lack of core functions. High fidelity prototypes are what we call beta versions; they are of a much stronger caliber and offers much of the content and functionality you would assume in a complete game. What's good about prototypes is that you can start out by creating something low fidelity, and do another user survey, a workshop or some interviews to see if you are on the right track before taking your prototype to high fidelity

## **4. Experimentation**

### **4.1 What to prototype?**

#### **4.1.1 Introduction**

The multi-touch technology is new in the sense that we now have affordable devices that can produce the technology. There is great competition to make the best games and the company with the best games sells the most games and gains the best reputation as the leading multi-touch developers, like Rovio with angry birds or gameloft with Dungeon Hunter. The competition for the market, increases security and monopoly on the research done. I assume there has been undergone major research to better understand what tomorrows youth will want when playing games on the multi-touch technology. And companies will probably never decide to share their findings.

Games has always been one of my main passions, close to programming and the combination of them both, so when I started out researching games for multi-touch, I've been drawn in multiple directions at ones. The need to make something I would enjoy was almost as important as creating a game as a product of user surveys, workshops and interviews. Ernest Adams explains that games designers design games for themselves[71]. And any conflicting results from user surveys, prototyping and workshops were ultimately decided by myself.

To start out with research on what type of games, and how to play these genres of games are to be figured out, I had to start my own research. The research will start with a user survey, and go on to prototyping a game with the results from the user survey in mind. There will be held a workshop revolving around the prototype and interviews will be conducted with the participants. This research in contrast to the major game develop companies will be done to further improve the technology and how the technology is used in games. Ultimately, with the release of this article make it available to anyone interested in learning what the public wants in a multi-touch game.

## 4.1.2 User survey on multi-touch tabletop game genres

I started out by creating a user survey to figuring out what game genre most users would enjoy playing, and by default what genres are most popular for the multi-touch technology for the participants. I continued to create following surveys for each of the top genres chosen by the users.

I chose to have 4 groups of individual answers, pro-gamers (participants that have worked or are working by making money from playing games), developers (participants that are developing either games, multi-touch applications, or both), casuals (participants I have played games with up through the years) and females (female gamers or friends). I chose to make different groups based on the research XEODesign did for their games[72], in order to get a wide spectrum of answers.

The first survey, about what game genre is most popular for the multi-touch technology, 112 were invitations and 30 finished the surveys. Of these 37 were 11 pro-gamers, 3 were developers, 13 were casual-gamers and 5 were females, of these 5 females, 2 are gamers. The survey has 11 questions, the first question asks the user his or hers name or handle (their online nickname). The reason behind this question, is to have the users take the survey more serious and put more thought into their answers. The survey continues to ask questions about the users experience with multi-touch technology, and how much and what type of games they play. These questions are important in determining the individual answers as a user response with great insight into multi-touch technology and dedication to games has a higher understanding of how a game can be designed. A response where the user does not like multi-touch or games can bring new ideas or see innovative elements that a hardcore gamer will overlook and there responses can be used in fine tuning how a game can be played. The 4th question asks the user what type of games the user mostly plays on their own free time. It is a multiple choice question with predefined genres popular for the PC and consoles.

The last 7 questions goes on to query the users what type of genre they would most like to play on a multi-touch tabletop, and what type of aspects are important in multi-touch gaming. The answers to these questions are important in figuring out what users wants to play on a multi-touch device.

### **4.1.3 User survey results for multi-touch tabletop game genres**

When asked what game genre they would prefer to play on a multi-touch device, 11 chose strategy games, 11 wanted board games and 7 chose role-playing games. 1 participant wanted racing games and one person did not want games for multi-touch tabletop at all as he felt games were meant for a PC.

The next 6 questions go on to explore how the game genre they selected should behave on the multi-touch technology.

All pro gamers and developers that completed this question thought it was important to be able to play against or together with someone else on a separate device, while the casual and female users were a bit divided. In all 17 wanted multiplayer while 6 were against it. 10 users across the survey thought it was important or very important to be able to play against or with someone else on the same device, while 11 were against it.

24 users wanted to be able to login and keep track of their game history, score and stats, regardless of genre.

5 participants wanted fast to ultra fast gameplay, 15 wanted slow to normal gameplay and 10 wanted turnbased.

When asked about the graphics, 10 of the users thought 3d graphics were important, while the other 20 were more into the thought of playing a 2D game.

When asked about sound 22 said that sound matters in a game, 5 did not care for sound and 3 didn't care for the question.

### **4.1.4 User survey conclusion for multi-touch tabletop game genres**

This user survey on game genres for multi-touch tabletops came to the conclusion that users don't want to have a game that is overly fast, or too slow, they either want something that is normal to fast paced, or a game that is turn based. For my research I will overlook turn based as an option since it counteracts multi-touch technology.

The responds to graphics might have been different if all participants would have been able to try out a 3D and a 2D game before answering the survey. If users were allowed to try a multi-user game on a single tabletop, the reply may have been different.



#### **4.1.5 User survey on board game genre**

I created a user survey for the board game genre, I focus the most on jigsaw puzzles. 1 pro-gamer, 4 casuals and 2 females participated in this survey.

#### **4.1.6 User survey results for the board game genre**

Everyone wanted to be able to choose difficulty settings, no one was against having a countdown timer and only 1 participant thought it would be good to be able to move the camera around the jigsaw puzzle. The participants wanted to be able to login and have a highscore and statistics, as they thought it would be important with a pause function. Participants were split down the middle when asked about having an undo/redo function but thought that being able to save and load were important.

Participants wanted pieces to be randomly rotated, but were split on where the pieces should be located on the table.

Having pieces automatically stick to the right position were also provided unreliable answers.

When asked about competitive play, 3 participants wanted to be able to play against someone else on another table, and have the table announce the winner. 2 players wanted to split the table in 2 and race to solve a puzzle. 1 participant wanted to be able to choose either of the 2 ways at the start of the game and the last participant did not want competitive play, but rather cooperative play on the same puzzle on the same table.

#### **4.1.7 User survey conclusion for the board game genre**

Being able to login or identify yourself as a player is an important part of any game, and participants also feel the need for this on the board game genre.

Piece positioning is not an important feature, neither is the auto-stick function, but creating auto-stick results in easier development of correct solutions.

Multiplayer is difficult to conclude from the survey, but combining it with previous work, as Jeff Han states, multi-touch is multi-user and leads to say that puzzles on the same table would prove the greater experience, being cooperatively or competitively.

#### **4.1.8 User survey on RPG game genre**

I also created a user survey for the RPG game genre. 1 pro-gamer, 4 casuals, 1 developer and 1 female participated in this survey.

#### **4.1.9 User survey results for the RPG game genre**

Participants wanted all the gameplay mechanics they are used to from the PC, moving their character, leveling up, gaining attribute points to spend in stats, selecting monsters to attack and attacking them with multiple spells and abilities, being able to go into melee combat and control the camera around the character. Participants did not care for being able to zoom in and out, watch a replay of the past game, or queue actions. Logging in and being able to save and load games were important.

Participants want to be able to move their character by a touch to the table and the character to path-find to that location. 1 participant was against this, and wanted to move the character by dragging him, like what was done in RRG.

When it came to attacking, the participants did not come to an equally unanimous conclusion. 2 wanted a double touch to indicate an attack in the pressed location. 2 wanted to toggle attacks by pressing an icon for a spell, then to the table to shoot in that direction. 2 participants wanted different gestures for different spells or attacks. And the last participant wanted to be able to attack only when pressing on top of a monster.

When asked about the game world, 4 participants wanted a huge world like we see on today's RPG games, with a lot of NPCs to talk to, and many side quests apart from the main storyline. 3 participants wanted something a little smaller.

#### **4.1.10 User survey conclusion for the RPG game genre**

An RPG game for a multi-touch tabletop should allow participants to be able to login and load/save games. The game world can be decided by the game itself, participants doesn't seem to mind a game being a straight forward storyline, or a open world RPG.

Movement and attack is conflicting, as you should be able to do both simultaneously. I therefore propose the mover-ball implementation that we will look closer at in a prototype.

#### **4.1.1 User survey on RTS game genre**

The last user survey that was sent out was for the strategy game genre. Specifically RTS games like Warcraft, Starcraft, Command & Conquer and Civilization in mind. This was by far the most popular survey to participate in, as I got 7 pro-gamers, 7 casual gamers and 1 developer to answer.

#### **4.1.2 User survey results for the RTS game genre**

I started out with questions about how important different gameplay mechanics were for the participants. The participants found almost all of the gameplay mechanics important, except for a few as we will take a closer look at.

It is important for all participants to be able to control every single unit, mark an area to control several units, build buildings and control each of them. It is important for 9 of the participants to be able to select multiple buildings, while 6 didn't mind. It is important to have control over which enemy unit to attack and to have control groups of units. Controlling the game speed and being able to zoom in and out was gameplay elements that wasn't important to the participants. Almost all the participants thought it would be important to be able to watch a replay of the previous game. Queuing actions as we are well known with from the PC was also a very important gameplay element. Saving and loading left the participants split down the middle, but no one said that they wouldn't want it.

Participants then answered questions concerning how to do these different gameplay mechanics. When it came to how participants wanted to move the camera around the map, almost half wanted to drag the screen with the palm of his hand, and almost half wanted to have a minimap to click on. 1 participant wanted both functions for moving the camera.

