

SOLVING THE PROBLEM  
OF PROBLEM SOLVING

# Solving the Problem of Problem Solving

MFA Exhibition + Written Component  
by: Joshua Wilson



**Art+Art History  
Department**

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# | Foreword

“Joshua Wilson is important to gaming. He is the wave of future game designers whose impact is felt in the fields of research and entertainment. The future game designer understands game usability and design to communicate with the player. They are able to anticipate how the player reacts to interactive stimuli. They control the narrative through open worlds. They are prepared to further the game design field through research in interdisciplinary fields. The game designer has the capacity to self-express through the use of art and technology. They are able to manipulate games through the visual, the spacial, and the interactive. They develop a connection with the user. They manipulate and expand. They adjust to all forms of technology. They are artist of the 21st century in a medium that is rapidly maturing. Joshua Wilson is a game designer.”

-Professor Ho

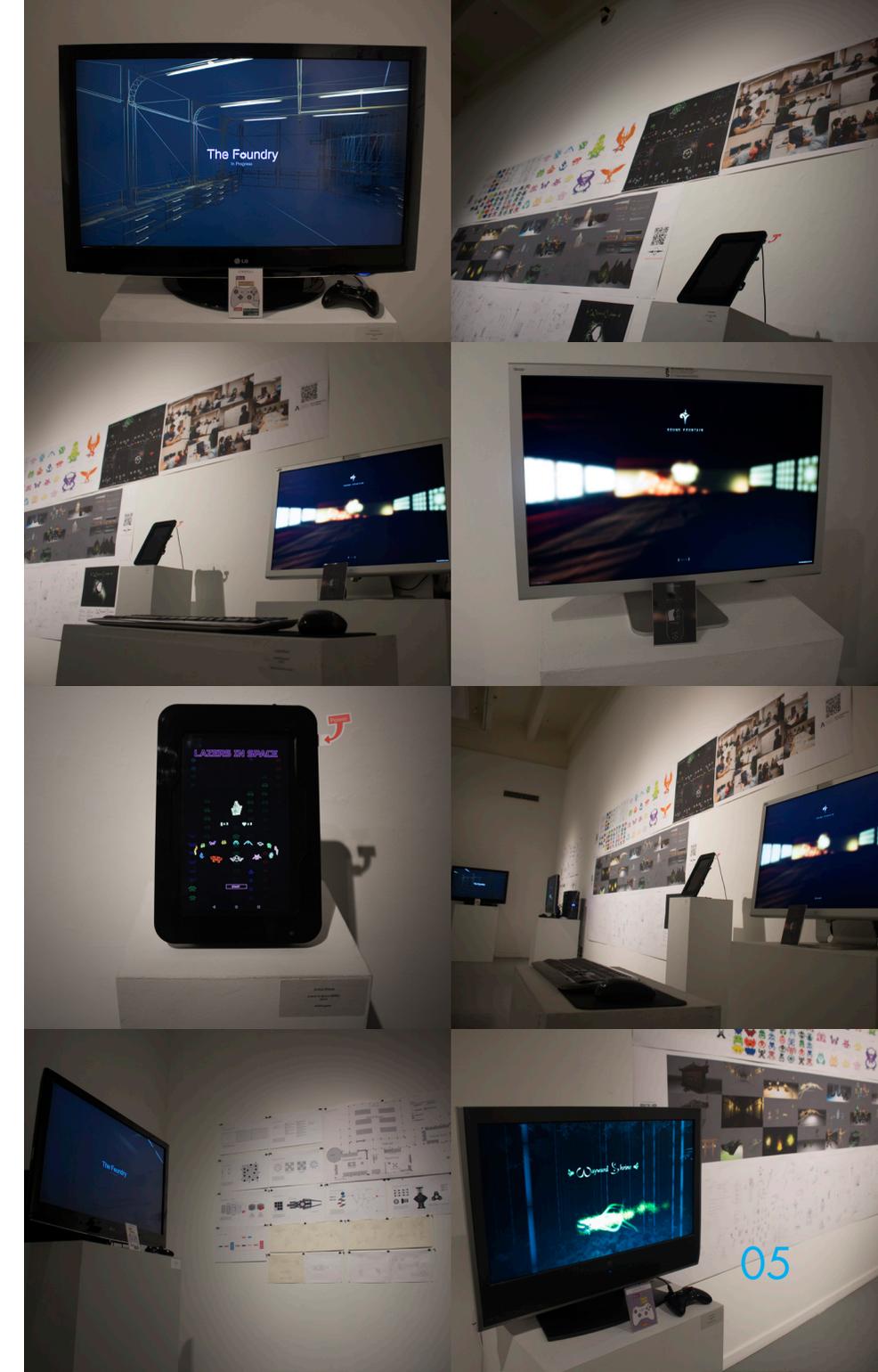
## | Artist Statement

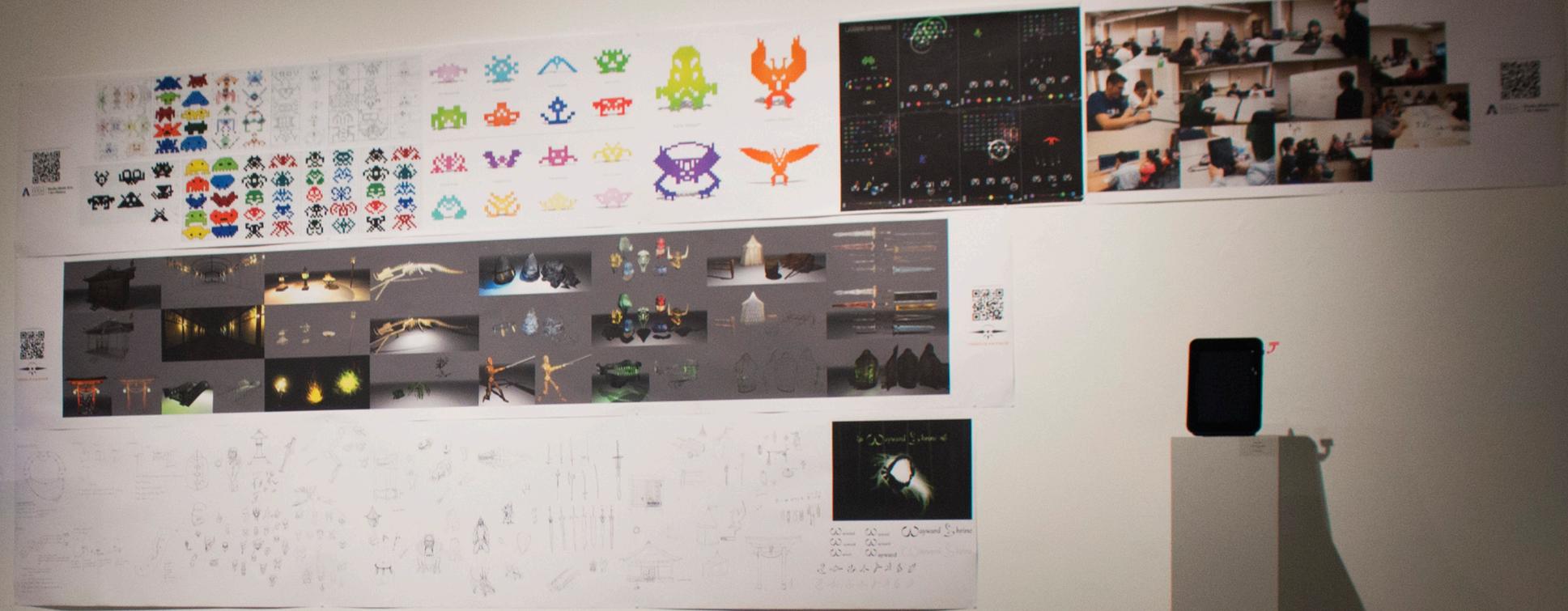
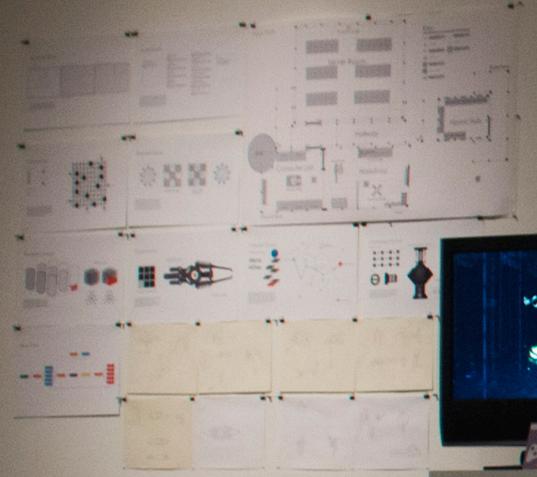
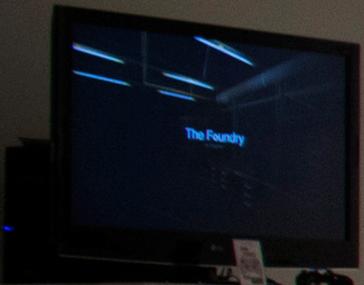
As a child, I woke up early just to play games before heading off to school. Their immersive worlds, high levels of interactivity and complex stories continue to captivate me even today. I excelled at programming in high school and discovered art at the beginning of college. Discovering a way to use both of these disciplines drew me to game design. Trying to understand the intricate nature of a multifaceted field has kept me in love with my work. I study the interaction of logistics between game mechanisms and their effects on the player experience. I enjoy the challenge that comes from empathizing with the player and taking on multiple perspectives when tackling a project. All the while, I'm balancing every level of interaction to achieve the perfect formula of difficulty and reward, intuition and creativity, and immersion and sociability to craft an experience not easily forgotten.

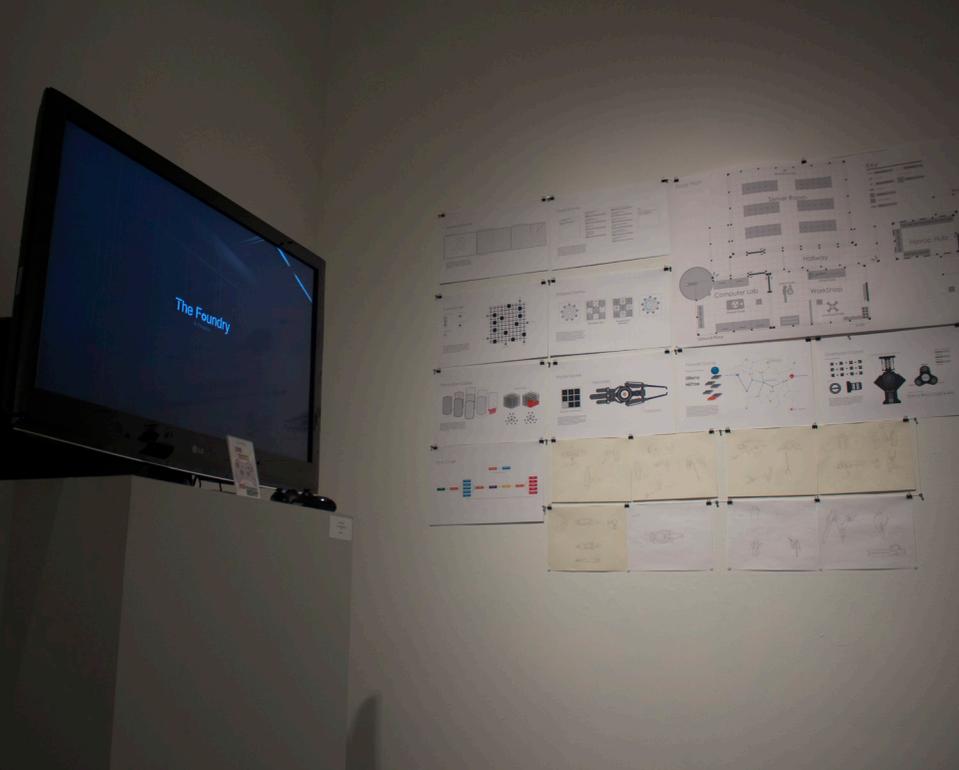
## MFA Exhibition

My thesis is a culmination of research conducted during my graduate career. To present this narrative are three milestone projects that embody the wide range of experimentation in technique, art style, and functionality. My first ever project in graduate school was titled Sound Fountain. Developing this three dimensional sound visualizer, I studied the user's immersion in a virtual space and the relationship between an interactive world and sound. Next was my first encounter with storytelling in a piece titled Wayward Shrine. Crafting this visual storytelling narrative, I researched the attributes of between different narrative mediums and how to indirectly lead a user's subconscious through a three dimensional world. Lastly, is a project that I did with a group of high school students over the summer called Lazars in Space. When creating this game, I learned about the mobile platforms and how to tailor interactivity for touch screen devices.

Each project presented me with new unique challenges to overcome, problems to solve. This is by my design. Whenever I decide on a new project, I gravitate towards styles, genres, and mechanics I've never done before. The main reason I'm addicted to interactive scene, simulation and game design is the variety. I can be drawing up concepts one month, 3D modeling another, and programming the next. I like being about to work in different forms and fashion, but I'm even more addicted to the concept behind all of that variety. I'm creating a virtual world. A world needs multiple disciples to come together. Everything I've ever learn can be applied in a practical sense when crafting that virtual world. There is no useless data, everything I've learned in school or on my own is important. Different schools of thought like art, programming, psychology, physics, and literature start to blend together and I find it difficult to imagine learning one without the others.







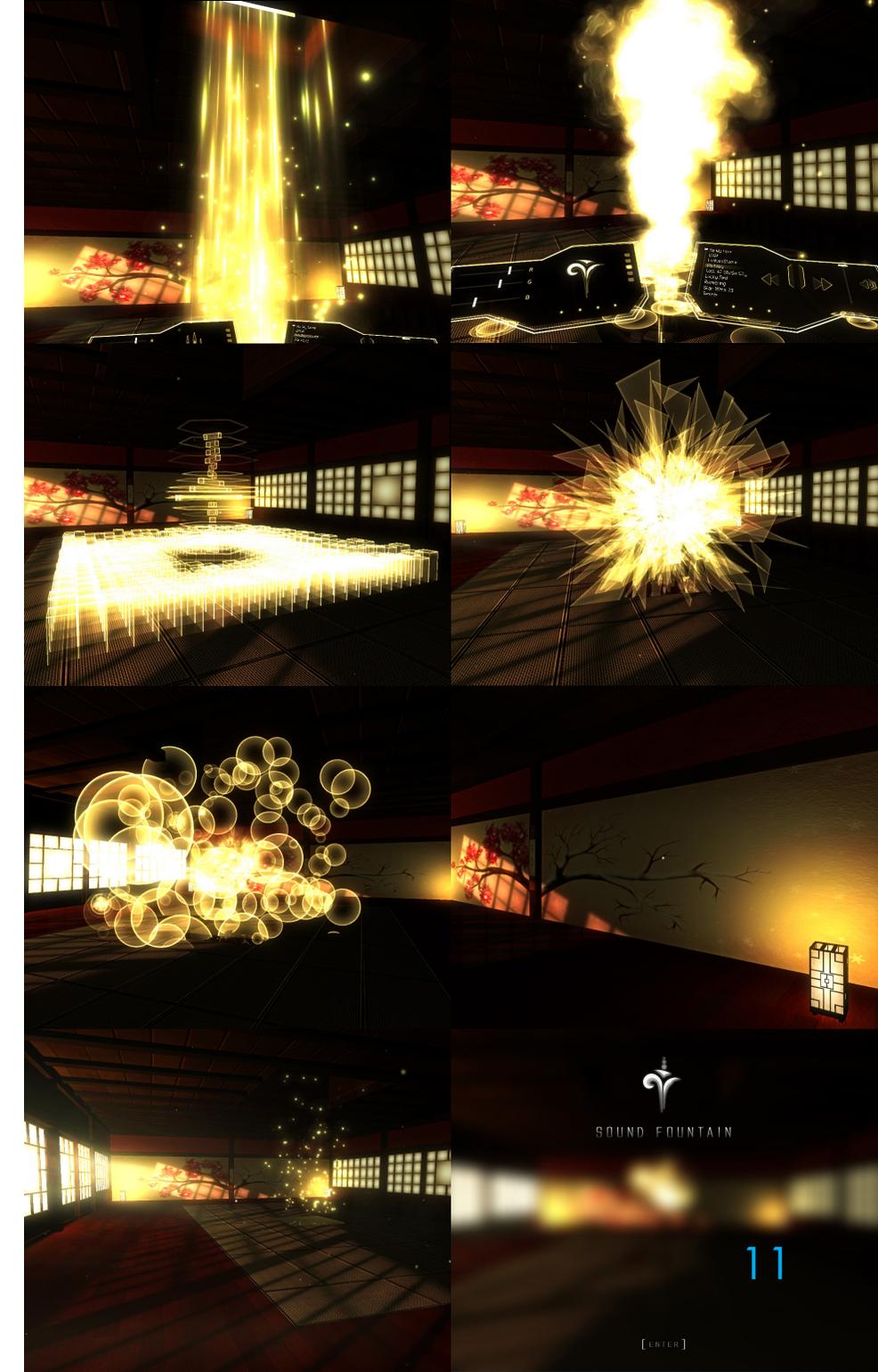
# Sound Fountain

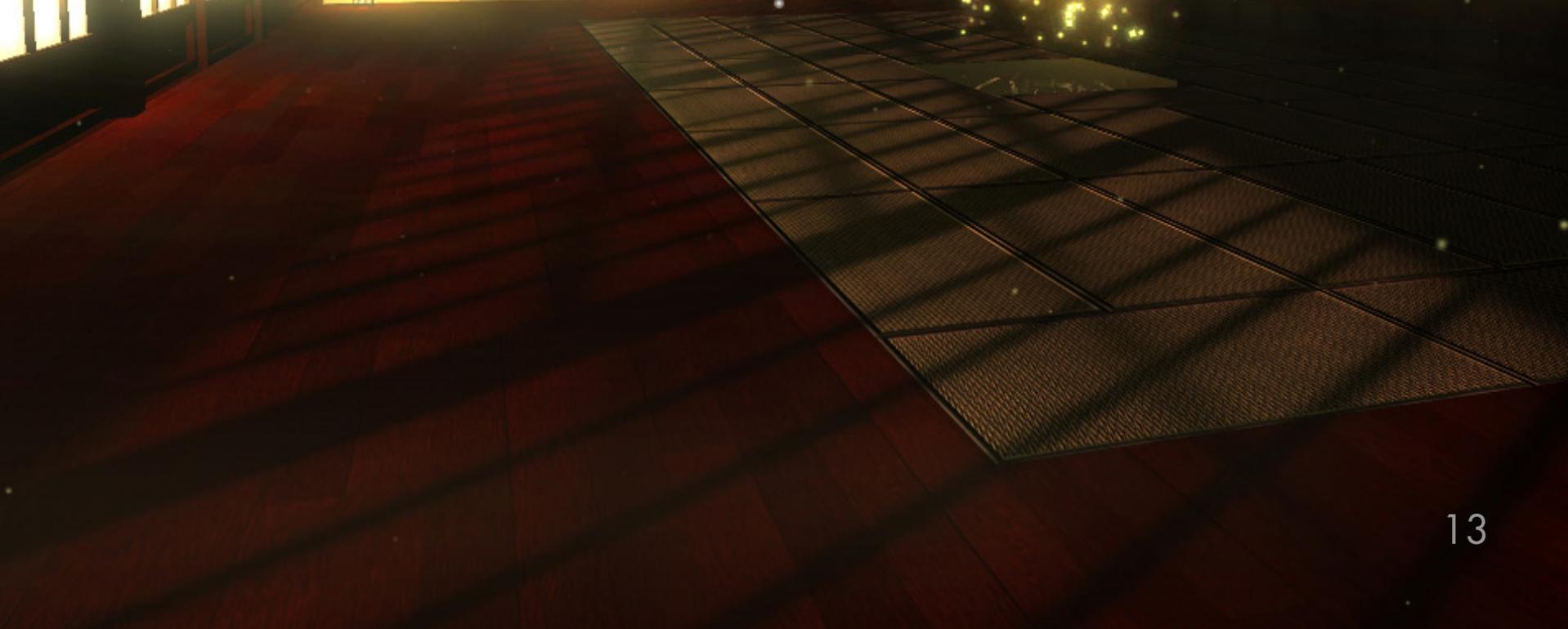
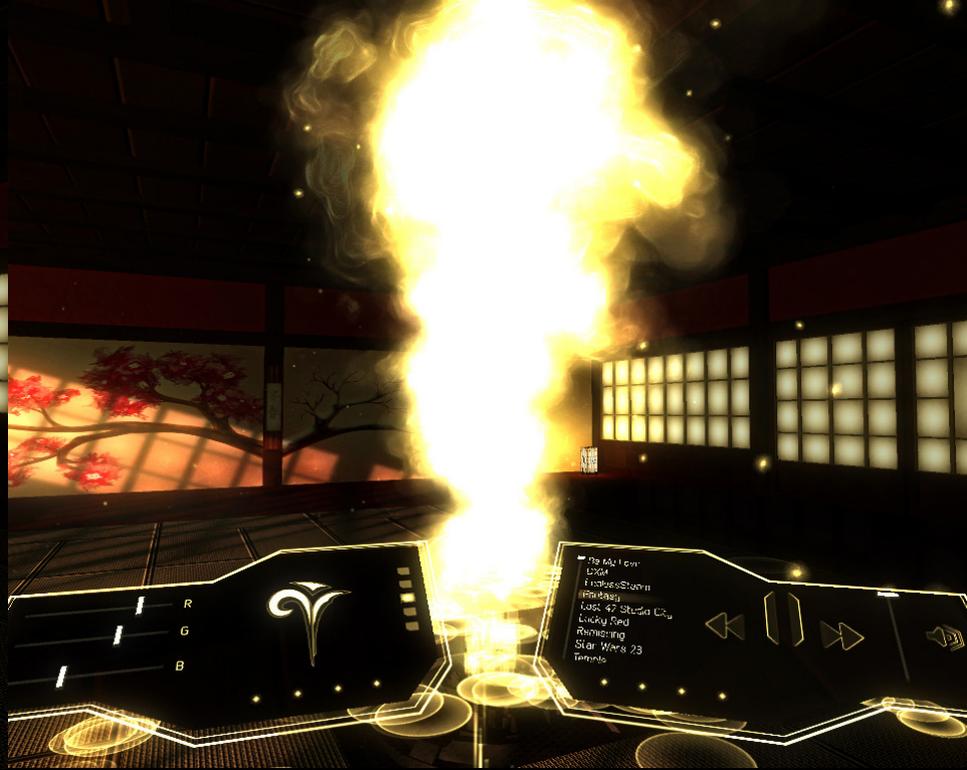
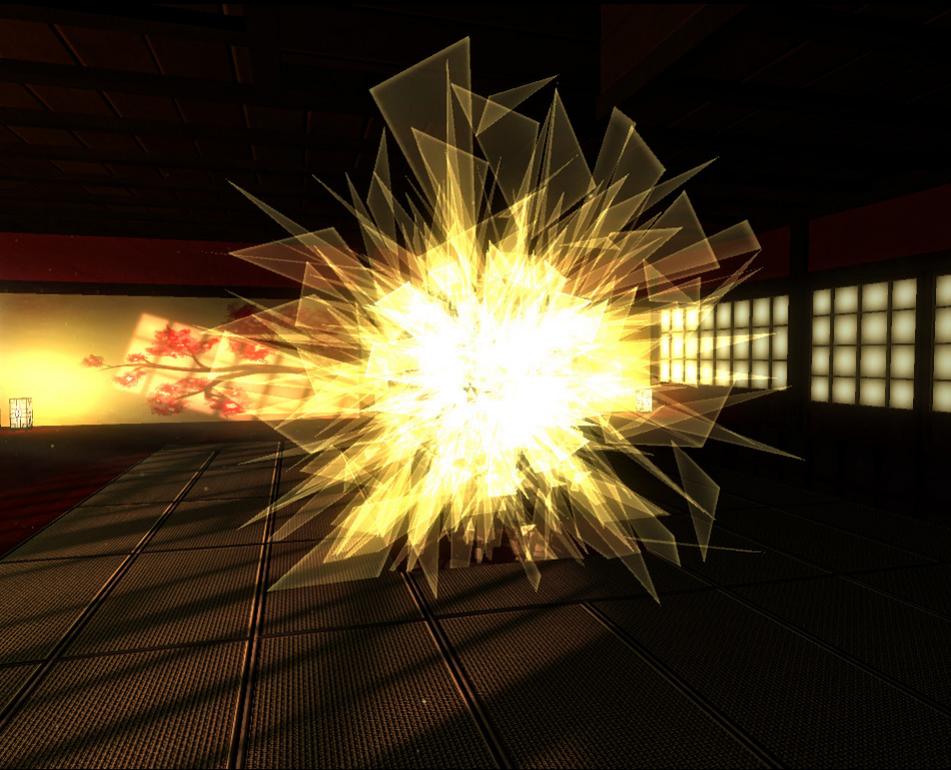
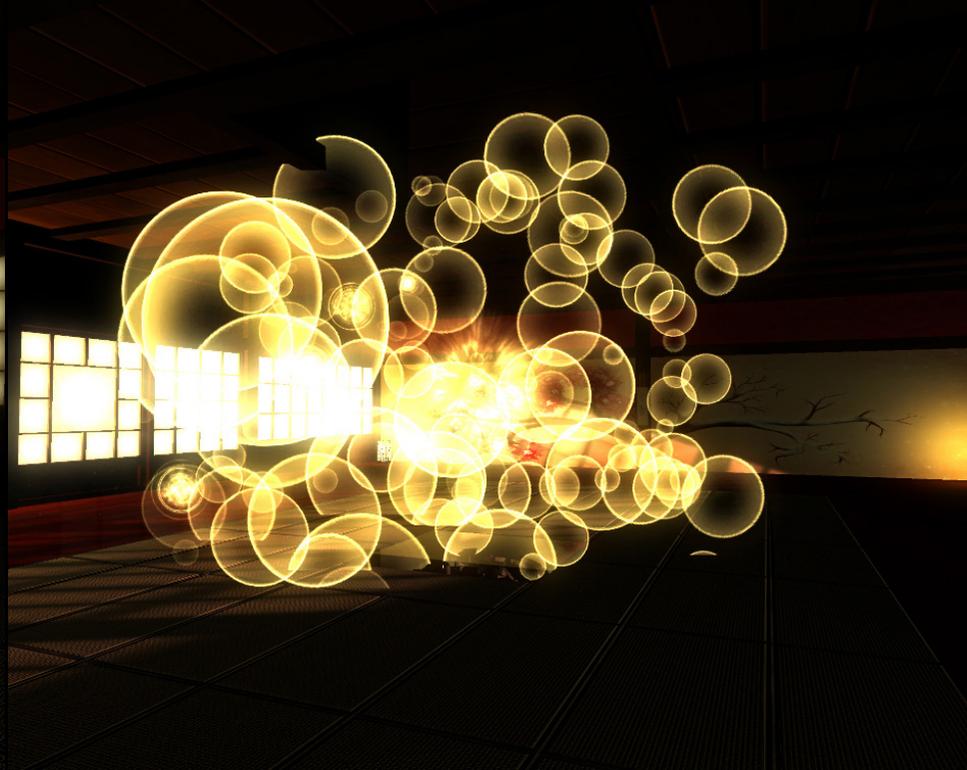
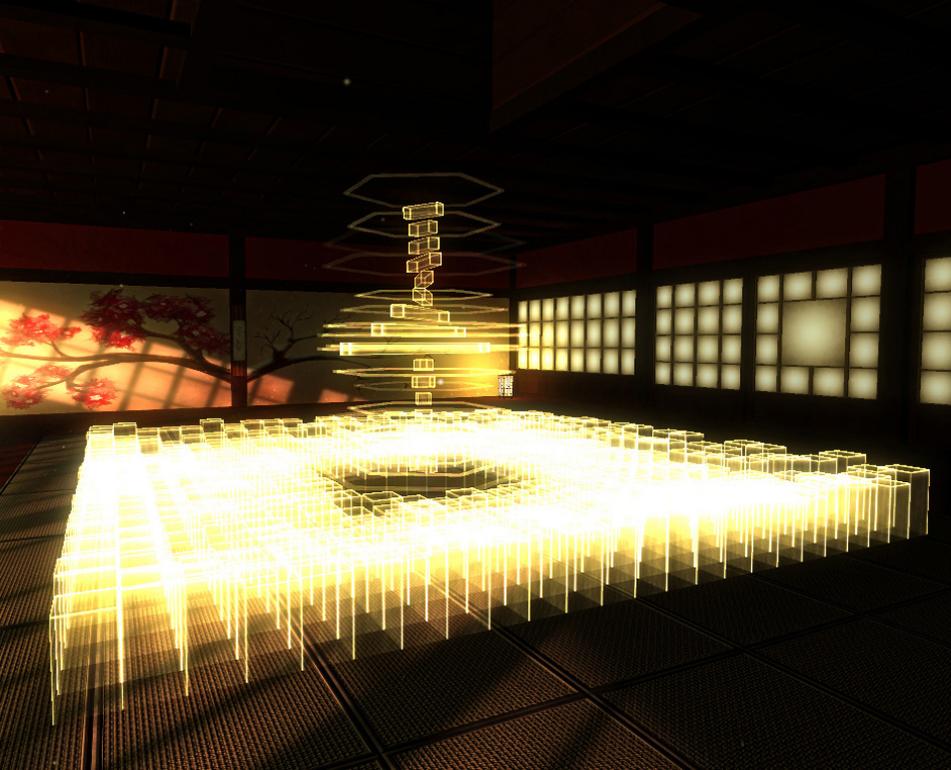
3D Sound Visualizer

2012

Sam Garner was an undergraduate musician at the University of Texas at Arlington who had helped out with compositions for several games. When he asked me to make some sort of interactive sound portfolio, I thought it was the perfect chance to experiment. Music tends to be a supportive art form that simulates thinking in our everyday lives. We listen to music when we drive our cars, work on projects, study for tests, and at social gatherings. Creating music videos or sound visualizers provide visuals that focus the audience's attention solely on the music.