When it came to selecting a single unit, 5 participants wanted to mark an area around the unit, while 10 wanted to single press a unit.

Selecting multiple units split participants up even more leaving 3 participants to want to draw an area around the units to select, 4 participants wanted to use 2 fingers in diagonal positions of a rectangle to select units inside and the last 8 wanted the function to work like it does on the PC where you draw a rectangle with 1 finger.

7 participants wants to use 2 fingers simultaneously to simulate a right click from the PC to move units. 4 participants wants to double press with a finger to move units. 2 participants wants to have a move toggle button, and 2 other wants to move with a single click anywhere on the map.

When it came to attacking, the majority of participants wants attacking to function the same way as moving, only doing their moving function on enemy forces.

2 participants doesn't want hotgroups, 5 would like a predefined hotkeybar with multiple buttons you press once to save your current selection of units, and twice to recall the selection. 7 participants wanted individual group buttons that could be moved about the table, and 4 of them wanted to have a "Create hotgroup" button to create this, while the other 3 wanted to have a gesture to create the hotgroup button.

When it came to building creation, 10 participants wants to be able to press a worker, get an overlay of the available buildings, chose one and select the area to create it, like on a PC strategy game. 3 wanted to chose buildings from a universal menu and have the closest worker rush to the area to construct the building.

9 participants wants 1 building for many unit types, and single pressing that building gives you an overlay over possible units to produce. 3 wants a universal menu with available units, and pressing to produce a unit start construction at the closest building. 1 participant wants individual buildings for each unit, and double pressing that building starts construction of that unit.

The last question of the survey queried the participant for additional thoughts, where 1 participant chose to answer that the current technology doesn't suit fast paced RTS games, and that it would be better with a turn based game like Heroes.

### **4.1.3 User survey conclusion for the RTS game genre**

To conclude the RTS user survey, I will point out last comment in the survey, that multi-touch tabletops doesn't have good enough technology to support a fast paced RTS, but

the technology will catch up, and if the standard is well established by then, games can flourish.

It seems that participants want what they know from the PC, in the area of selecting units and attacking, being dragging a finger over the tabletop to produce an area to select units. Moving them with a simple command like a double tap or a dual tap, with the same function for attacking. This may prove to be difficult to achieve when playing an intense game, where you might miss a unit and order your forces to walk into an onslaught. This could be circumvented by creating larger bounding boxes for units.

When it comes to building and unit creation, the survey shows that participants enjoy the way it is being done on the PC, namely, target the worker or building, have a menu show what your options are.

## **5. Prototyping**

### **5.1. Prototyping Hack'n'Touch**

#### **5.1.1. Introduction**

After coming to the conclusions on the user surveys, I sat down to figure out which genre to prototype. I saw the massive buzz around the RTS genre, so I started doing research on the field. I went through the different multi-touch frameworks and read through the forums looking at the community projects. I came to the conclusion pretty quickly that creating an RTS was basically like creating a very advanced RPG and that it would take too much time to complete, and maybe not having the option to hold a workshop. I gathered my data and experience on the RPG genre and started creating my interpretation.

#### **5.1.2. Interpretation of RPG for a multi-touch tabletop**

My game is an old-school single player dungeon crawler hack and slash, meaning you play a character with spells that can be changed through a moveable HUD menu, as you usually would change spells in a computer game. You move your character by moving a path-ball, an interactive multi-touch way to move a secondary object, and your character moves at a slow, steady pace towards the ball. You shoot spells by choosing a spell from your hotbar, then pressing anywhere on the table to shoot in that direction.

The purpose of the game is to find your way down 3 levels of a straight forward maze. As you venture deeper you will encounter monsters that will attack you as you move closer to them. The monsters move completely erratic and are always shooting at you when you come within their agro range. When you kill a monster, you gain experience points, as you would in any computer game. When you gain enough experience points you level up, gaining faster movement speed, more max mana and more max hitpoints. When you use a spell, you lose mana, and when you are hit by a spell, you lose hitpoints. Mana being the magical energy in your character, and your hitpoints being your life energy. If your mana empties, you cannot shoot more spells, and if your hitpoints empties,

you die. You can monitor your mana and hitpoint levels in a HUD at the top left of the table.

At 3rd floor, you find the last boss, he is larger than the rest and his damage spells are faster and does a more damage if you are hit.

This is the very basic of what a hack and slash dungeon crawler is on the computer platform, and if I had included the keyboard and mouse into this game, it would be very much the same as the first Diablo game from blizzard entertainment.

### **5.1.3. Different development frameworks**

I looked into a few different frameworks as described in the multi-touch framework chapter. I researched the different frameworks and wrote code to implement the basic functions of creating a character and moving it with the help of a moverball. This was pretty easy with MT4J which had some of the functions already, but the complications with creating a 3d rich universe made me go over to Openframeworks and c++. Many may disagree, but I find that programming in c++ is a much more complicated matter than prototyping something in Java.

So I ended up with JMonkeyEngine and Multiplicity because of the great help I could get from InterMedia next door to the University of Oslo. JMonkeyEngine also has a great community with a large forum with questions/answers, help and support.

Starting out was a breeze, I followed the instructions on InterMedias wiki to install JMonkeyEngine and get Multiplicity to work with it. As I always do when learning something new, I started looking at the source code for the built-in examples, and got to a place where I found something I could base a game platform on.

### **5.1.4. JMonkeyEngine with Multiplicity prototyping**

I created a sphere at the center of the world, positioned my camera 150points over the character and 1 point south of him, to force the camera to look north while it looked down on my character. I locked the camera to the sphere and started with the moverball as described in the user survey chapter.

I did not want to implement physics into the game, as I only wanted a proof-of-concept on the gameplay. So while adding the floors might look like it was just for show, they are also used to find legal spawning locations for new monsters. I added walls to stop

monsters and spells to travel outside the map, and after tweaking of my awful hack algorithms got corners where 2 walls meet to gently push the approaching character away instead of bugging him through the walls.

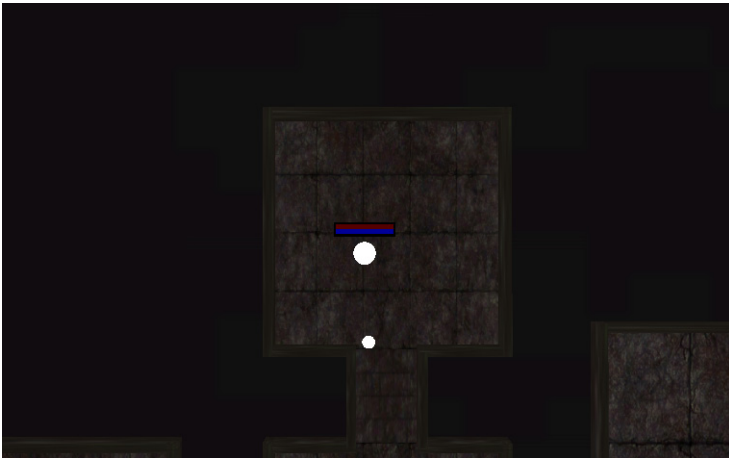


Figure 5.1:

This was the stage where I was running around in my dungeon with nothing happening, so I implemented some static monsters without the ability to move or shoot. With them standing there I wrote a spell system with a HUD to display my mana and hp, and a hotbar with spells I wanted to implement to give a diverse feeling to the game. The fireball was my first spell, with simple particle effects, blowing up when hitting walls or monsters, depleting both mana on cast and enemy hp on hit.

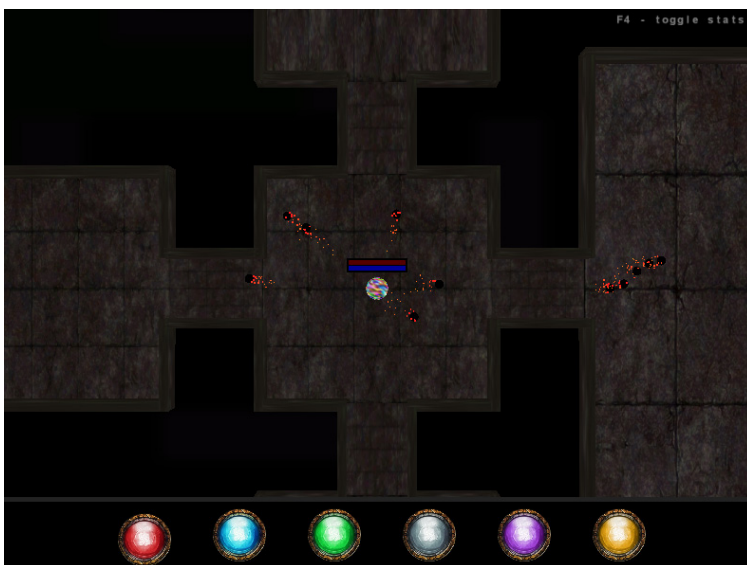


Figure 5.2:



I felt the need to improve my spell arsenal, and finished 6 other spells, some fast, some slow, fast damaging, flame throwers and meteor strikes were a few, each with a distinct look and feel. Spamming meteors down from the sky was a bit too much, so the need for a cooldown system allowed itself into the game, to stop spamming of single spells and enhance the changing of spells to allow for a more diverse fast paced action gameplay.

I quickly found that having a static hotbar for spells at the bottom of the screen was bad for productivity. My hands were always on the tabletop, moving the character or shooting spells, so when I wanted to change spells, I was usually blocking the spell I wanted to enable with my other arm. I wrote a quick code function for the monster handler to shoot at my character whenever I was in range, where skeletons could shoot 100points and zombies shot really fast at 20range, to simulate a melee attack.

This became too easy, and the need for some challenge was long due, and thus the random walk movement of monsters was born, erratically walking this way and that, trying to trick me into traps.



Figure 5.3:

I finished the last 2 levels and added a boss at the end. After this was done and the game took around 5 minutes to complete, I wrote the loot system, with mobs being able to drop health, mana or rejuvenation potions at their feet when they die. I also added some 3d models as will be described in the JmonkeyEngine+Multiplicity complications chapter below, to give the game a better feel of actually destroying opponents instead of balls.

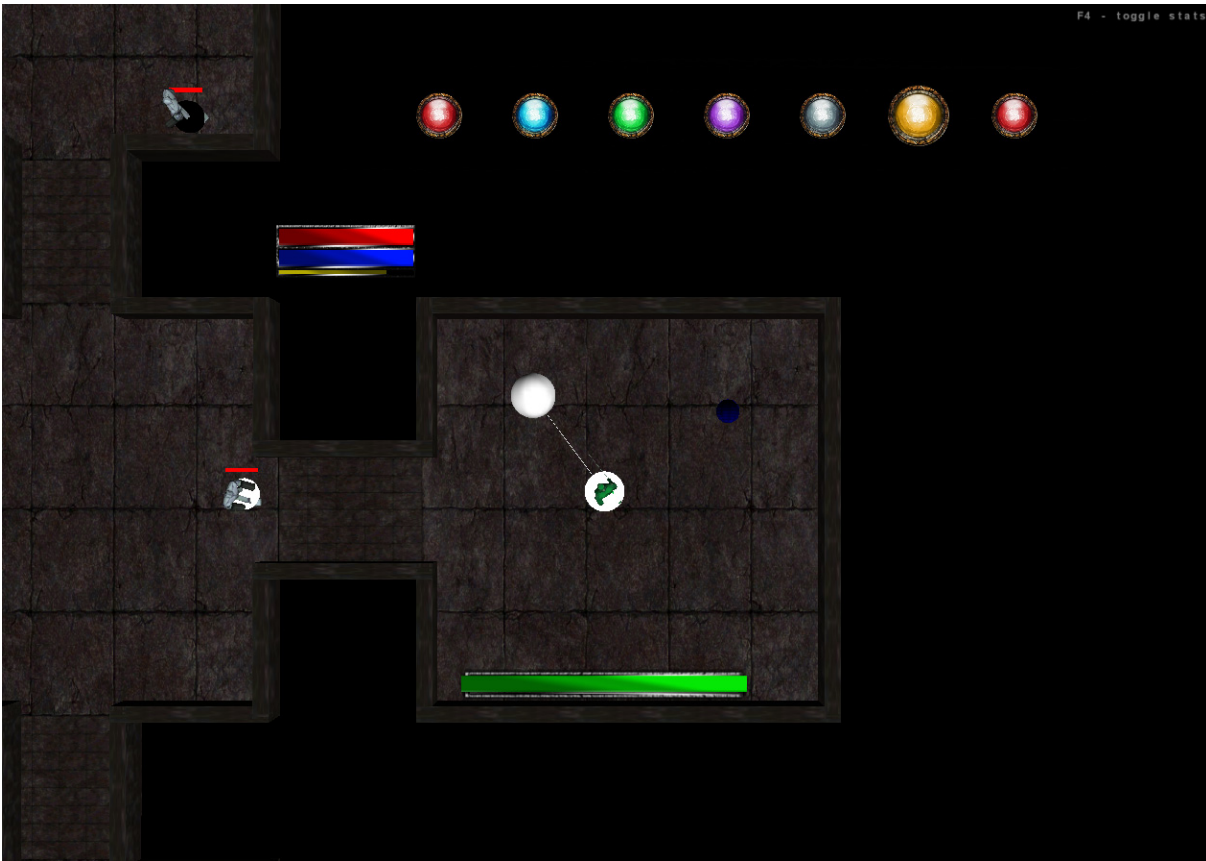


Figure 5.4:

At this point, I felt my Hack'n'Touch game was complete and invited people to a workshop to find out if this was the way they thought the genre could be played.

### 5.1.5. Hack'n'Touch workshop

The first workshop was invitation only where 1 and 1 participant came in and tried out the game, I invited people from RPG gaming interaction designer, to non gamer programmers, to university professors with multi-touch background. The sessions all started the same, I introduced the system, even though they were familiar with multi-touch technology. I introduced the genre and the game, before starting it. 100% of participants started out by walking up to the table and with their right index finger try to click around on the table, background, moverball and HUD. Observation showed difficulty in pressing the moverball correctly, and also the rear DI table observed fingers up to 15mm above the surface, making it confusing when then character did not respond as intended. The first multi-touch

interaction came 45second for the fastest participant and one participant had to be told to try more then 1 finger to play the game, after which, his experience was greatly improved.

### **5.1.6. Hack'n'Touch workshop conclusion with interview**

After each participant had tried the game for up to 15minuts each, I sat down with each of them and asked some pre defined questions about the feel of the game, and general improvements. Participants also had comments and criticism that shed light on difficult aspects of the genre.

Any spell cast that would require multi-touch gestures would be a great waste of time, and might mean your death in certain situations. So a multi-touch spell casting method is being left out. Participants also agreed that spells at the bottom of the screen is not the way to do it on a multi-touch table, because your other hand is constantly on the table moving the path-mover ball for your character movement. Most participants kept the hotbar above and to the right of the character for easy access.

Participants all felt the game was a little confusing and would like some basic instructions at the beginning of the game, or a help menu/overlay.

The walkball needed to be easier to get hold of, so it became larger and easier to press.

Most participants wanted the character to move faster the longer the moverball was away from the character.

One participant argued that the genre is too simple, and does not cater to the multi-touch technology as she wanted multi-user. I stepped in and we played the game together, her controlling the character and the different spells while I stood on the opposite side of the table, shooting spells at monsters. Her reaction was positive and she enjoyed the multi-user aspect, although almost all participant wanted to control their own character in a multi-user RPG game. As we read on the DiamonTouch technology, this would be fun to implement. As it is now with the spell system, a spell shot would trigger spells for all characters on the table.

Another participant wanted the status window to show more information about how much hp, mana and experience, and what level you are.

All participants were confused with my cooldown system and over half of the participants wanted the cooldown system to be implemented on all spells with an overlay showing the time left for each individual spell.

Overall, Hack'n'Touch was a success at the first workshop, and the changes was made in preparation for a school class coming to try the game.

### 5.1.7. Hack'n'Touch second workshop

15 students from Valler high school came for a visit to the University of Oslo for a guided tour. One of their stops was to come in for a closer look at the multi-touch work being done at the Institute for Informatics. I started off with a short presentation of the technology and went over to the game details. Most students were familiar with touch devices in the form of a mobile phone, but only 2 had experience with a multi-touch table. Everyone was familiar with the genre.



Figure 5.5:

Once the game was up and running, they flooded the table, but no one wanted to touch it, probably out of fear of doing something wrong in front of your class. After I asked if anyone wanted to touch, 2 girls reached out and took charge, they started exploring the same way the individual workshops had proceed, but attempted multi-touch interaction after a much shorter time. This might show that multiple people see that multi-touch is possible sooner than a singular individual. One of the girls took charge of the moverball, while the other changed spells and fired at the monsters like I did with a participant at the first workshop sessions. They got carried away and everyone was paying close attention to their rampage. After some minutes I had to ask if anyone else wanted to try, and even though the 2 girls still played, more people tried to shoot different spells, smiling as a touch provided a function of the game. Most of the students came up after they had tried to touch the table or do some functions to talk about the technology, the game, or to give improvement feedback. Most saying “the green spell does not work” where I had to reply, “yeah, I forgot I was working on redesigning it...”.

### **5.1.8. Hack’n’Touch second workshop conclusion**

The results from workshop 2 was that I was clearly on the right track, but that it needed more content to be a game they could enjoy to play for greater lengths.

Some students felt that a help menu would be helpful, or even a sheet of paper next to the table to give instructions on how to play. But after understanding how to move your character, and how to change spells and shoot, they couldn’t stop playing. The spell system does not show information about what the spells does or how long it took to recharge, some students enjoyed experimenting, while other were visibly annoyed.

### **5.1.9. JMonkeyEngine with Multiplicity complications**

JMonkeyEngine provides an update function that gets called every frame update, helping you to control all elements in the game that revolves around artificial intelligence. When you add multiplicity to JME, you lose this function, and have to add controllers to objects and use the controller update function for all artificial intelligence commands.

Another problems with JMonkeyEngine and multiplicity is the problems of interacting with 3d models. Multiplicity has a wrapping element which is interact able, but this wrapper can only have children of a specific type. A 3d model is imported as a Node, but an approved child is a spatial. A Node contains many spatials. You can think of it as not being able to put a specific salt grain into a salt shaker, because the salt is inside its container, and is never at the same place in the container. I figured out the workaround for this working on another project called colorTable[73]. But I have yet to implement the new function calls to Hack'n'Touch. This means that the balls under the 3Dmodels are the controllers for the 3d models, making them walk or shoot.