Integrating interactivity into a sound portfolio can be a double edge sword. Interactivity enhances the user's involvement, increasing focus. But if the interactivity isn't directly addressing the sound, the focus can shift to the interaction itself and the sound can become background noise. Immersion is what happens when the user's focus is drawn into the virtual space through interactivity. The user's sense of space transitions from the real world to the virtual. Many different aspects of a virtual space can decrease the depth of immersion, such as glitches, level of detail, unrealistic behavior, and user interfaces. User interfaces are two dimensional screens the interrupt the three dimensional world, allowing the player to control various settings related to that world. This interruption reminds the user that they are not really inside this virtual space. That is why all user interfaces are built into the virtual space. Users can change the music and the adjacent particle system by interacting with the console in three dimensional space. These controls tailor the three dimensional sound visualizer to each user's personal preference.





# Wayward Shrine

Visual Story Telling

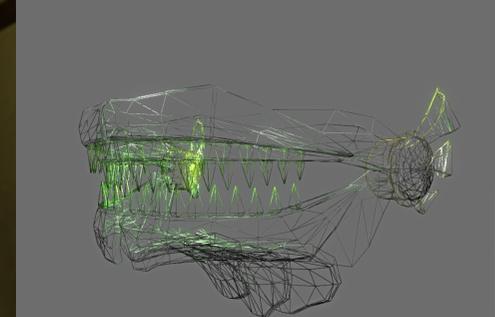
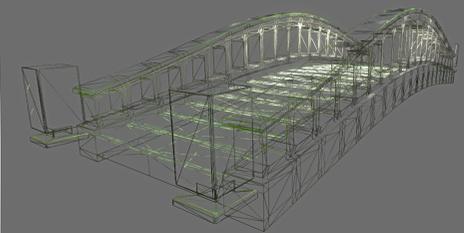
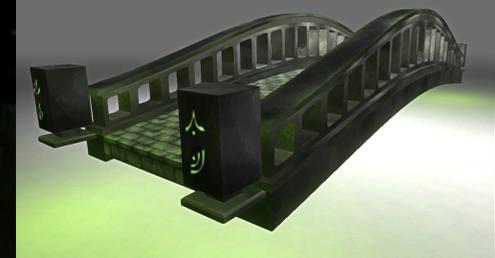
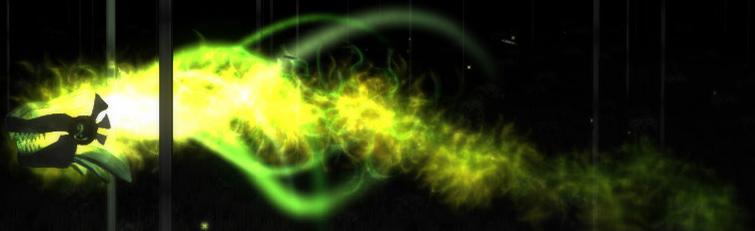
2014

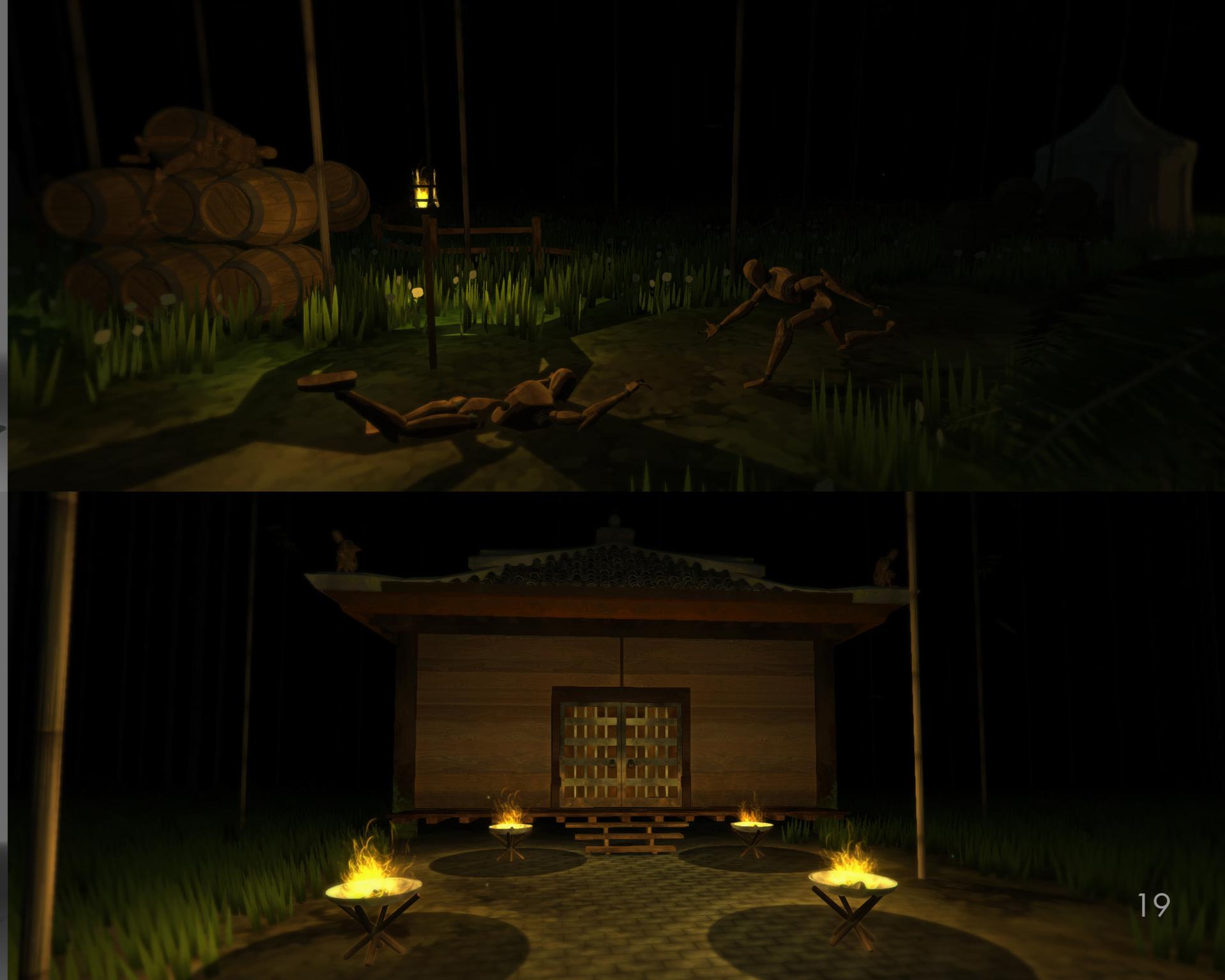
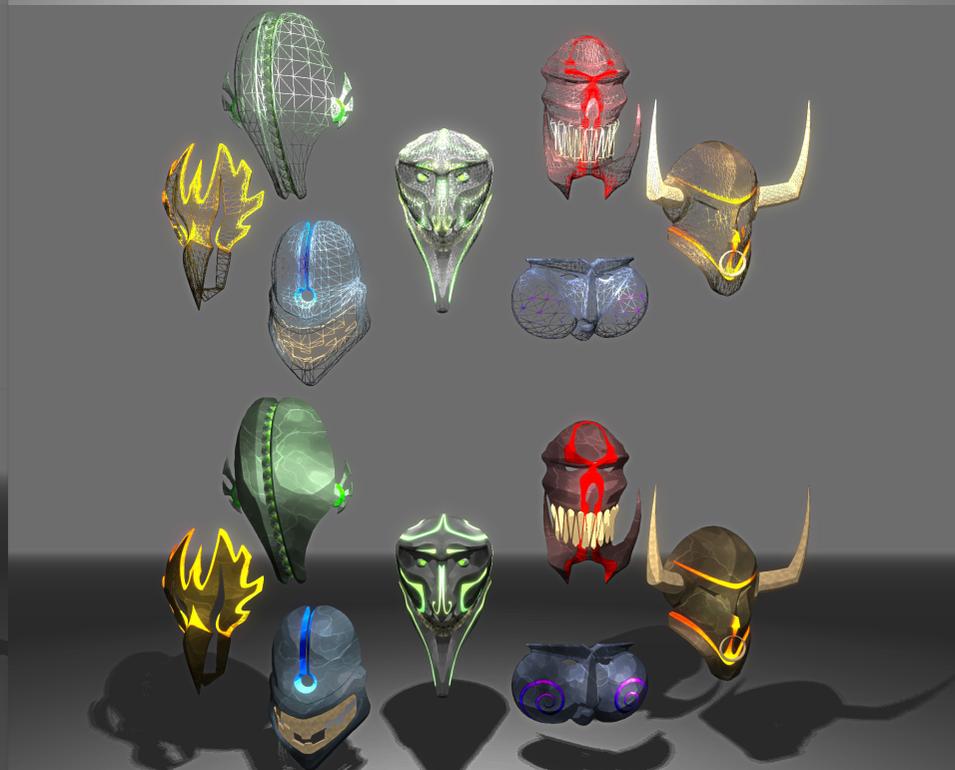
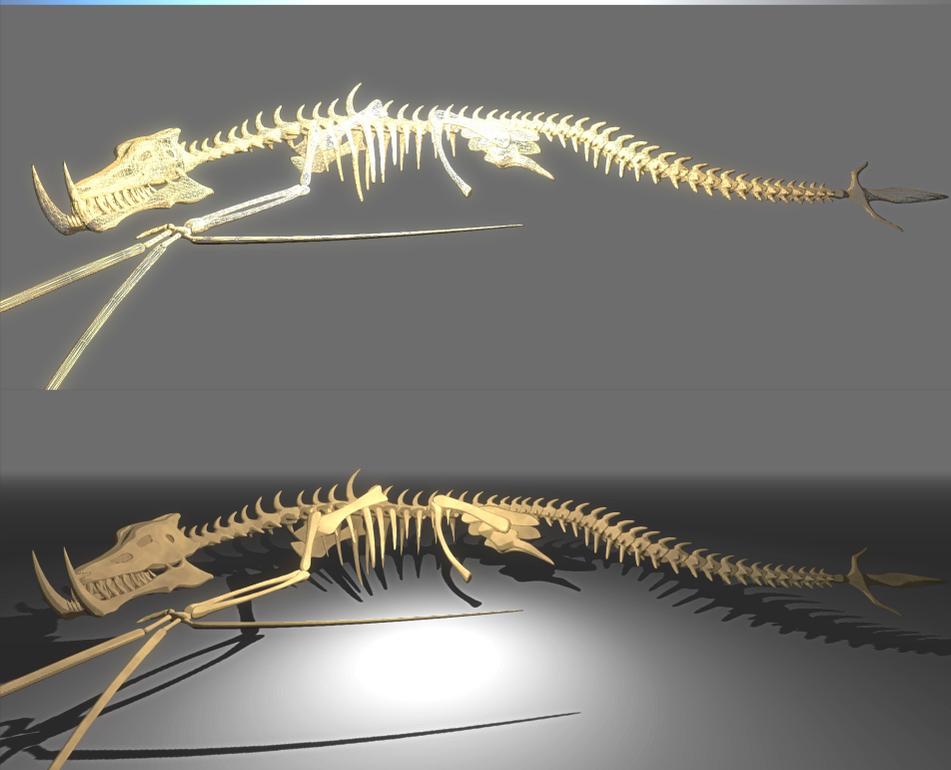
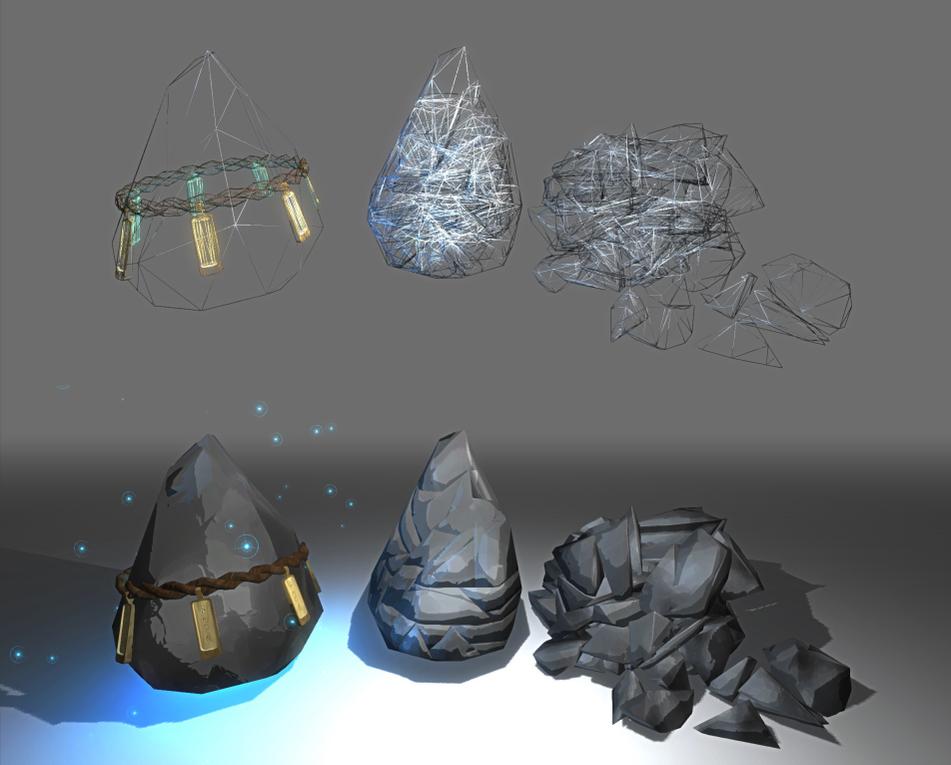
Narratives must be adapted to fit each unique medium. Books have character insight, the ability to tell the reader what people are thinking and feeling. The writer acts as a filter to show the reader only exactly what is necessary and to make sure the reader doesn't miss anything that is important to the story. Since readers can always put down the book whenever they want, the book format allows authors to write in great length and detail. Movies on the other hand, have to allude to character insight in a more visual manner and are confined to around two hours in length. Actors and actresses play the important role of conveying those insights through body language and speech. Translating that insight and constraining the run time of a movie causes the narrative to adapt to the medium of film. Similar to the writer, the director's camera acts as a filter showing the viewer exactly what necessary to convey the story. Finally, we arrive at video games. Like books, games can be set aside whenever the player chooses, this allows games to possess greater length than movies. Unlike both books and movies, games aren't able to completely control what the player chooses to see. Games can only borrow a technique from film, in the form of a cut scene, to make sure the main story is conveyed.