The version of JMonkeyEngine and Multiplicity I have been working with is now outdated, and only supported 15 simultaneous blobs. Any excessive touches would crash the application, and a restart would be required. One person would have a hard time exceeding this restriction, but it was soon discovered that when 4 people was playing Hack'n'Touch trying to shoot everything at once you exceeded the limitations very quickly.

## 5.2. Prototyping Popper

### 5.2.1. Introduction

Popper is based on the popular PC game OSU[74]. The game follows simple rules, to have a song play, and to have positions on the screen you have to click with your mouse, in synergy with the beat of the song. Beat maps are created by the community for each song, and are rated by the community to improve the quality of content.

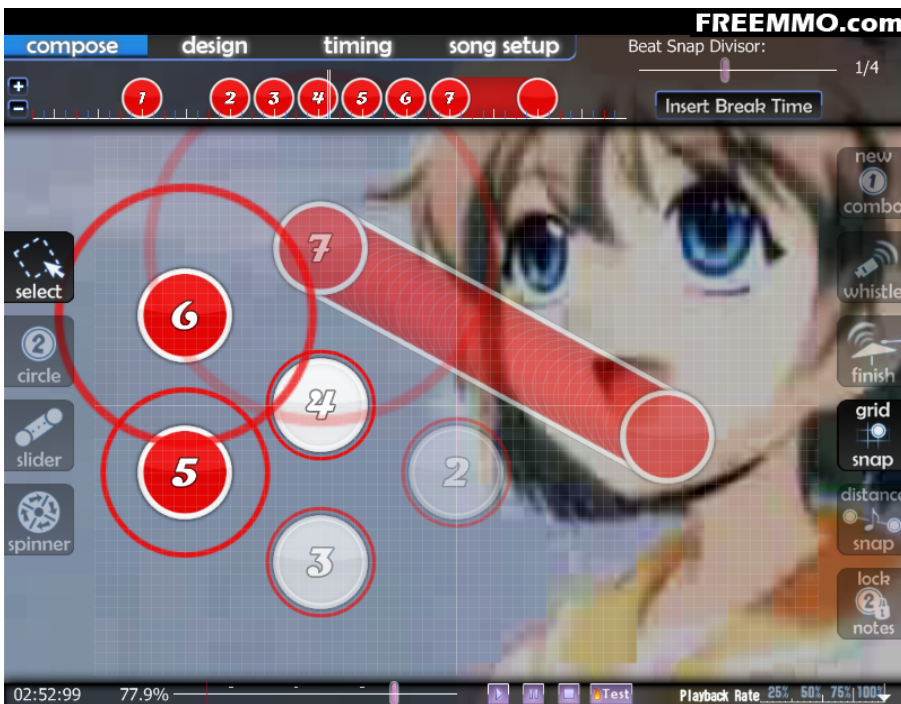


Figure 5.6:

The purpose of the game is to wait for the outer ring for each position to hit the outer edges of the position before you click it, and the closer the outer ring is when you press the position, the more points you get. In the pc version you also have to slide some positions to another position to gain points.

This seemed like a great multi-user multi-touch game for a tabletop, so I wrote a quick beta game, which was enough, the simplicity in the game makes the gameplay, and the gameplay makes the experience. I called it popper and created bubbles instead of circles to create some effects of a bubble popping when you press them.

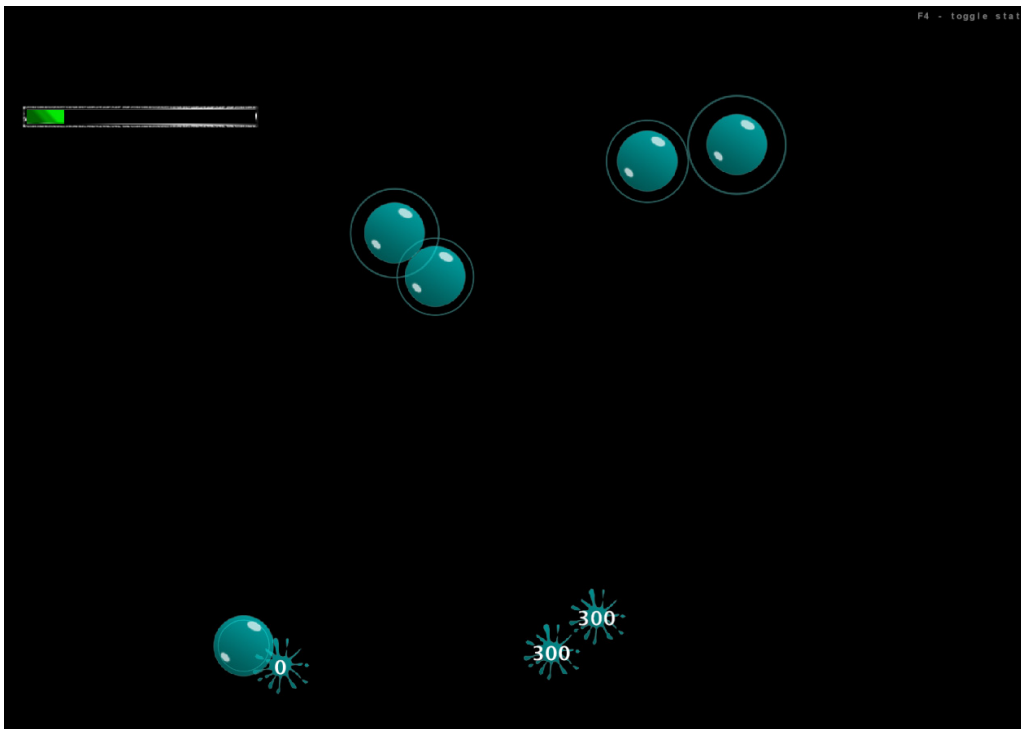


Figure 5.7:

Each game lasts 20 seconds with a countdown bar depleting. Popper also introduced a highscore list, with the ability to draw your signature for 3 seconds on the tabletop after the session was over. The drawn highscore pictures show up in an ordered list with the highscore after each game for another 3 seconds.

### 5.2.2. Popper workshop

After the beta was complete, I invited groups of 3 and 3 master students and professors to a workshop. None of the participants in any group was familiar with the PC game OSU. Instructions at the start of each game reads “Hit the bubbles as their outer ring hits them.”. Every participant in every group ignored the message and hit away at the bubbles the moment they popped up, finding the experience of popping bubbles hilarious and entertaining. They soon enough figured out how to play the game without the instructions and every group told each other how to do it right. 100% of participants in all of the groups started with their right index finger, but most soon found that using the index finger on both hands improved their ability to score additional points. Participants were very cooperative, talking while playing, dividing the table into spaces for each participant, but more then not, stepping over their boundary to hit someone else’s bubble.



100% of participants were eager after each game to draw their highscore picture and the groups of participants that knew each other from before the workshop talked strategy in anticipation for the next round.

None of the groups engaged in competition, but rather played it cooperatively.

### **5.2.3. Popper workshop conclusion**

This is basically a have been a single-touch multi-user game as the only multi-touch function used is `onPressed`. The ability to pop bubbles at the same time was a great experience to the participants. The spawn rate of bubbles does not check for neighbors, so feedback showed that they should spawn so far away from each other that they don't overlap, to enhance the gameplay.

Most participants enjoyed drawing after each game, and found it enjoyable looking at others drawings while waiting the 3 seconds for the next game. This was enough time to give participants the urge to play for another 20 seconds, finding scores they had to cooperate to beat.

Feedback from participants gave the clear impression that music or some sort of feedback sound would have been preferred.

## 6. Results and evaluation

### 6.1. General multi-touch games results

The user survey on games for multi-touch tabletop gaming came to the conclusion that users don't want to have a game that is overly fast, or too slow, they either want something that is normal to fast paced.

Participants does not want 3D over 2D or vice versa, interviews show that a 2D game can be better for multi-touch as it relieves problems in first/third person views.

Multiplayer formats feedback gave very different results when was datamined from user surveys and given through workshop feedback. Here are the results when it came from the user surveys.

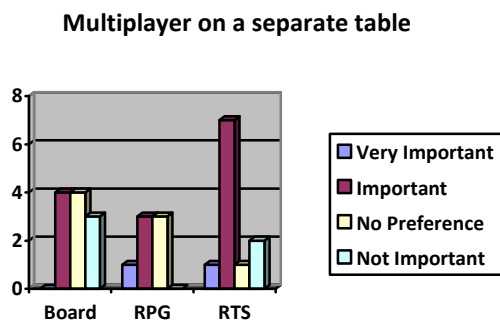


Figure 6.1:

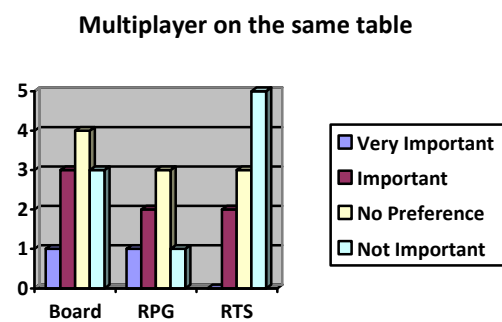


Figure 6.2:

After every single participant had attended a workshops, for either Hack'n'Touch, popper or demo ware for the table, gave feedback that they found multi-user gameplay enjoyable.

When it comes to the user interface for multi-touch games, we look at Fitts and Hick's law to show that intractable elements should scale based on importance and be initially placed at the corners of the screen. The amount of intractable elements should also be kept to a minimum, and games should allow what users are with; moving user interface menus around the table to fit their need.

Independently of game genre, participants in user surveys want to be able to login and have a history of their games and achievements.

## 6.2. Multi-touch genre results

Participants want what they want, this is based off of Nicole Lazzaros research on the 4 cornerstones. Some want one genre, some want another genre, resulting that every genre is viable for a multi-touch table. Some genres more then others, as we saw with simple interaction multi-user games.

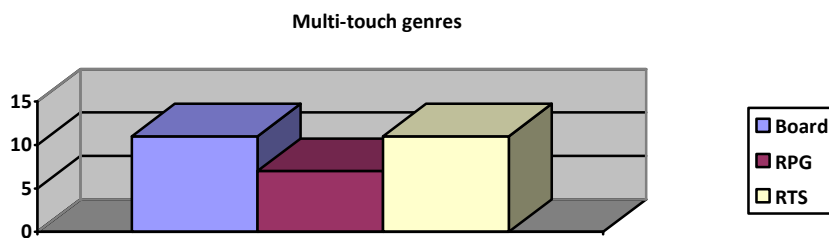


Figure 6.3:

## 6.3. Specific board game genre results

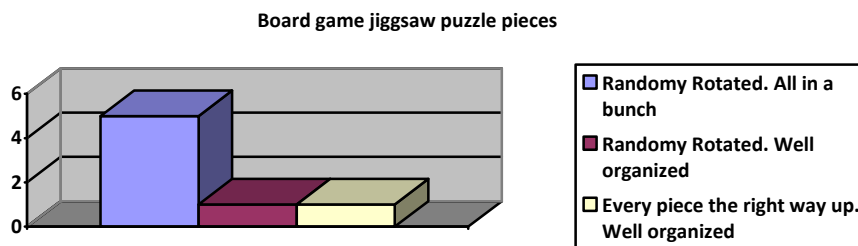


Figure 6.4:

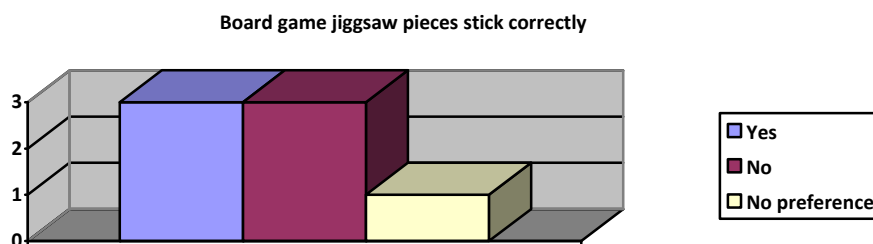


Figure 6.5:

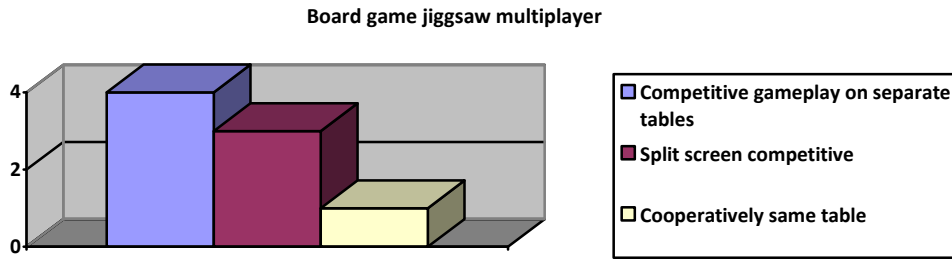


Figure 6.6:

## 6.4. Specific RPG genre results

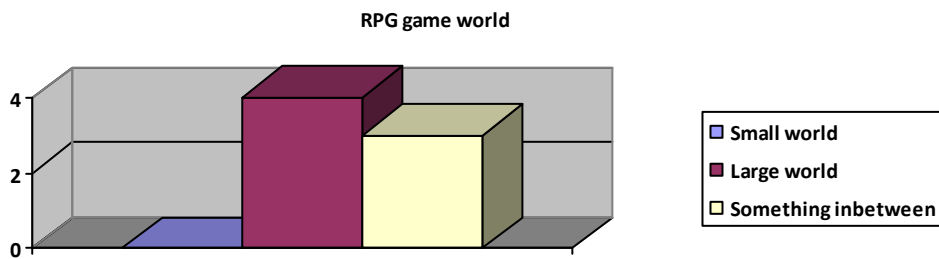


Figure 6.7:

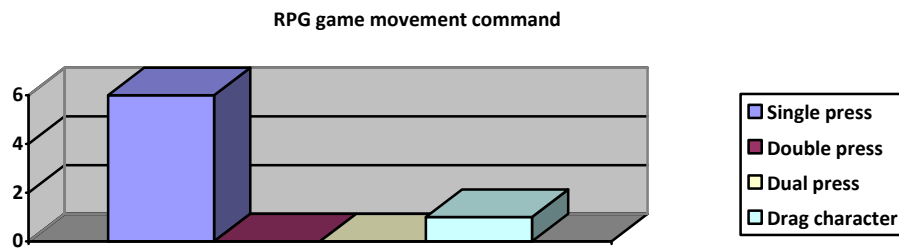


Figure 6.8:

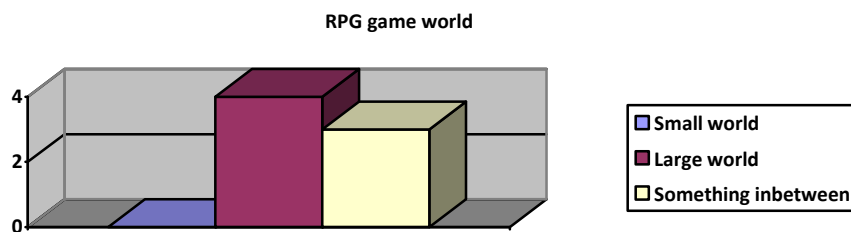


Figure 6.9:

## 6.5. Specific RTS genre results

Important for all participants to be able to control every single unit and building separately as well as simultaneously.

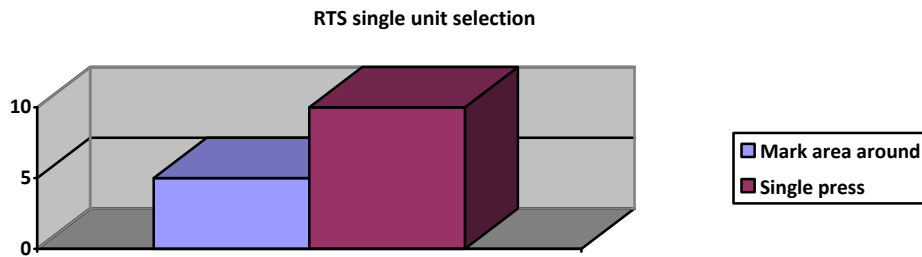


Figure 6.10:

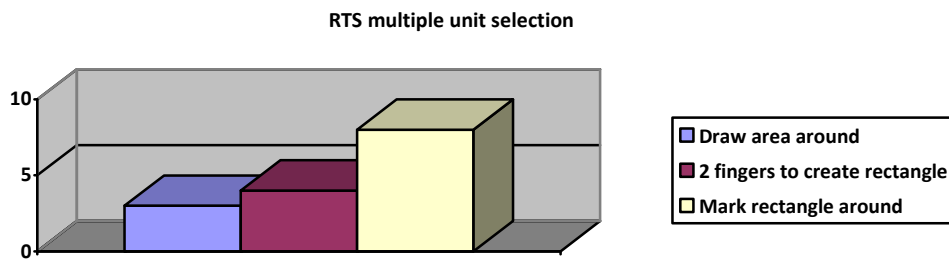


Figure 6.11:

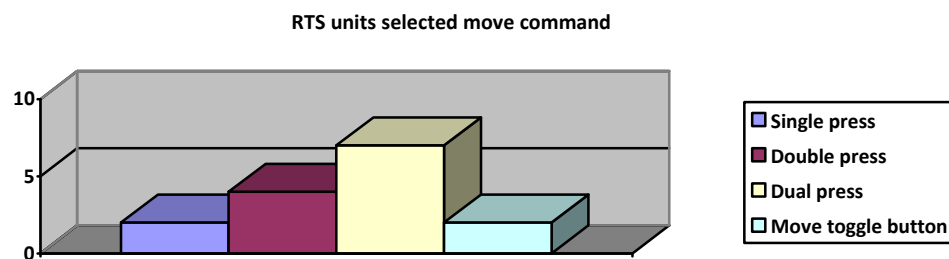


Figure 6.12:

Majority wants the same function for attacking as for walking, but on the enemy units.