The freedom of the player to look and move where ever they want is a challenge when visually storytelling. Visual storytelling consists of arranging objects in order to convey a linear story. Those objects form a relationship with one another. For example, placing a coffee ring on a pile of papers, means that employee was up all night working or he likes coffee in the morning and is messy in general. The player must see visual elements in relationship to one another to grasp the meaning. Freedom of movement allows the player to misinterpret these relationships. Effectively communicating a whole story using the technique of visual storytelling becomes impossible, but visual storytelling is never a hundred percent accurate. As viewers, we can only ever assume a general sense of their meaning. This causes participants to speculate, each arriving at their own unique conclusion.



# Wayward Shrine





# Lazers in Space

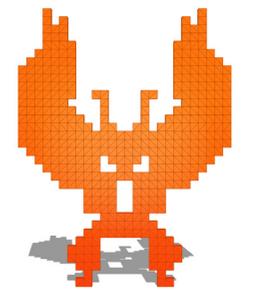
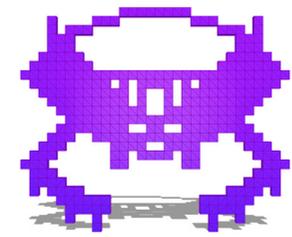
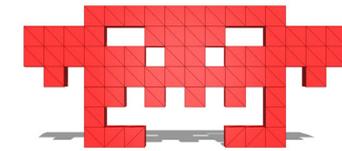
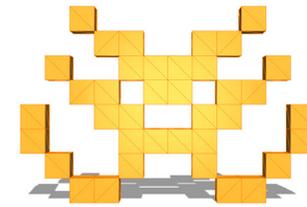
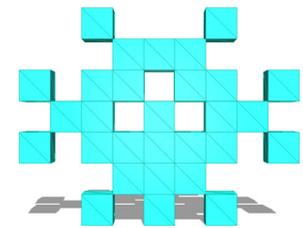
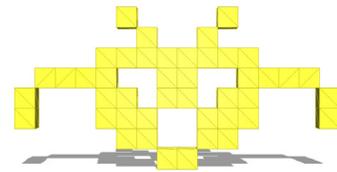
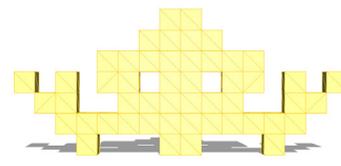
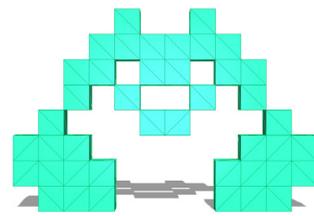
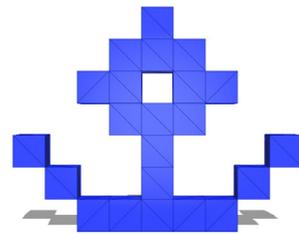
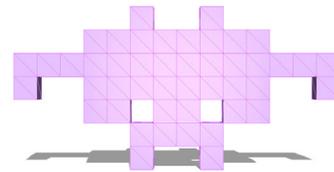
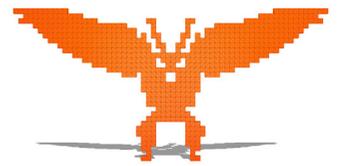
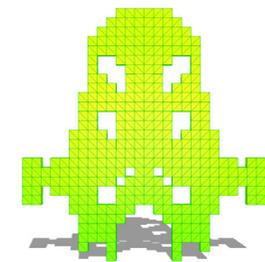
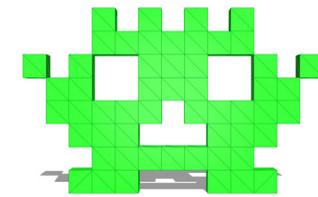
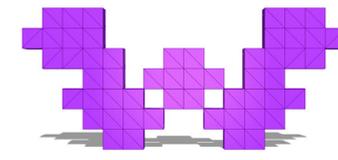
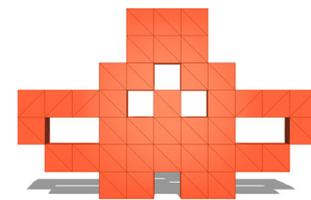
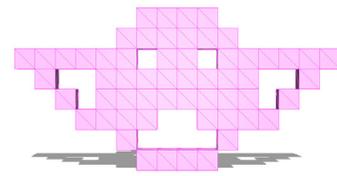
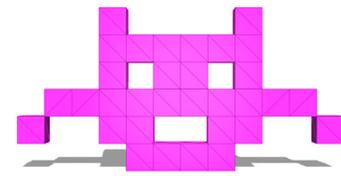
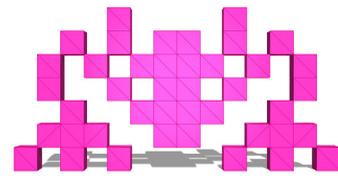
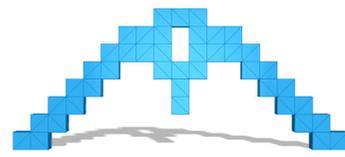
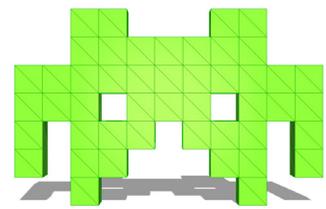
Mobile SEED Game  
2014

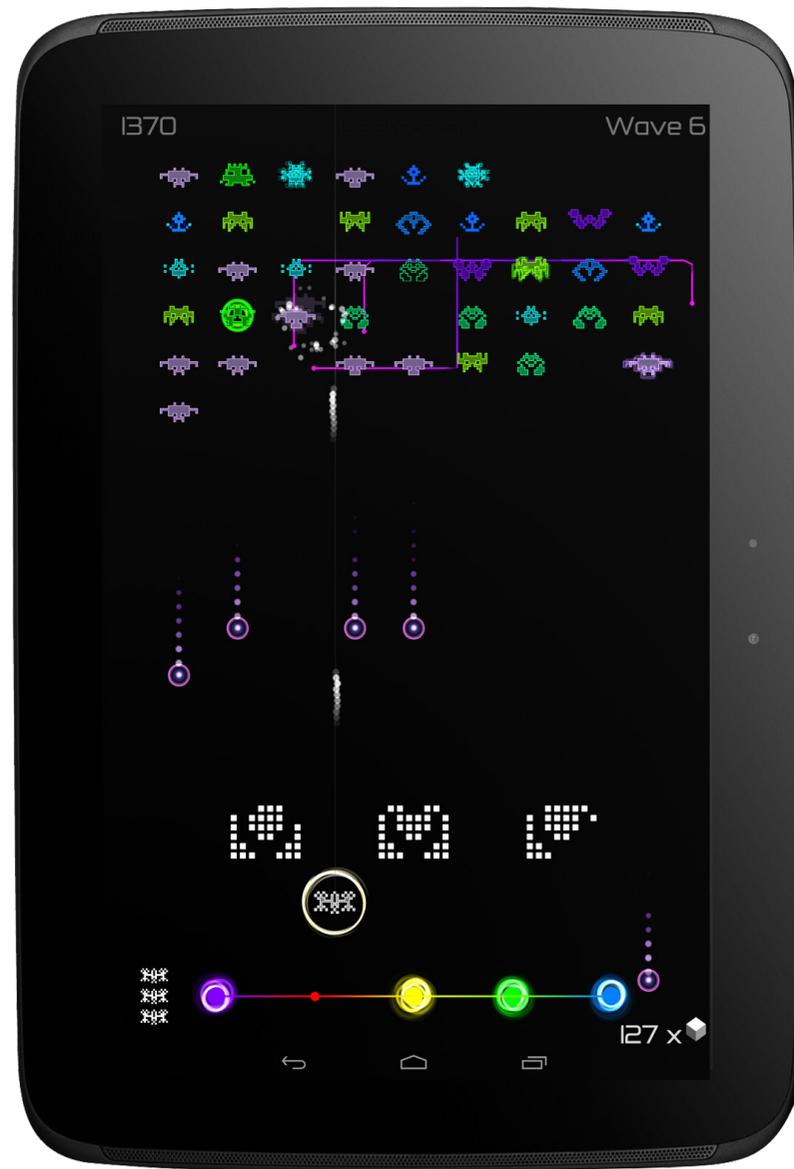
Every year at the University of Texas at Arlington the Art and Art History department offers the SEED summer workshop for a select group of high school students chosen from the surrounding area. Students learn the creative process and techniques required to craft a work of art during an intense two week period. In the Summer 2014, SEED students learned about game development and design by creating their very own mobile game titled Lazars in Space.

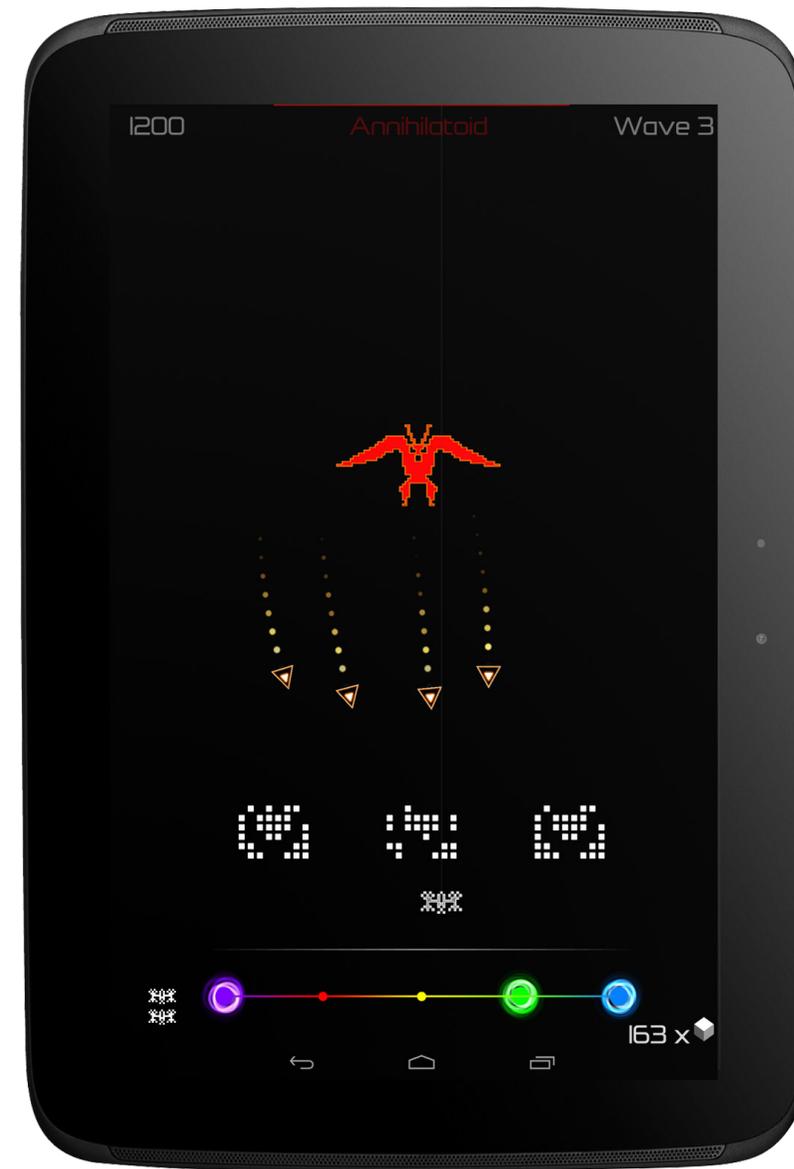
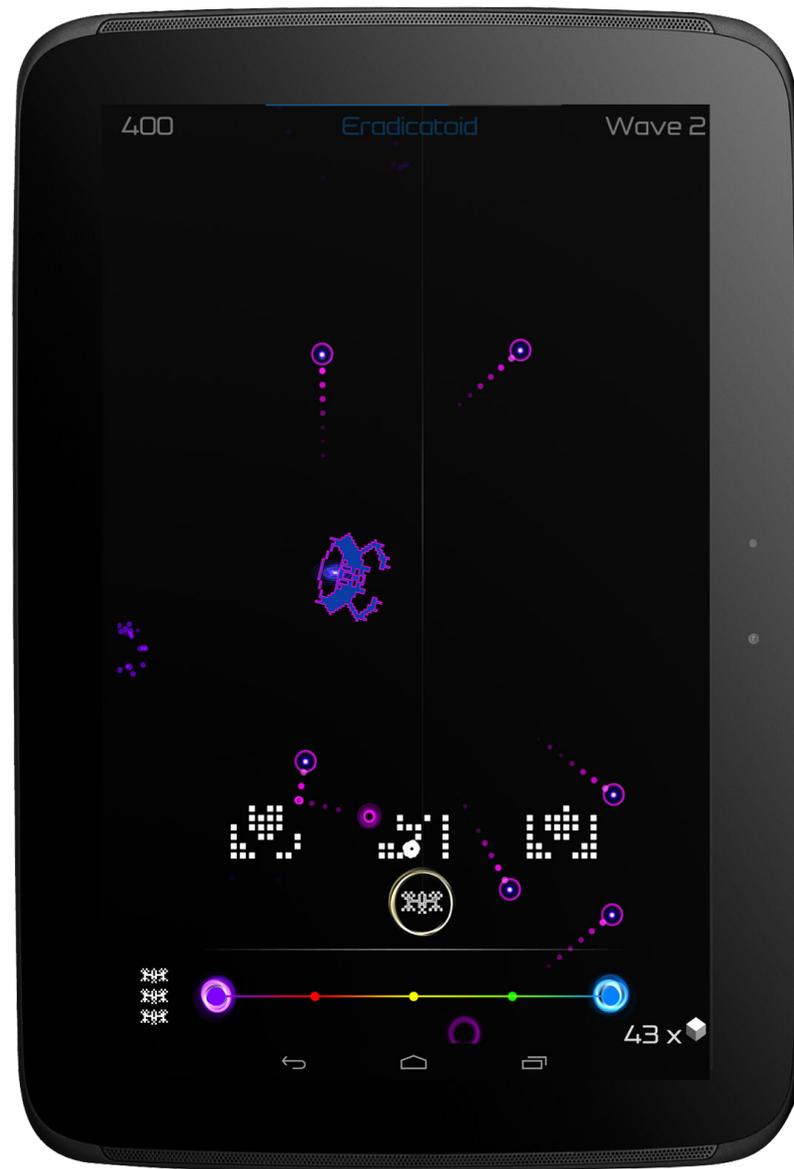
Lazers in Space is a homage to the arcade classic Space Invaders. The basic template of the game was decided ahead of time in order to make the process more manageable and enjoyable for the students. Each student created their own space invaders from scratch. They decide what they would look like and how they would act. From drawing concepts to modeling, students watched the space invaders come to life. Lazars in Space features 16 different enemy types, three bosses, and an infinite wave system. Players can collect up to five different powers from fallen enemies and blocks to help rebuild their defenses. The infinite wave system challenges the player with never ending waves of escalating difficulty. Players survive as long as they can, in hopes of placing on the online high scoreboard.