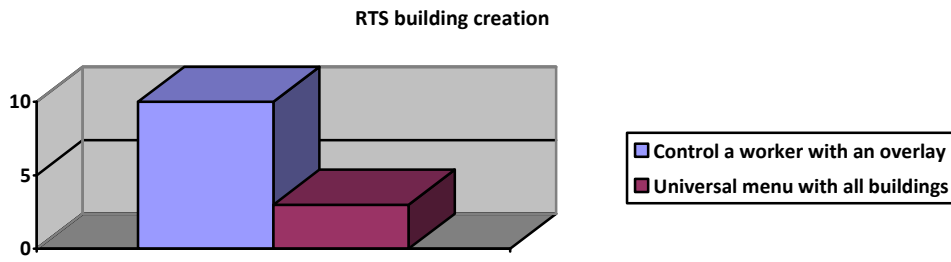


Figure 6.13:

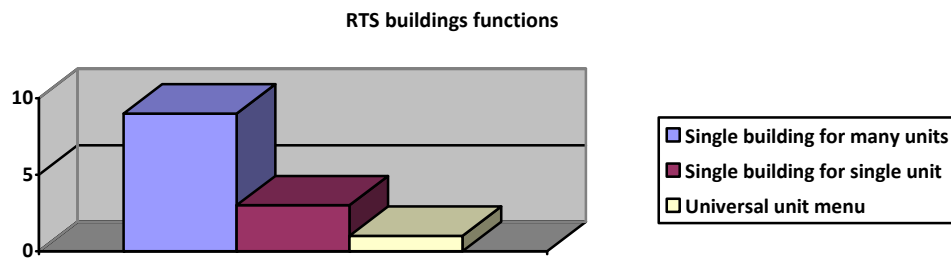


Figure 6.14:

## **7. Discussion**

Through this research I wanted to figure out what game genres held the best gameplay experience on a multi-touch tabletop. My results point me everywhere depending on the person playing the game, but what always stays at the top of the list, is being able to play with someone. This is also supported by what Jeff Han stated about multi-user for multi-touch, and that it holds true in general for games on multi-touch tabletops as well.

Looking at how user interfaces could be done more efficient or clearer for these multi-touch tabletops, it seems clear that an over cluttered tabletop will decrease the flow, and the positioning of these user interface elements should be placed strategically. From what we learned by Fitts and Hicks the user interface should have as many of its interact able elements moveable as well as larger elements for the more frequently used element. . Elements should be placed along the sides of the tables, and there should only be as many user interface elements as are needed to play the game.

### **7.1. Specific board genre**

Piece positioning is not an important feature; neither is the auto-stick function, but creating auto-stick results in easier development of correct solutions, as shown in user surveys.

Multiplayer is difficult to conclude from the survey, but combining it with previous work, as Jeff Han states, multi-touch is multi-user and leads to say that puzzles on the same table would prove the greater experience, being cooperatively or competitively. This is supported by the popper prototype where the gameplay experience increases for each individual as player number increases.

### **7.2. Specific RPG genre**

An RPG game for a multi-touch tabletop should allow participants to be able to login and load/save games. The game world can be decided by the game itself, participants doesn't seem to mind a game being a straight forward storyline, or a open world RPG.

Movement and attack is conflicting, as you should be able to do both simultaneously. I therefore showed through my Hack'n'Touch prototype that a moverball is a viable movement function, more interactive and fun than a D-pad. While users show interest in the D-pad from interviews, a preview of other methods may change their minds.

The user interface in a RPG genre should be movable and more important interactive elements should be larger than others as discussed previously.

### **7.3. Specific RTS genre**

Participants of the user surveys and interviews want what they know from the PC. And from what I see in the developed touch games, so does the developers. There should be a HUD to contain a list of units that are marked. A moveable minimap should be placed at top right together with the resource and supply information.

Players should be able to control / select all units and all buildings, separately or together. Players should be able to create rectangles with his hand, either by dragging a finger on the table from A to B in indication of a rectangle, selecting the unit inside the rectangle. Or with two fingers on a and b indicating a rectangle that selects the unit inside the rectangle. Or by pressing with a finger on a unit, if you only want one.

You are going to move around the map, perspective, put your hand on the table and drag, or click on the mini-map.

You should use two fingers to represent a right click from a mouse, to move, work, or attack with the units you have selected.

There should be a "Create Hot group" button you can press on after you have selected units, and then get a button you can move around the table with a finger, and you should be able to press this button with two fingers to get control of the units again.

There must be a type of building to create multiple units, so one can choose one or more of the same type of building, get an indication of which and how many units you can make, and press to create.

When you target a worker you should automatically get an indication of the buildings that the worker can make, then select the building and decide where the building should be built. As when to produce units from a building.



## 8. Conclusion

Through research, user surveys, interviews, prototyping and workshops, conclusions to my research questions have emerged. I started by asking “*What game genres does multi-touch tabletop technology best cater to?*” and I have had to realize that different people want to play different game genres, even though the technology can’t do enough, or so much more. This is based on user surveys, prototype workshops, interviews and genre comparisons between PC/console and multi-touch tabletop games.

I continued to ask “*Multi-touch inherently means multi-user. What is the most desired multiplayer format and what proves to work the best for multi-touch tabletops?*” and found that; Humans are social creatures, and while there are many viable game genres that hold great potential for multi-touch tabletops, the simplistic multi-user interaction genre holds the greatest gameplay value. A game that brings multiple people together and envelopes them in cooperative or competitive gameplay brings the social aspect to it. And with the social aspect, comes communities and interests that go beyond the game itself. This is based on research, interviews and prototype workshops.

The last question I asked was “*Multi-touch gaming provides all the input/output you need with the screen and multi-touch tracking technology. How does the current control standards and user interfaces from PCs and consoles transfer to multi-touch tabletops?*”. For multi-touch tabletop games, if the game uses interactive user interface elements, these should all be configurable by the player in the form of moving, rotating and or scaling. Using gestural controls where it is appropriate to use them, may create a more enjoyable experience for the player over normal menu interaction, but players become more immersed in the game when using a direct manipulation interface. For the multi-user interaction genre, the user interface should have boundaries that indicate the location and area of interaction for each player. This is based on research and prototype workshops.

## 9. Future work

Our world revolves around time and how it affects us. My time on this thesis ran out too quick, and there is still so much I would have enjoyed to research and prototype. First off I wanted to research the last of the most popular game genres, FPS (First person shooter), Driving, TD (Tower Defense) and the multi-user genre we are starting to see with multi-touch tabletop games.

I would have liked to finish my 3rd game which is a duplication of popper, but instead of popping the bubbles, you have to split the bubbles, by pressing 2 fingers on a bubble and dragging it apart, into smaller and smaller pieces, until finally they pop. This game was designed and prototyped specifically with multi-touch gestures in mind. I would have loved to have time to finish the bugs and have a workshop for this game to see how it holds out as a high-fidelity multi-user prototype.

I love my Hack'n'Touch and popper, but I am sure another 50hours work on Hack'n'Touch could have turned it into a completely different, more polished game, with fine-tuned algorithms for spell casting, better graphics for everything from textures to spell effects. Add physics to the game, to have better movement around edges and collision detection when bumping into monsters. Implement better level changing mechanics and further more implement different types of monsters to battle. I would add information on spells and create, by workshop feedback, a cooldown system on the hotbar to signify cooldown for each spell.

I would have loved to have the time to try out one of my big to-do this year, which is the creation of a thin fabric glove with some fiducial markings on each finger. This glove, with good tracking hardware, software and implementation could support multi-user the same way DiamondTouch does with currents.

With the gloves, I would have loved to implement another character to Hack'n'Touch, with the camera between and above them. This would remove the biggest problem with multiplayer in Hack'n'Touch and any other RPGs.

Popper is pretty much a done game at this point, but like I wrote in the prototype chapter, I would have liked to have the time to listen to my beta testers and fix the issues that were

frustrating. Set a min distance between bubbles, number them in order to easier track which bubble will pop next and create some nice art for the highscore list. Beta testers also would love some sound and or music, and I would have wanted to implement this as well.

How we control a character in any game where you have a character is essential in how well you enjoy the game. If time had permitted it, I would have looked into different gestures or methods of simulating a right click by the mouse. And with a right click by the mouse, I mean a second standard command. While at this, I would also have researched the possibility of multiple detectable differences in common intuitive gestures to support more standard commands. Imagine the kinds of games we could build for the multi-touch devices if we had 4 of these different touches to simulate 4 different core commands.

The final thing I have wanted to do since I started this thesis was to collaborate with a cognitive psychologist to see how gamers think differently when playing with their hands instead of their mouse and keyboard / console. This would be interesting in evaluating how to create new gestures that would be game/genre specific and increase the flow of the gameplay.

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# APENDIX A

## Interviews

**Interview with Olav "Creolophus" Undheim - 2007 WCG (World Cyber Games) Winner Warcraft 3: Frozen throne [ questions about RTS ( WC3 ) and RPGs for Multi-touch ]**

**Hello Olav, thank you for taking the time to participate in this interview. Can you tell us a little about your gaming background?**

Hi! I am currently 24 old years and do not play as much games as I used to, but in the past I have played quite a bit. Up to the age of 16-17 I used to play quite a lot of different genres, but from the age of 17 to 22 I focused on the real time strategy game Warcraft 3, and I also spent a year playing professionally for a British organization.

**Can you tell us about your experience with multi-touch devices and tables?**

I do not have much experience with multi-touch devices. I own an Iphone, but only with a few games. I have seen "my game", Warcraft 3, being played on a multi-touch table, which have given me some ideas of how it might look in practice, ref:

<http://www.youtube.com/watch?v=KtKkOhMqVhY>

**Imagine playing an RTS game like Warcraft 3 with your hands instead of your mouse and keyboard; what do you feel would be the most difficult aspects of the gameplay? And what changes to the game would you make to better suit hand gestures and touches?**

RTS games have a speed element in them, which will be the most important functionality which a multi-touch device should support. That means to be able to use both hands in combination with a lot amount of time (or "clicks") to perform any action. As an example, there needs to be support for building units from hotkeyed buildings, so that you can build units during a fight. Possible ways to implement it may be to assign a hand gesture to a hotkeyed group (units or buildings), or for instance to have groups on the left margin of the screen and the actions the units/buildings can perform at the right margin of the screen.