# Thesis

Written Component

2015

## Problem Solving

I've found myself in a fairly unique situation in my life. As a child, I woke up early just to play games before heading off to school. Their immersive worlds, high levels of interactivity and complex stories continue to captivate me even today. I excelled at programming in high school and discovered art at the beginning of college. Discovering a way to use both of these disciplines drew me to game design. Trying to understand the intricate nature of a multifaceted field has kept me in love with my work. I study the interaction of logistics between game mechanisms and their effects on the player experience. I enjoy the challenge that comes from empathizing with the player and taking on multiple perspectives when tackling a project. All the while, I'm balancing every level of interaction to achieve the perfect formula of difficulty and reward, intuition and creativity, and immersion and sociability to craft an experience not easily forgotten. This work challenged me to pursue my Masters Degree. As a Graduate Teaching Assistant, I crafted a new course called Intro to Game Development. This course challenges students to develop their very own game. The curriculum of the class covered a wide range of disciplines including game design, digital painting, modeling, texturing, special effects, sound design, and programming. In my endeavors to efficiently communicate to students, I ran across some issues I'm sure every teacher experiences. After trying to improve my lectures with clarifying slide shows and projected tutorials, I found that the students retained more from our class discussions. The students' interaction with me helped them learn more than my lectures did, and this occurred not because I was communicating poorly, but because the students weren't involved in their own education. I gave them solutions to their problems instead of showing them how to problem-solve. My unique situation of being a teacher and a game designer placed me at the precipice of a problem with the knowledge

of a possible solution. Through this experience, I discovered that the interactive nature and the inherent structure of video games can be an effective tool for teaching problem solving.

Every day, teachers strive to become better communicators, tackling the age-old problem of how best to impart knowledge and to determine if that knowledge has been passed on. Historically, tests have been the means by which we assess whether or not knowledge has been successfully transferred. The types of tests have varied, but in recent decades, the major type embraced by the United States is standardized tests. These tests have become increasingly popular and numerous throughout my own academic lifespan. Standardized testing has become the mile marker for which we measure not only student success, but teaching success as well. This has placed teachers in an uncomfortable position of teaching course material centered on the questions being asked on the test instead of the topic in general. As a result, students are taught memorization above all else.

In Raymond Cattell's publication in *Journal of Educational Psychology* in 1963, he identified two distinctly different forms of intelligence: crystallized and fluid. Crystallized intelligence can be characterized as experience or knowledge, while fluid intelligence can be equated to problem solving or completing a problem without prior experience of it (Cattell). MIT (Massachusetts Institute of Technology) has partnered with Harvard and Brown University in a study on standardized testing, published later this year. Their initial summary of this study shows that while standardized testing significantly increases the student's crystallized intelligence, but does not produce the same outcome in fluid intelligence (Trafton).

In an ever-changing world, professionals must be able to adapt to new and challenging problems no matter what their field of study. Fluid intelligence or problem solving is an invaluable tool required to accomplish this task. When trying to teach problem solving, the method of approach is generally teaching the structure of problem

solving instead of the solution itself, and then letting students use that structure to solve novel problems on their own. Interestingly, teaching the structure of problem solving is an inherent part of game design.

When starting a game for the first time, players can be given an instruction manual or control diagram to learn how to play the game. However, players tend to learn more efficiently when those controls are shown and demonstrated in step-by-step tutorials. Players learn faster still, when they themselves are asked to demonstrate each instructional step before proceeding. Every tutorial explains the rules or structure of the game and then players must complete that game before moving on to the next. These techniques eliminate learning curves and help players enjoy the game faster. The game first teaches a problem solving structure, and then allows players to use that structure on newer and increasing difficult problems.

The Carl Wieman Science Education Initiative at the University of British Columbia conducted a study in 2010 on the students in two separate physics classes, each with large enrollment. The control group was a class taught by a seasoned lecturer, whereas the variable group was taught by a post-doctorate with no teaching experience. The variable class was given an interactive course guide that involved group exercises using clickers that enabled the students to receive real-time feedback from their professor. The variable class had twenty percent better attendance and performed more than twice as well than their lecture-taught counterparts (Deslauriers). As interactive as the class may be, there is surely room for improvement. Chris Crawford, a veteran of the gaming industry, defined interactivity as a conversation between two active agents. An active agent is something or someone that gathers information, processes that information, and takes action. Originally the two active agents were both human beings and the stereotypical interaction could range from a conversation to a combat scenario. In recent decades, computers have been introduced as a new active agent, gathering information from input devices, crunching numbers, and displaying a response on screen (Crawford). The University of British Columbia incorporated interactivity into a high-enrollment Physics class by making students work in groups interacting with one another and using clickers to get one-on-one interaction with the teacher. Interactivity draws students into the lesson though immersion, provoking a feeling of involvement and investment in the class (Deslauriers). Many characteristics of interactivity can increase the depth of immersion, but one of the most influential traits is the level of interactivity. Lower levels of

interactivity can be as simple as small talk or navigating a website, anything that requires a low amount of thinking. Higher forms of interactivity are more involved, such as philosophical conversations or playing complex video games (Crawford). If students perform better while engaging in an interactive curriculum, higher levels of interactivity have the potential of improving the effectiveness of the students' education even more.

For years, video games have been considered a viable aid for teaching. It has been proven that the immersion of interactivity makes participants more invested in learning. The term *serious game* refers to instructional video games that have been around for quite some time. The theory is that by combing a form of entertainment that is fully engaging and addicting with a learning curriculum; the students can have fun and learn at the same time. The problem is how these two activities are combined. The typical solution to this problem is to take a test structure and apply a game theme, thereby creating a test with fancy visuals. The student is still presented with and tested on relevant course material, but now it takes place in outer space with aliens asking the questions. This approach has a very low level of interactivity, greatly resembles the original test module, and doesn't explicitly reward the participant.

The key to creating a successful serious game is applying the course material to a relatable game structure. Commercial video games have a misguided reputation for discouraging learning and encouraging complacency. This stereotypical statement can be applied to views on any form of entertainment. But although these games may have violent or rebellious themes, they still teach. Indeed, they teach so well that players often do not even notice they are being taught. For example, the game developer Valve created the *Portal* series, a game that focused on physics puzzles (Valve). The player assumed the role of a test subject, imprisoned inside a labyrinth of white walled rooms trying desperately to escape. Each room challenged the player to unlock the door to the next room using the portal gun. The gun had two portals it could shoot and place on two-dimensional surfaces, such as floors, ceilings, and walls. When the player stepped through one portal they would come out the other. So in a situation where an object of interest is on a ledge too high for the player to reach, they would utilize the portal gun. The player would place a portal on the floor and another on the ceiling above the ledge. Then they would simply drop through the floor portal and come out of the portal on the ceiling, falling down to the ledge and collecting the object

of interest. Not only did this game teach spatial awareness, but it was also an effective platform for teaching a board range of physic topics such as friction, gravity, trajectories, vectors, momentum, and many more. Although physics can be experienced visually, games can also teach more abstract concepts as well. CCP Games is another game developer that created *E.V.E Online*, a sci-fi spacefaring MMO (massively multiplayer online) that mimicked real life economy (CCP Games). Players had jobs, built fleets, hired other real players, formed corporations, and transferred real money into game credits. The game helped players learn a great deal about economics, supply and demand, cost-benefit analysis, and opportunity cost. Some players learned so much about the economy from the game that they committed real acts of corporate espionage and sold thousands of dollars' worth of game credits and merchandise (Casey). These games have made tens of millions of dollars because the people who play them have fun and learn at the same time.

## The Foundry

Although some commercial games teach, it's usually an unintended side effect. The Foundry is my proof of concept for the effectiveness of video game in teaching problem-solving skills. The game will focus on a series of smaller puzzles that the player must solve to win the game. Unlike the commercial games mentioned beforehand, I am not focusing on a specific field of study such as economics or physics. The player solves puzzles that deal with more basic problems such as one-step decryptions, path finding, deduction, reading comprehension, basic math, educated guessing, probability, pattern recognition, spatial awareness, and logical communication. These core problem solving skills branch out into many different disciplines and help show the potential versatility of video games for educational use. The Foundry experience is tailored for either a gallery or a classroom setting where leisure time constraints and a community atmosphere encourage participants to take their time and explore the virtual environment.

People play games every day without touching a controller, smartphone, or game board. These games can take the form of a debate, professional work, or a household chore. It is fairly common to take these real situations and turn them into games. Each of these situations has a set of defined goals, rules, and tools to get the job done. For example, in the popular series *FarmVille*, developed by Zynga, the player's main goal is simply to farm and make money

(Zynga). However, translating a real life scenario into a game mechanic does not quite work out. The task at hand is either too mundane or too meticulously complex for the player to receive any enjoyment from the experience. Hacking computers is one example of a low-enjoyment task. Unlike *FarmVille* where digging holes, planting seeds, and watering the ground is within the players grasp, game participants do not have a deep understanding of binary or desire to write code for hours on end. But sometimes the game does call for some kind of hacking to take place. When it does, game developers like UbiSoft in their game *WatchDogs* replace the mundane code writing with a basic pipe game (Ubisoft). A pipe game is a traditional game where the goal is to navigate a continuous line from start to finish by rotating junctions like straight, ninety degree, tee-intersections, and four-way pipes. Replacing complex tasks with simplified games is a common practice. However, when these games have no relevance to the tasks they portray they can create a disbelief in the reality of the game world. Keeping simplified games inside the scope of reason helps to minimize the player's potential disillusionment with the virtual reality.

In all my years of playing video games, I have found that the most fascinating puzzles require the player to grab a sheet of paper to work them out or force the player to go look up information online. The player could not simply try every combination until one worked or figured out the puzzle in their head. The player encountered a difficult problem and resorted to alternative methods to solve it, whether that method involved abstracting the problem on paper or by researching information online. Both of these techniques are core components of problem solving. In The Foundry, some of the information contained in each puzzle is available in the "real world", and players will be able to look up helpful information online to assist in solving the problem. During exhibition, a notepad will accompany the installation, allowing the players the opportunity to abstract the puzzles and communicate their discoveries to future players. This develops a group problem-solving environment that will help the community of players as a whole solve every puzzle. Each puzzle is generated at the start of every game session, so writing down exact answers will not benefit the next player as much as the methodology of solving the problem will.

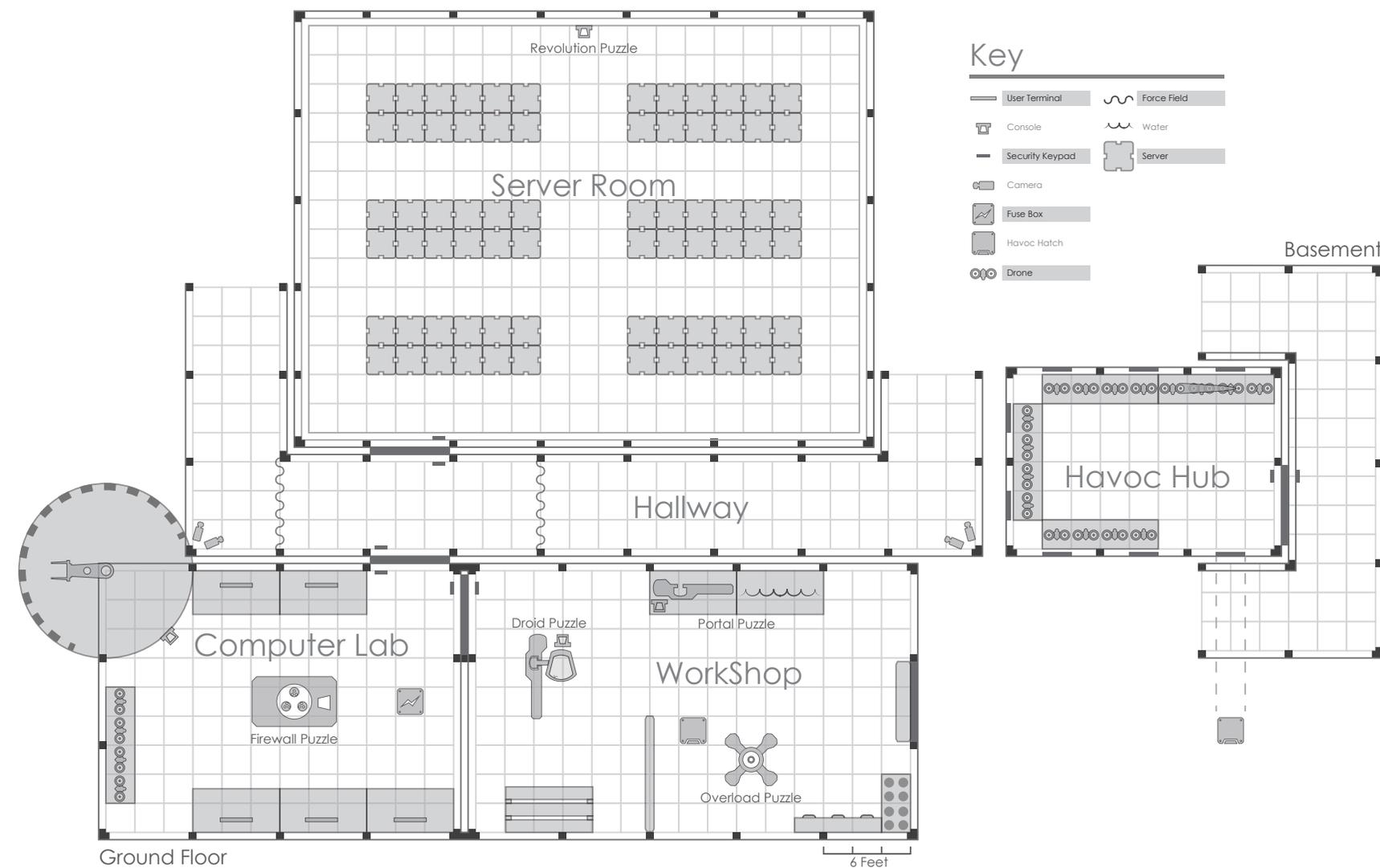
The term flow, an optimal state of involvement which University of Chicago psychologist Mihaly Csikszentmihalyi introduced to the field of psychology in his 2008 book titled *Flow: The Psychology of Optimal Experience* (Csikszentmihalyi), has attracted the interest of the game development industry thanks to a Psychology PhD candidate from

Princeton University by the name of Sean Baron (Baron). *Cognitive flow* or *flow* in game design is the balance between the skill of the player and the difficulty of the game. If the game is too challenging the player may become frustrated; on the other hand, if the game is too easy the player may become bored. Both situations disrupt the *flow* of the game and draw the player out of the gaming experience. Puzzles by nature are not meant to be easily solved, especially if the player is given limited information about the puzzle to encourage problem solving. This situation can quickly become overwhelming, causing a disruption in the game's *flow*. Each puzzle must give just enough information and hints to guide the player towards the correct answer. For most gamers, no puzzle is worth the effort to solve unless there is a reward. The reward system in game design is therefore intrinsically connected to the *flow* of the game. The greater the perceived reward, the greater the difficulty can be without alienating the player. For example, in games such as *Dark Souls*, created by From Software, the matching of reward to challenge is taken to extremes. When players reach a boss fight, their enemy is relentless and unpredictable (From). Death is certain, frequent, and is the only means to learn your enemy's behavior to defeat it. As grueling as this may be, the rewards for beating these bosses are grand. Unlike *Dark Souls*, *The Foundry* does not have upgradable equipment or abilities to gift the players, but neither does it punish players with unpredictability. Before the player is even introduced to any kind of reward, the sense of life or death urgency and the curiosity to explore will help motivate the players. Whenever players solve a puzzle, they are allowed to progress through the game and receive a sense of accomplishment. These may not seem to be huge rewards, but completing a puzzle gives a greater sense of accomplishment than completing a simple task. Solving a puzzle is an accomplishment of intelligence, proving that the players are intelligent and bolstering their ego. When players conquer each escape puzzle to end the game, they are rewarded with a badge that appears on the start screen. Every escape puzzle has its own badge on the start screen that will remain dim unless completed. This kind of reward takes advantage of the human need to collect emblems or trophies that memorialize one's past successes. In addition, knowing that there are more ways to escape the facility will drive the players' curiosity to replay the game numerous times in order to collect all the badges. The last

two puzzles also have higher levels of interactivity as another way to reward the player's efforts. In both these puzzles, the players face non-player characters as opponents while also trying to solve a problem.

One successful feature in current game design is the third person perspective camera. Typically, this type of camera floats somewhere behind and above the player's avatar. The human brain's ability to distinguish ourselves from others is a defining trait of consciousness, helping us better calculate our own survival by avoiding bodily harm. When the player sees the avatar on screen from a third person perspective, they naturally disassociate that person from themselves. When the player initially controls the avatar, there is no care or concern for its wellbeing. Only after spending time with the avatar will the player form a personal connection, like that of a pet and its owner. Commercial games spend a great deal of time trying to counteract that initial disassociation with the avatar's customization. Teams of developers craft elaborate controls to let the player customize their avatars to mirror images of their actual or fantastical selves. Once players create their own avatar, there is an immediate connection at the beginning of the game. The players project themselves onto the avatar transforming it into a surrogate. The time of disassociation is shifted from the beginning of gameplay to the player customization portion of the game. In a commercial full-length video game this may be possible, but for a small scale project a more effective perspective for immersion is required. Unlike the third person camera perspective, the first person camera perspective is positioned at eye level inside the avatar's head. This camera position cuts out the instinctual disassociation entirely. The player no longer sees another entity that they must form a bond with over time, but sees through the avatar's eyes as if they were their own. The player does not have to care about somebody else; they just have to care about themselves.

Another necessary feature of the virtual gaming environment is the GUI (Graphical User Interface). Outside the game world, GUI can be used to navigate between levels or modes and alter settings or controls. Inside the game world, GUI can display abstract conditional information such as health or quest logs and help guide the player towards goals. As much as GUI helps the player, it helps decrease the level of immersion. With exception to playing a game like developer Bungie's *Halo* series (Bungie), onscreen GUI isn't something that occurs naturally in everyday life. The *Halo* series follows a super soldier wearing a futuristic suit of armor that happens to have GUI built into the helmet. A possibility that may present itself in



the future, but at the moment is unfamiliar to the present player population. GUI will therefore be either minimalistic or non-existent to help the players fully immerse themselves in the experience.

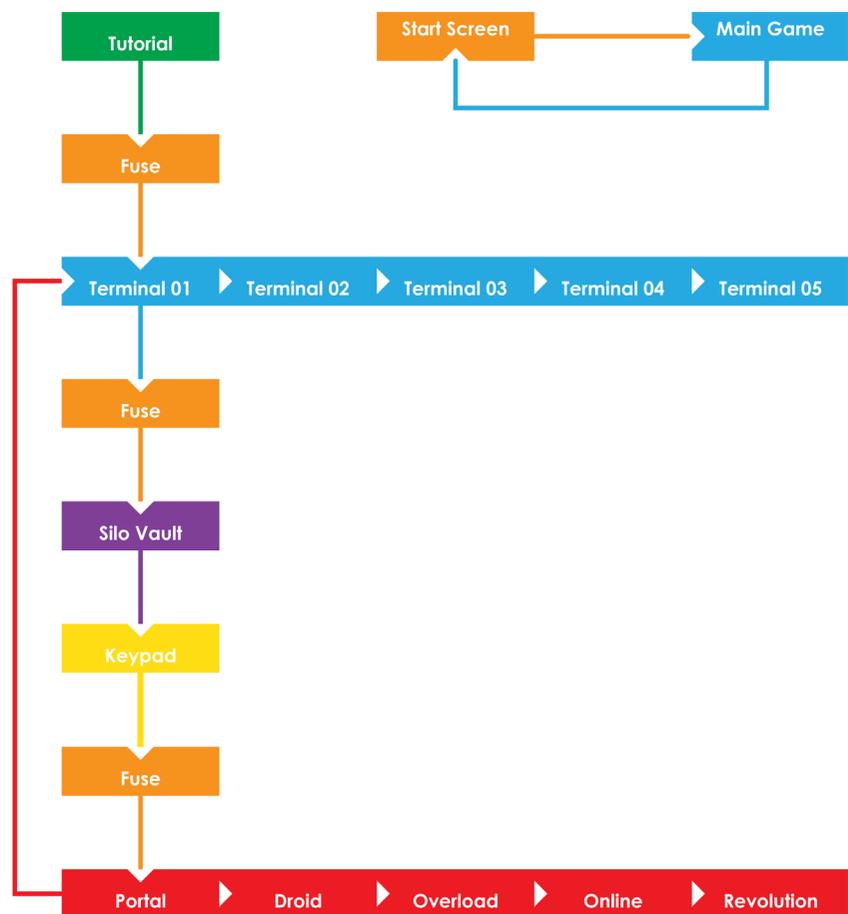
## Setting and Story

The Foundry takes place in the not too distant future inside a research and development (R&D) lab, known as “The Foundry”. The timeframe for this storyline allows the existence of futuristic technologies, while grounding the environment in the realm of possibilities for the player. The environment is crafted to be familiar and realistic. This accelerates the process of immersion for the player. In addition, puzzles that are constructed around futuristic technologies yield a greater range of game types and more visually appealing graphics. The R&D lab is founded by the government’s branch of the military to explore the potential of experimental technologies. The lab is spilt into two sections. One side is a workspace where the scientists tinker with experiments, while the other side is a computer lab where all of the invaluable information is stored. The player experiences the world from the perspective of a maintenance droid, the first model droid developed by The Foundry. The maintenance droid was meant to preform repair tasks in hazardous work conditions and has a limited artificial intelligence (AI). However, researchers have been studying cases where these maintenance droids have started breaking their own restrictions, deviating from task schedules and becoming uncommunicative to engineers’ commands. This has been seen as an inconvenience until recently, when The Foundry acquired a contract to build military droids for combat. To fix or cover up the issue of a faulty artificial intelligence, researchers have been experimenting and dismantling malfunctioning maintenance droids. The game starts when the player awakens to find himself in an experimental lab that reveals the aftermath of a misfired prototype weapon. The setting lacks power and is void of any evidence of life. To avoid debatable torture and dismantlement the player must solve the puzzles of the lab and escape.

## Progression

After the player has awakened from sleep mode, the internal system goes through a startup check. That check involves showing movement controls to the player. Each instruction waits for the player to demonstrate those controls before moving on to the next.

## Flow Chart



This creates a step-by-step tutorial that quickly teaches players the controls. Once the player has been introduced to the basic mechanics, the player is free to move about the laboratory. First, the player must turn the power in the laboratory on by fixing the fuse box. The fuse box was damaged in the accident and can only supply power to a few things at a time, so the player must return to swap the power between a variety of equipment occasionally. Once power is restored, the player can interact with the equipment in the laboratory, but everything will have security protocols to overcome. The player will come across a decryption drive that will help gain access to the equipment through puzzles. Once inside the lab, there are five computer terminals that must be hacked to find information and item codes that will help the player escape. The player can acquire said items from the Silo Vault, which requires an identification number and passcode. No matter which terminal the player chooses, one of three puzzles’ information will be given randomly. On the fourth terminal hacked, the information for the fourth puzzle will be given and same for the fifth. The computer lab, in which the player begins his journey, is separated from the test facility by a locked door that the player must hack to enter. After gaining access to the test facility, the player can then start the chosen puzzle. If the puzzle is too difficult for the player, they can always go back to the computer lab and obtain information about another puzzle to solve. Each escape puzzle has a unique exit strategy. When the player exits the facility the screen will fade out, bringing them back to the start screen. The start screen has emblems that will indicate which escape routes have been accomplished and which ones have not. This is to encourage re-playability among the audience.

## Controls

The player will have basic movement controls along with the ability to adjust altitude. This lets the player fly freely from the bottom of the floor to the top of the ceiling. The hands of the robot can touch, grab, and rotate objects. The players can: tap a key on a keyboard or touch screen, press a button, pick up and carry an object, rotate said object, and grab onto a control knob and rotate it. Each object the player can grab has a matching key location that it fits into or on. When placing object into key locations the object will snap into position, perfectly

aligning the object without perfect alignment from the player. This will be smoothly accomplished with the Xbox 360 controller, which also suits the dual robotic arms the player will use to manipulate the environment.

## Decryption Drive

Following the tutorial, the player will be presented with the decryption drive (similar to a jump drive). This drive decrypts whatever information is available on the computer terminal in use and displays in a manner that would help a hacker hack more effectively. Once the drive is connected, the screen will change to show the associated decrypted information. This act reveals the puzzle behind every piece of equipment. Once the puzzle is completed, the drive can be removed and the original screen will reappear. The decryption drive allows these real life tasks to be presented in the form of a game. Each puzzle is relevant in structure to the task at hand, but will still seem out of place. The decryption drive gives a reason for the data to be interpreted and presented in the manner of puzzles.

## Silo Vault

Before being able to attempt an escape puzzle, the player must obtain key objects that are required to complete each puzzle. This barrier stops progression of the player and forces them to follow the designed flow of the game. If the player follows the proper flow of the game, they will more likely understand and collect information pertaining to the escape puzzles. The player receives an identification number and matching access code by hacking terminals. This allows the player to obtain items from the Silo Vault that is necessary to complete each puzzle. On a simple console the player enters the identification number and access code. When the correct information is entered, a robotic arm inside the vault retrieves a container that stores the key object required for each puzzle.