**What is your favourite RPG game, and what do you feel makes it work so well for the PC?**

My favourite RPG is Diable 2, which I used to play with a group of friends. It is an easy game to get started with. Once you have learnt how to move around and attack, you already know enough to have fun. I would argue it is especially well suited for a PC because of the mouse, which is important when moving and aiming your attacks. It is very easy to do something like turning 180 degrees, which on console games often takes a lot more time.

**Imagine playing that RPG game with your hands instead of your mouse and keyboard; what do you feel would be the most difficult aspects of the gameplay? and what changes to the game would you make to better suit hand gestures and touches?**

With a multi-touch device the most important thing to focus on would be movement and aiming, which as I said before is important in this game. I think it would be nice to use one hand to point where you are moving, perhaps one finger for walking and two for running, and the other hand for aiming shots, such as shooting arrows. Different attacks could be achieved by using different gestures or amount of fingers on the screen. I could see a problem with this type of game on a small screen, as you want to be far enough away (bird perspective) to discover enemies from a distance.

**As the technology is today, tables come in every dimension and with as low as 7ms touch delay; is the technology good enough to support gaming?**

I think the technology on the tables will not be prevent good games from being produced. 7ms is very good for most uses, and for games such as RTS the major obstacle is still the network latency and not the screen. The same can be said about RPGs, while FPS games might be the most demanding. As said before, some games might have problems if they are not designed for a small screen, or they need to be exclusively developed for the tables of a certain minimum size.

**What game genre do you think would fit best for a multi-touch device, and why?**

I actually think RPGs would be a good fit, but I would love to see a good attempt at developing an RTS game as well.

**Thank you again for your time Olav.**

**[ /Creolophus ]**

**Interview with Patrick "ScreaM" Roth - Former CPL participant in Counter Strike  
[ questions about FPS ( CS ) and MMORPG ( WOW ) and Multi-Touch ]**

**Magnus: Hello Patrick, thank you for taking the time to participate in this interview. Can we start off with some background from your gaming career?**

Patrick: Hi, I'm Patrick 25 years old and going by the nick ScreaM in gaming. I am a former CS pro back in 2000-2003 and started to play wow after that hardcore.

**Magnus: Do you have any experience with with multi-touch devices and tables?**

Patrick: The only experience I have with that is from my HTC phone which is pretty neat.

**Magnus: In your professional opinion, does competitive FPS gaming work best with mouse and keyboard on a computer, or with your hands on a multi-touch device?**

Patrick: When it comes to FPS games, there is nothing that can compete with a good mouse and a good keyboard. You could maybe do some imba haxx stuff that reads your thoughts and with brain power interacting with your character

**Magnus: so, in short, its the responsive nature of the mouse and keyboard that makes FPS better suited for a computer?**

Patrick: Yes it's a more precise using a mouse to aim with and those delicate moves you need to do sometimes in high level play which I don't think you can perform with a touch screen today. It also feels more comfortable to aim with a mouse than with a touch pad in long sessions of gaming.

**Magnus: Does multi-touch FPS gaming have a higher entertainment value then PC / console gaming?**

Patrick: I think that multi touch have a high potential to develop to something really cool, but for FPS games now id say its about the same as playing on a console. However a touch screen should offer much more precision than a joypad if you aim with your finger rather than with some steering stick on a joypad. And of course on a touch screen you could choose to add a steering stick to the screen and use. which you can not do with console joypads

**Magnus: For future multi-touch table generations, how would you suggest them to change weapons in a FPS game?**

Patrick: Maybe having a scroll type of button which you can scroll between weapons back and forth. Alternative is that you have a dedicated next/previous weapon button somewhere placed on the screen. You could prolly bind the volume buttons to function like that too if you want.

**Magnus: Moving on to your experience with Massively Multi player Online Role Playing Games, do you believe an MMORPG would hold a good gaming experience on a multi-touch table?**

Patrick: Yes I do believe a MMO would work just as great on a multi touch as with a mouse and keyboard. They are usually slower and dont require the same accuracy. I enjoy some RPG games myself on my phone so. Give it some more time and it will be really great I think. You can even have fun features with touch screens as you wont have with mouse / keyboard which could spice it up a bit.

**Magnus: What game genre do you think would fit best for a multi-touch device?**

Patrick: RPG games definatly, you can sink in to a nice story and do a lot of clever stuff which the developers can come up with. Combining that with the options a multi-touch can give you to interact with the game it just becomes really fun. also MMORPG, platform games and TD (Tower Defense)

**Magnus: Thank you again for your time Patrick.**

Patrick: Thanks you and no problem Mangel!  
[/ScreaM]

**Interview with Haza1nO - Former Australian Pro Evolution Soccer 6 Champion  
[ questions about Soccer games, MMORPG ( Ultima Online ) and Multi-Touch ]**

**Hello Haza1nO, thank you for taking the time to participate in this interview.**

**What makes soccer games work so well on a console?**

Freedom, comfort and control over more particular parts of the game.. like dribbling ... major advantage on the console as apposed to the keyboard

**What is the most difficult aspect of the gameplay on a console?**

having to press multi buttons in order to achieve a specific movement in the game. multiple buttons I should say

**Imagine playing an soccer game like PES with your hands instead of your controller; what do you feel would be**

E



**the most difficult aspects of the gameplay? And what changes to the game would you make to better suit hand gestures and touches?**

\*\*\*\* I dont know man. hard question lol

**What game genre do you think would fit best for a multi-touch device, and why?**

MMORPG, Ultima Online on the IPAD

**how would you want to play uo on an iPod? how would you want to issue a move command, and how would you issue a attack command?**

everyone would need to be only on their iPod to make it even. you would have all nessesary spells on the right of the screen. you touch to where you want him to ride and click where to attack and start using spells with a button saying attack last.. like macros down the button, setting your attack last with the same move command

**also, why the right side of the screen? ^^**

because thats where I want it \*\*\*\*

**Thank you for your time Haza1nO**

[/Haza1nO]

**Interview with Hubert "Net" Thieblot - CEO and founder of Curse.com**

**[ questions about MMORPG, Multi-touch and gaming for Multi-touch ]**

**Hello Hubert, thank you for taking the time to participate in this interview. Can you start us off with a short introduction to your gaming background?**

Hi, I am 26 years old, and have been playing games since the age of 6, every type of genre on every type of console.

**What experience do you have with multi-touch devices and tables?**

I own an iPhone and iPad, with many games on the iPad.

**What games do you enjoy the most on the iPad? And why?**

I enjoy FPS and driving games, mostly doom for the iPad, the touch feel on a game is what makes a touch game good. I also enjoy the MMORPG: Order and chaos, but the genre still has a way to go before it feels like it belongs on the iPad.

**Imagine playing an MMORPG game like World of Warcraft with your hands instead of your mouse and keyboard; what do you feel would be the most difficult aspects of the gameplay? And what changes to the game would you make to better suit hand gestures and touches?**

A 2D mmo might be better, less complex, less movement, so less fuss with controls.

**Multi-touch technology is getting better and better, today we have screens of every dimension with as low as 7ms touch delay; how responsive would the tables have to be before competitive gaming could take place?**

iPad latency is good enough, but it is the UI that is too hard to use, maybe more like an action rpg, god of war or hard rain. Controls are the frustration and ruin the gameplay.

**Being the CEO and founder of curse.com, a service loved and treasured by gamers world wide, could multi-touch gaming catch the attention of your company and the services it provides?**

When the games get more complex so curse can add to the value with a community, we will definitely put up a page for it.

**What game genre do you think would fit best for a multi-touch device, and why?**

FPS fits well because of easy controls with a d-pad

Driving games for the iPad is really good, but I don't like the accelerometer.

The mmo, rpg genres are harder to play since there is more to do.

Action RPG easier then MMORPG, because of the simplicity in the action RPG genre.

**Thank you again for your time Hubert.**

[ /Net ]

# User Surveys

## Multi-Touch And Games

Thank you for taking time to fill out this user survey!

**Please read:**

Multi-touch technology allows for multiple touches to coherently play a part in how you interact with your application and games, each finger on the screen is translated into a separate mouse type command.

**1. What is your Nick / real name?**

**2. What is your age?**

- 15 - 19
- 20 - 24
- 25 - 29
- 30 - 35
- 35 - >

**3. What type of gamer are you?**

- I don't play games (0h/week)
- Casual Gamer (1-5h/week)
- Moderate Gamer (6-21h/week)
- Hardcore Gamer (more than 22h/week)

**4. How well do you know what it's like to play games on the multi-touch technology?**

- Not at all
- Some
- Moderate
- Well
- Very Well

**5. What type of games do you usually play?**

- Board Game ([Jigsaw Puzzle](#), [Ludo](#))
- First Person Shooter ([Half Life](#), [Counter Strike](#), [Battlefield](#), [Unreal](#))
- Role Playing / Adventure ([Diablo](#), [Final Fantasy](#), [Baldur's Gate](#), [Neverwinter Nights](#))
- Strategy ([Warcraft](#), [Starcraft](#), [Command & Conquer](#), [Civilization](#))
- Other (Please Specify)

**Please read:**

Consider that for a touch to register and for an action to register on the multi-touch screen, there is a 1/5th of a second (200ms) delay. A mouse on a regular computer has roughly 1/100th of a second (1ms) delay.