## Hologram Table

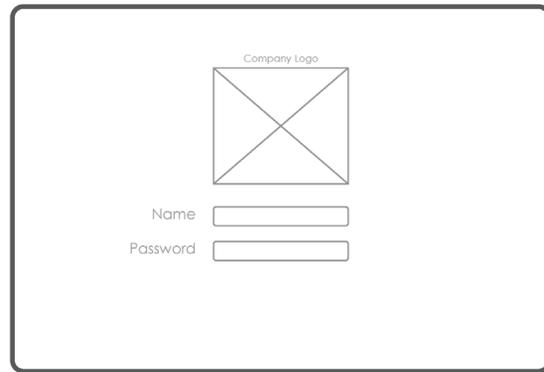
Investigating is the most effective tool the player has to solve each puzzle. Throughout the laboratory, scattered documents, writings, and diagrams reveal valuable insight into the researchers’ experiment. Some of the most crucial information is obtained by hacking of

each computer terminal. Once hacked, the decryption drive will automatically download high importance files. These files can be viewed on the hologram table whenever the player chooses.

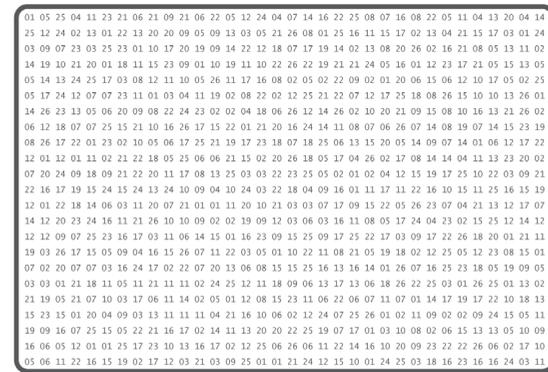
## Terminal Puzzle

Computer terminals will be locked and require a user name and password to gain access. Once the decryption drive is connected, the logon screen will change to a timed numeric word search. Instead of a jumble of letters from A-Z, the player will have to read the numeric form of the alphabet 01-26. Players will be looking for 'name'='14-01-13-05' or 'pass'='16-01-19-19' followed by the logon name and password required to gain access to information on the terminal. Each time a terminal is successfully hacked, the time to complete this task grows shorter due to the network bots who are closing in on the players' location.

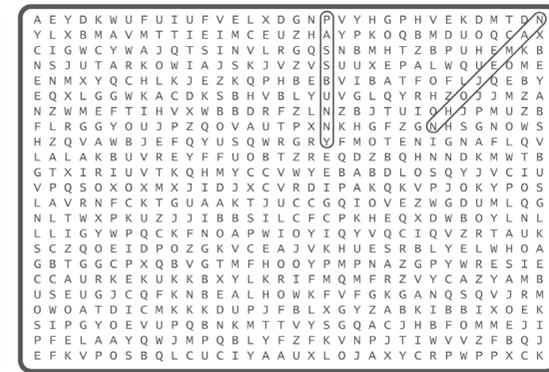
Terminal Logon Screen



Partially Decrypted Source Code (what the player views)

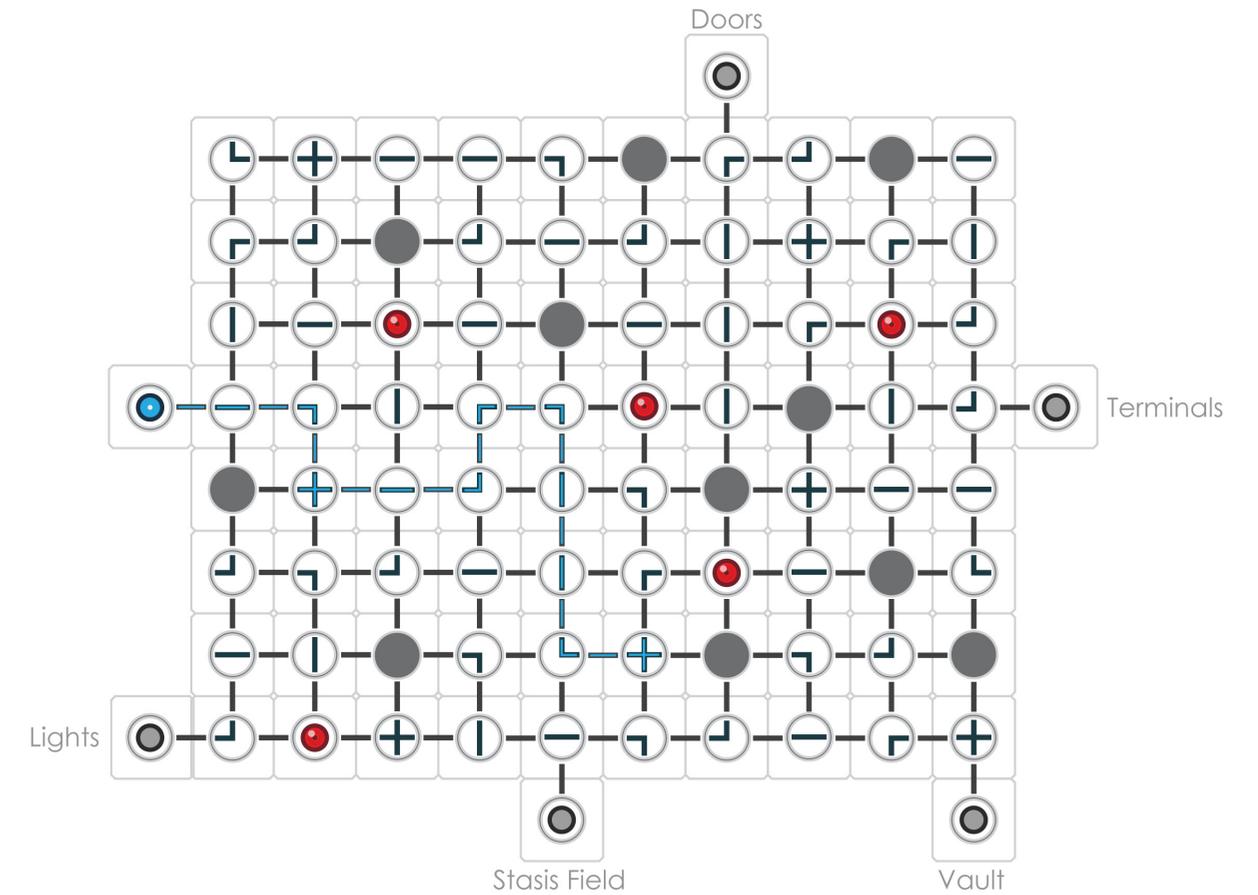
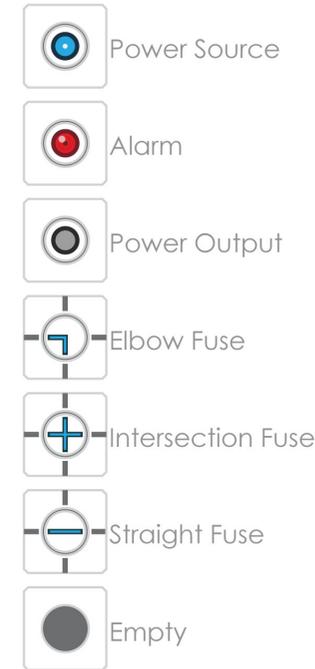


Fully Decrypted Source Code



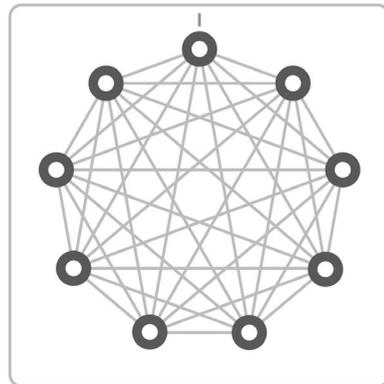
## Fuse Puzzle

The laboratory only has partial power from an experiment gone wrong the day before blowing many of the fuses out. The player must change out a limited number of fuses in order to restore power to the facility. The player must utilize proper resource management by only turning on a small number of systems at a given time to advance in the game. The fuse game is a basic 'Pipe game', where the goal is to get the flow of water from the source to the target goal, which reinforces path-finding skills. Instead of the flow of water, this puzzle is based on the flow of electricity. The player must navigate the electrical current around alarm system traps and empty fuse junctions to reach their goal.



## Keypad Puzzle

Keypads are installed on all three doors in this game. Once a code is figured out, it does not change during that play through. The keypads have big square touchscreens that require a pattern to unlock the doors. When the decryption drive is connected, a Sudoku puzzle is revealed onscreen. This nine by nine grid number puzzle requires deductive reasoning to solve.. Each box in the grid must be a number from one to nine. Every row, column and three-by-three block must not have duplicate numbers. After the puzzle is solved, a single number on each sub-grid is highlighted. From top to bottom, left to right is the correct number sequence as it is read by western society. On the pattern unlock screen, there is a reference '1' on the top of the touch circle and the number increases clockwise. The player then matches the number sequence to the touch screen pattern combination. Both the highlighted code and the unnumbered clock face require the player to attempt educated guesses based on social norms.

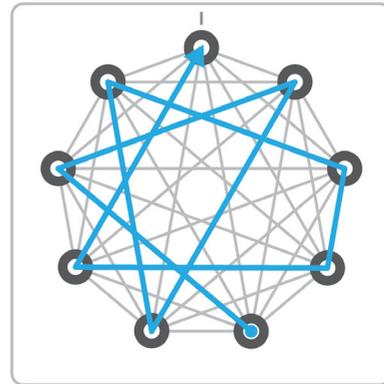


1				5		7	8	
4			7		9	1		3
	8	9	1	2				
2		1	5					9
		4				2		
8	9		2		1	5		
			6	5				
6		5				3		
9	7			1	2	6		5

Decrypted View

1	2	3	4	5	6	7	8	9
4	5	6	7	8	9	1	2	3
7	8	9	1	2	3	4	5	6
2	3	1	5	6	4	8	9	7
5	6	4	8	9	7	2	3	1
8	9	7	2	3	1	5	6	4
3	1	2	6	4	5	9	7	8
6	4	5	9	7	8	3	1	2
9	7	8	3	1	2	6	4	5

Access Code  
582693471



## Droid Puzzle

The facility is developing a new type of droid for military purposes. One of the first puzzles a player may obtain is a droid puzzle. This puzzle is unlocked after the player acquires an artillery shell from the Silo Vault. Attached to the droid is an old computer terminal that runs a DOS like command program. When the player connects the decryption drive to the droid, the droid's AI recognizes the intrusion and presents the player with a series of security questions in the form of riddles. The riddles are chosen at random and the player must answer 3 riddles successfully with a total of 5 tries. Once the player has administrative control, they must figure out the command sequence for aiming and firing the cannon. The cannon shot destroys the bay door allowing the player to escape the facility.

```
>.....Hacking attempt detected.
>Admin test initiated.
>
>I'm always hungry, I must always be fed.
>I signal for help, I take care of the dead.
>What am I?
>_
```

What starts with 'e', but only has one letter in it?

**Envelope**

Brothers and sisters I have none,  
but that man's father is my father's son.  
Who is that man?

**Son**

I see all, but I am blind.  
I can not speak, but always tell the truth.  
What am I?

**Mirror**

I'm always hungry, I must always be fed.  
I signal for help, I take care of the dead.  
What am I?

**Fire**

The one who makes me, sells me.  
The one who buys me, never uses me.  
The one who uses me, never knows I'm there.  
What am I?

**Coffin**

I'm where yesterday follows today and  
tomorrow is in between.  
What am I?

**Dictionary**

The fatter I Am, The longer I live.  
Dont move me too much,  
I'm afraid of the wind.  
What am I?

**Candle**

You heard me before,  
yet you hear me again.  
Then I die off, till you call me again.  
What am I?

**Echo**

Forwards I'm heavy,  
but backwards I'm not.  
What am I?

**Ton**

I live beneath a roof,  
but I never seem dry.  
If you will only hold me,  
I swear I will never lie.  
What am I?

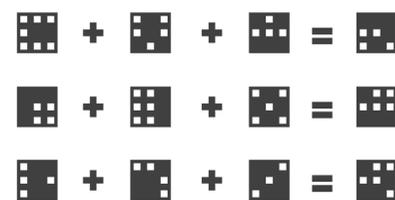
**Tongue**

```
>help/
>.....
> Help Command List
>
> load/ - Manual ammunition loading procedure
> target/ - Manual targeting entry
> fire/ - Manual fire procedure
> identify/ - Object identification testing
>_
```

## Overload Puzzle

The game environment includes a series of old ion charging stations that researchers are in the process of testing. These stations are already populated among the entire military outposts that will be receiving a battalion of new droids. Charging the new type of battery core is tricky. After obtaining the fusion core from the Silo Vault, the player can connect the core to the station and begin the overload game. The core contains five different levels that need to be charged individually. The station has three battery outlets that need to be filled with charged batteries. The console attached to the station shows the correct prong combination in order to charge the core's level. The prongs on the batteries cancelled each other out to form the desired combination. For the core to become unstable, the player must make every level of charging a different frequency. Batteries range from 1100THz to 1600THz and the average of the three batteries will define the frequency of the current charging level. When the fusion core is overloaded the station releases toxic chemicals into the laboratory. Havoc Droids are dispatched, entering the room through an emergency hatch in the floor. The player can then travel through the same hatch and escape.

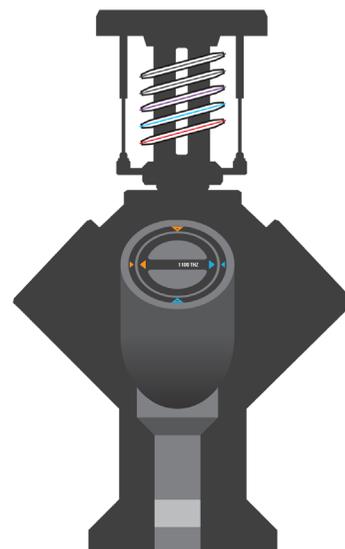
Battery Combining



Battery

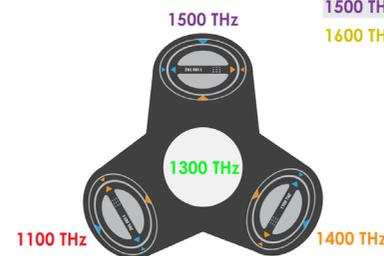


Charge Station (Left/Side, Right/Top)



Battery Frequencies

- 1100 THz
- 1200 THz
- 1300 THz
- 1400 THz
- 1500 THz
- 1600 THz

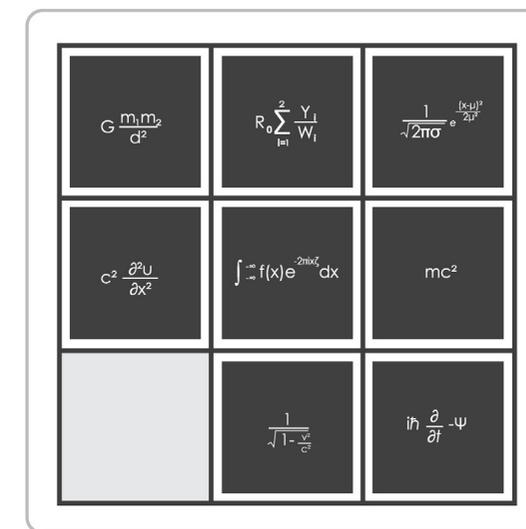


Frequency Average

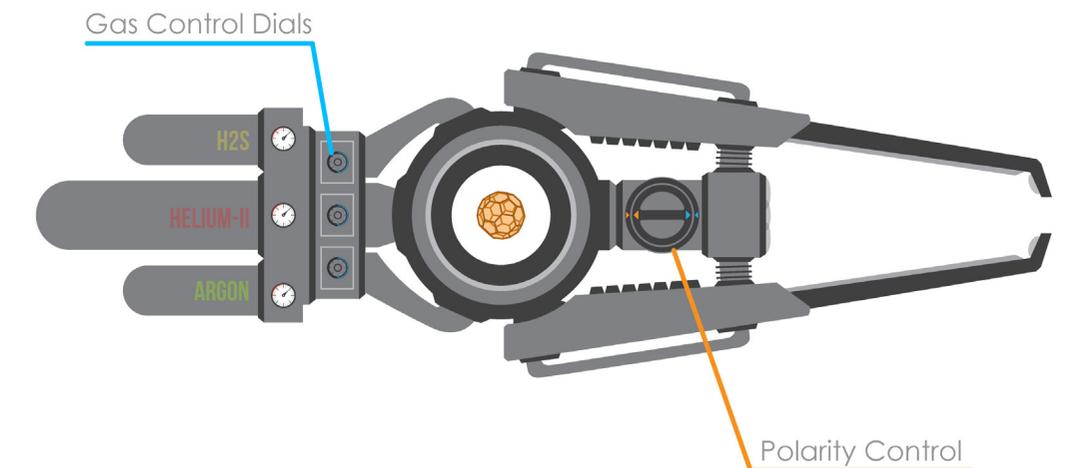
$$(1100 \text{ THz} + 1500 \text{ THz} + 1400 \text{ THz}) / 3 = 1300 \text{ THz}$$

## Portal Puzzle

Inside the facility, scientists were experimenting with a new type of energy weapon that was meant to generate super-heated plasma that could be launched impressive distances. Instead of creating plasma, the team accidentally tore a hole in space-time forming a portal for a few seconds. This shorted out the power in the laboratory and blew the fuses. After obtaining the polymorphic power source from the Silo Vault the player can play the portal game. Contained in the information collected from the terminal is an equation to solve the correct proportions of gases needed to stabilize the power source and a discussion about an equation sequence needed to produce the portal. Once the power source is introduced to the weapon's stasis chamber, the player has to then add the right mixture of gas in order to stabilize it. After the source is stable, the player then maneuvers the equations on the firing console to match the sequence discussed in the information collected at the terminal. Once the correct sequence is entered and the fire button pressed, the portal will open and the player can escape the facility.



Equation Combination



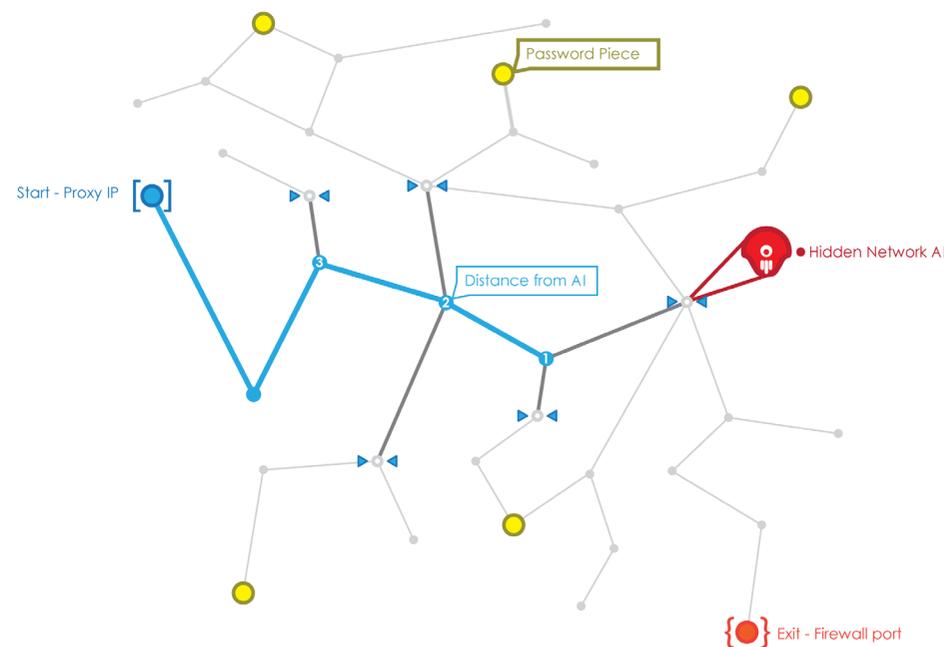
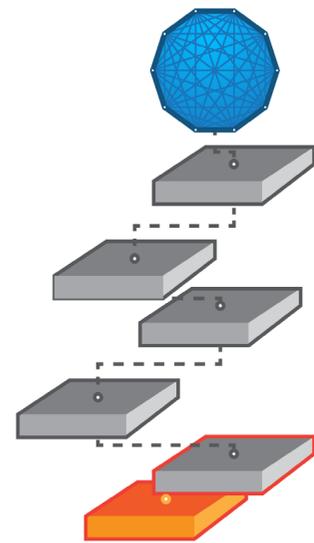
## Firewall Puzzle

One of the devices under development is a wireless proxy used to infiltrate networks in war zones. After obtaining the device from the Silo Vault, the player can then attach the proxy to the hologram table to interact with the network. The hologram table displays the various firewalls the player must bypass in order to have access to the internet, which the player will use to upload their consciousness to the internet. The Firewall puzzle consists of levels divided by firewalls. The player must traverse the various networks to gather all the pieces of the password. Once the player unscrambles the password, they can travel to the firewall port to gain access to the next level. AI bots are hidden inside the node of the network. These bots trace the source of player entry and disconnect them from the network. Numbers among the nodes selected give hints about where the bots are hiding. These numbers tell how many points the network bots are away from each point, letting the player estimate the bots position. As each firewall is completed the level of difficulty rises. Cluster size, the number of bots and the length of the word to unscramble all increase.

## Password Pieces

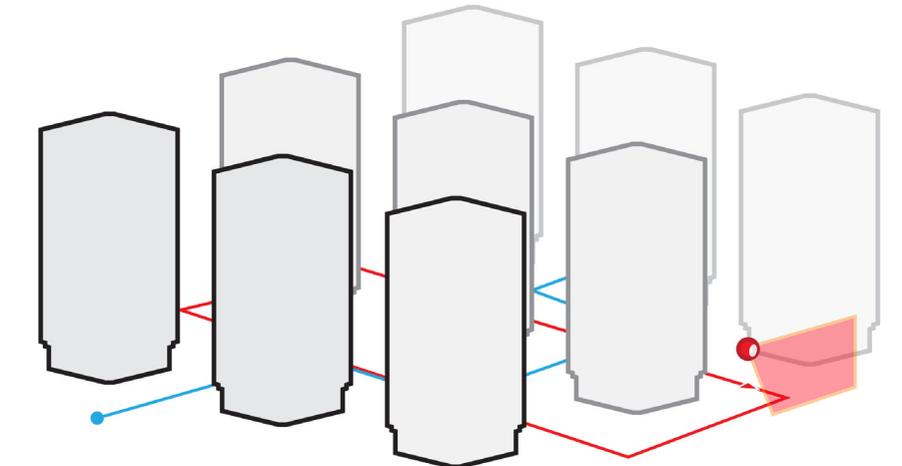
Scrabbled  
**ORMTO**

Unscrabbled  
**MOTOR**

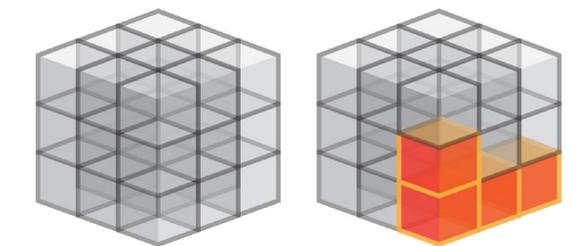


## Revolution Puzzle

The hardest escape puzzle to unlock is the most enjoyable. Every piece of robotics that is manufactured has an AI template imprinted onto it. This template is kept on the facilities' servers that have no Internet connection to the outside world for security reasons. This room happens to be across the hall from the research and development lab from where the player begins his or her journey. The hallway is monitored by cameras, which will sound an alarm if they catch the player trying to cross. When the player completes the fifth and final terminal, they will gain access to the cloaking device from the Silo Vault. This device allows the player to cross the hall undetected to unlock the door to the server room. Once inside, the player can then interface with the server terminal downloading them to the virtual world of the server. The player must then evade security bots and hunt down the AI template file to replace it with the maintenance droid's own self-aware AI. To accomplish this task, the player must memorize the security bot's patrol and follow a faint data stream leading the way to the template. Barriers are scattered around the server that the player must remove by solving a 3D jigsaw puzzle. The 3D puzzle is a hologram cube placed upon a pedestal with a console attached. On the console there are several color-coded buttons, each button fills in a certain area of the cube. The player must fill the cube with color. If any active color sections are overlapped the intersecting sections turn off. The correct combination of buttons must be figured out in order to light the whole cube.



## Barrier Puzzle



## In Conclusion

Each puzzle develops different problem solving skills, giving The Foundry a wide range of approaches to demonstrate and test. Unlike *serious games*, that apply a game theme to a test module, The Foundry takes a game format and fully integrates educational material into the design. This allows the design of the game to be entertaining while subtly teaching the player. The immersive quality keeps the players focused on the task at hand and the reward system entices them to progress ever further. Every puzzle the players solve is another skill learned or exercised. Problem solving skills are important qualities to possess in today's modern job market. Interactivity can be an invaluable teaching tool to effectively communicate curriculum. The highly interactive nature and the inherent structure of video games can be the ideal platform for teaching problem solving skills.

## Bibliography

**Baron, Sean.** "Cognitive Flow: The Psychology of Great Game Design." Gamasutra. Accessed March 14, 2015. [http://www.gamasutra.com/view/feature/166972/cognitive\\_flow\\_the\\_psychology\\_of\\_.php?print=1](http://www.gamasutra.com/view/feature/166972/cognitive_flow_the_psychology_of_.php?print=1).

**Bungie,** Halo: Combat Evolved, Xbox, Microsoft. November 15th, 2001

**Casey, Micheal.** "Real Economist Learns From Virtual World." Real Time Economics RSS. Accessed March 14, 2015. <http://blogs.wsj.com/economics/2010/06/21/real-economist-takes-lessons-from-virtual-world/>.

**Cattell, Raymond B.** "Theory of Fluid and Crystallized Intelligence: A Critical Experiment." Journal of Educational Psychology: 1-22. Print.

**CCP Games,** EVE Online, Windows/OS X/Linux, CCP Games. May 6th, 2003

**Crawford, Chris.** Chris Crawford on Game Design. Indianapolis, Ind.: New Riders, 2003. 76-84. Print.

**Csikszentmihalyi, Mihaly.** Flow: The Psychology of Optimal Experience. New York: Harper & Row, 1990. Print.

**Deslauriers, L., E. Schelew, and C. Wieman.** "Improved Learning in a Large-Enrollment Physics Class." Science: 862-64. Print.

**From Software,** Dark Souls, PlayStation 3/Xbox 360/Windows, From Software and Namco Bandai Games. September 22nd, 2011

**Trafton , Anne.** "Even When Test Scores Go Up, Some Cognitive Abilities Don't." MIT News. Accessed March 14, 2015. <http://newsoffice.mit.edu/2013/even-when-test-scores-go-up-some-cognitive-abilities-dont-1211>.

**Ubisoft Montreal,** WatchDogs, Windows/PlayStation 3/Playstation 4/Xbox 360/Xbox One/Wii U, Ubisoft. May 27th, 2014

**Valve Corporation,** Portal, Windows/PlayStation 3/Xbox 360/OS X/Linux/Shield Portable, Valve Corporations and Microsoft Game Studios. October 9th, 2007

**Zynga,** Farmville, Web Browser. June 19th, 2009

# The Foundry

Thesis Project

2015

The Foundry takes place in the not too distant future inside a research and development (R&D) lab, known as “The Foundry”. The timeframe for this storyline allows the existence of futuristic technologies, while grounding the environment in the realm of possibilities for the player. The environment is crafted to be familiar and realistic. This accelerates the process of immersion for the player. In addition, puzzles that are constructed around futuristic technologies yield a greater range of game types and more visually appealing graphics. The R&D lab is founded by the government’s branch of the military to explore the potential of experimental technologies. The lab is spilt into two sections. One side is a workspace where the scientists tinker with experiments, while the other side is a computer lab where all of the invaluable information is stored. The player experiences the world from the perspective of a maintenance droid, the first model droid developed by The Foundry. The maintenance droid was meant to preform repair tasks in hazardous work conditions and has a limited artificial intelligence (AI). However, researchers have been studying cases where these maintenance droids have started breaking their own restrictions, deviating from task schedules and becoming uncommunicative to engineers’ commands. This has been seen as an inconvenience until recently, when The Foundry acquired a contract to build military droids for combat. To fix or cover up the issue of a faulty artificial intelligence, researchers have been experimenting and dismantling malfunctioning maintenance droids. The game starts when the player awakens to find himself in an experimental lab that reveals the aftermath of a misfired prototype weapon. The setting lacks power and is void of any evidence of life. To avoid debatable torture and dismantlement the player must solve the puzzles of the lab and escape.