**6. What genre would you most like to play on a multi-touch screen?**

- Board Game ([Jigsaw Puzzle](#), [Ludo](#))

- First Person Shooter ([Half Life](#), [Counter Strike](#), [Battlefield](#), [Unreal](#))
- Role Playing / Adventure ([Diablo](#), [Final Fantasy](#), [Baldur's Gate](#), [Neverwinter Nights](#))
- Strategy ([Warcraft](#), [Starcraft](#), [Command & Conquer](#), [Civilization](#))
- Other (Please Specify)

**Please read:**

Consider your answer to question 6 while answering these following questions.  
Also consider that this survey is about how to play games on a multi-touch screen.

7. **Considering your answer to question 6: How important would it be to play against, or together with someone, on a separate multi-touch screen?**
  - Not Important
  - No Preference
  - Important
  - Very Important
8. **Considering your answer to question 6: How important would it be to play against, or together with someone, on the same multi-touch screen?**
  - Not Important
  - No Preference
  - Important
  - Very Important
9. **Considering your answer to question 6: How important would it be to be able to login and keep track of your game history with score and stats?**
  - Not Important
  - No Preference
  - Important
  - Very Important
10. **Considering your answer to question 6: What type of game play would you prefer to play?**
  - Turn-Based
  - Slow Speed
  - Normal Speed
  - Fast Speed
  - Ultra Fast Speed
11. **Considering your answer to question 6: How important would it be to play a game in full 3D graphics with lots of cool explosions rather than the same game in 2D graphics?**
  - Not Important
  - No Preference
  - Important
  - Very Important
12. **Considering your answer to question 6: To what degree should sound matter in such a game?**

- Not Important
- No Preference
- Some
- A lot

Thank you very much for taking the time to help me develop libraries and articles about games on the multi-touch technology!

## Multi-Touch Technology And Board Games

Thank You For Taking Time To Fill Out This User Survey!

**Please read:**

This is a user survey about how to play Boardgames ([Jigsaw Puzzle](#), [Ludo](#)) on a multi-touch screen.

1. **What is your nick / real name?**

2. **How important would it be to be able to....**

	Wouldn't like it	Not important	No preference	Important	Very Important
.... choose difficulty settings ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... have a countdown timer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... move the camera around?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... zoom in and out?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... login and have a highscore and statistics?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... pause the game?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... have an undo / redo function?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... save and load?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. **In a jigsaw puzzle, how would you like the pieces to be organized as you start the game?**

- Randomly rotated, all in a bunch
- Randomy rotated, well organized
- Every piece the right way up, all in a bunch
- Every piece the right way up, well organized
- Some other way

4. **In a jigsaw puzzle, would you like a pieces to stick to the right position once you placed it where it should go?**

- Yes
- No preference
- No
- Some other way

5. **In any board game, how would you want competitive play to be played?**

- Play versus eachother on separate screens, and have them linked, so that the screens announce the winner

- Play on the samescreen, and split the area so that one play on the right side and one on the left side and have the screen announce the winner
- I would just want to play alone!
- I wouldn't like the option to play competitive, but rather with someone else on the same puzzle
- Some other thought

6. Any other suggestions to how you should play a board game on the multi-touch technology?

Thank you very much for taking the time to help me develop libraries and articles about games on the multi-touch technology!

## Multi-Touch Technology And Role Playing Adventure Games

Thank You For Taking Time To Fill Out This User Survey!

**Please read:**

This is a user survey about how to play Role playing / Adventure games ([Diablo](#), [Final Fantasy](#), [Baldur's Gate](#), [Neverwinter Nights](#)) on a multi-touch screen.

1. What is your nick / real name?

2. How important would it be to be able to....

	Wouldn't like it	Not important	No preference	Important	Very Important
.... move your character?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... level up?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... pan the camera around your character?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... put attribute points into stats and improve your spells?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... select the opponents unit to attack?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... have more then 1 spell?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... use hand weapons, like swords and axes, as well as spells?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... loot armor / weapons and other stuff off slain monsters?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... use potions and bandages to increase your health and mana?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... zoom in and out?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... watch a replay after your current game?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... have the option to queue actions?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... save and load?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. How would you like to move your character?

- I want to single click on the screen to have the character move there
- I want the character to be static on the playfield until all monsters are dead, then be teleported to the next level
- I want the character to move automatically
- I want to drag the character with my hand

- I want to have "up,left,down and right" buttons somewhere on the screen to use as a keyboard to move the character
- I want to click on the character to toggle moving and have the character to move after my finger as the finger moves around the screen
- I want to double tap the multi-touch screen and have the character move there
- Some other way

**4. How would you like to shoot spells / abilities (like fireballs, lightning or frostbolts) ?**

- Single click on the screen to have the character shoot in that direction
- Double click on the screen to have the character shoot in that direction
- Use different gestures on the screen to cast different spells to the target location ( drawing a circle on the screen might indicate shooting a fireball to that location, while a straight line might indicate a lightning bolt)
- Drag from the character to the target location to have your character shoot in that direction
- Click on a spell icon somewhere on the screen to activate shooting that spell, then click once somewhere on the screen to shoot there, then you would have to click your spell button again to use that spell
- Only be able to shoot by clicking on an enemy on the screen and have the spell or ability automatically seek out the enemy
- Some other way

**5. How should the town be like? ( a town would be a place where you could sell items and buy new ones, as well as train spells and abilities )**

- I wouldn't like a town
- I would like it to be a small place with just the 1 shop where you could do everything
- I want the full Roleplaying game feeling and have a huge area where you could explore the different areas of the city and talk gossip with alot of shop owners aswell as alot of side quests and useless shop items
- I want something in between option 2 and 3
- Some other way

**6. Any other suggestions to how you should play a role playing / adventure game on the multi-touch technology?**

Thank you very much for taking the time to help me develop libraries and articles about games on the multi-touch technology!

## Multi-Touch Technology And Strategy Games

Thank You For Taking Time To Fill Out This User Survey!

**Please read:**

This is a user survey about how to play Strategy games ([Warcraft](#), [Starcraft](#), [Command & Conquer](#), [Civilization](#)) on a multi-touch screen.

**1. What is your nick / real name?**

**2. How important would it be to be able to....**

	Wouldn't like it	Not important	No preference	Important	Very Important
.... control every single one of your units?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... select an area to mark several units?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

.... build buildings and control each of them?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... select an area to mark several buildings?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... select the opponents unit to attack?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... have control groups for groups of units?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... control the game speed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... zoom in and out?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... watch a replay after your current game?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... have the option to queue actions?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.... save and load?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**3. How would you like to move the camera around the game map?**

- I want to be able to see the whole map at all times
- Drag the screen with the palm of your hand
- Have a minimap to click on
- Have a camera button somewhere on the screen to toggle moving the camera
- Some other way

**4. How would you like to select units?**

- Mark an area around the unit
- Single click with 1 finger
- Double click the unit with 1 finger
- Some other way

**5. How would you want to select multiple units?**

- Like with the mouse, press 1 finger on the playfield and drag and release to mark an area
- Use 2 fingers at opposite sides of a rectangle to mark that area
- Draw a circle around the area you wish to mark
- Some other way

**6. How would you want to move your units after you have them selected?**

- Double click with 1 finger on the screen to move units there
- Use 1 finger on the screen to move the units there (this will make it difficult to cancel your current selection)
- Use 2 fingers at the same time to simulate a right click from a mouse
- Click an icon somewhere on the screen to activate the move function (like in normal RTS games) and then click on the playfield to move
- Someway else

**7. After you have selected your units, how do you want to command them to attack something?**

- Same as moving your units, but clicking on enemy forces instead of the play field
- Single click the unit with 1 finger
- Double click the unit with 1 finger
- Click an icon somewhere on the screen to activate the attack function and then click on the enemy unit to attack

Some other way

**8. If you enjoy hotkeys for grouping several units, how would you like them to work?**

I don't want hotkeys for grouping units

Have buttons at the bottom of the screen you can single click to add units to the button, and double click to target all units in the group

After a group of units has been made, click a button somewhere on the screen to create a custom icon I can move around the screen, and when I click it, I get target of my group again

After a group of units has been made, use a gesture to create a custom icon I can move around the screen, and when I click it, I get target of my group again

Something else

**9. How do you want to build buildings?**

Target a worker, instantly get an overlay with building options, select a building, and select the area to build on the playfield

Target a worker, instantly get an overlay with building options, select a building and have it built where the worker is

Have a menu for buildings somewhere on the screen you can chose buildings from, and place it on the playfield, the closest worker will come and construct

Target a worker and use a gesture on the playfield to have a building constructed there

Some other way

**10. How do you want to build units?**

Have 1 building for ONE unit type, single click the building, and click on an overlay to create the unit

Have 1 building for MANY unit types, single click the building, and click on an overlay to create the unit you wish to create

Have 1 building for ONE unit type, double click the building to make a unit

Have a menu somewhere on the screen with all the units, click on the unit to create a unit at a available building for that unit

Some other way

**11. Any other suggestions to how you should play a strategy game on the multi-touch technology?**



Thank you very much for taking the time to help me develop libraries and articles about games on the multi-touch technology!





