April 2012

Lilium: Exploring Collaborative Artificial Intelligence

Amy Takara Mazzucotelli
Worcester Polytechnic Institute

Benjamin Aaron Kaplan
Worcester Polytechnic Institute

Bishop S. Myers
Worcester Polytechnic Institute

Graham Sebastian Leto
Worcester Polytechnic Institute

Jennifer Rose Lay
Worcester Polytechnic Institute

See next page for additional authors

Follow this and additional works at: https://digitalcommons.wpi.edu/mqp-all

Author

Amy Takara Mazzucotelli, Benjamin Aaron Kaplan, Bishop S. Myers, Graham Sebastian Leto, Jennifer Rose Lay, and Robert Nathan Bass

Lilium

Exploring Collaborative Artificial Intelligence

Interactive Media and Game Development

A Major Qualifying Project Report
submitted to the faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the requirements for the
Degree of Bachelor of Science

By:

Robert Bass

Benjamin Kaplan

Jennifer Lay

Graham Leto

Amy Mazzucotelli

Bishop Myers

Advised By:

Professor Charles Rich

Professor Britton Snyder

Professor Keith Zizza

Abstract

Lilium is an Interactive Media and Game Development Major Qualifying Project created to test the bounds of cooperative play with teammates controlled by Artificial Intelligence (AI). The AI interfaces with an experimental, real-time planning application called Disco4Games. *Lilium* is a single-player, 3D action role playing game built in Unity featuring unique levels, characters, and sound created in a highly detailed, futuristic style. This project was an experience in bringing together the interdisciplinary aspects of game development.

Acknowledgments

We would like to thank our advisers Professor Charles Rich, Professor Britton Snyder, and Professor Keith Zizza for constantly pushing us to do our best throughout this project.

We would like to extend a special thanks to Elena Ainley and Anthony Russo, who contributed their talent and enthusiasm for two terms each. Elena animated Kevin and created the Generator level and the Garden level, character portraits, and the Juggernaut enemy. Anthony is responsible for implementing sound and music, creating the Jellyfish and Kamikaze enemies, and editing video footage for our trailers.

We would also like to thank Michael Johnson for his help with animation, Nick Konstantino for his help with rigging and animating, and Ryan Cassidy for his help with miscellaneous technical tasks.

Table of Contents

Table of Figures

1. Introduction

Lilium is sci-fi, party- based dungeon crawl in which players collaborate with computer- controlled allies to combat an extra dimensional threat.

1.1 Gameplay Briefing

In *Lilium*, the player will assume the position of the leader of three computer-controlled teammates. See Figure 1 for a screenshot of the player character and her three allies. Each teammate has a role: A defender/striker, a healer/saboteur and a marksman/controller. As the leader, the player has the versatility to attack with either ranged or melee weapons. The player can also give three overarching commands to the team: aggressive, defensive, and retreat. With the "aggressive" command, the team will use all of their best skills to take out enemies. The "defensive" command tells the team to be more cautious and not take risks in battle. When the player gives the command to "retreat", all allies withdraw from the battle. As the team leader, the player is given a special headset that allows for the player to switch between the current dimension and

9

another dimension. This allows for the player to attack creatures the team otherwise

wouldn't be able to damage. The overall gameplay would involve the player and his or

her team exploring through a level, fighting in several encounters of monsters that

spawn periodically, and activating a beacon at the end of the level to proceed to the

next area. Figure 2 shows an example of gameplay in the Lobby level with the player

character fighting enemies.

Figure 2: An action gameplay screenshot

As a result of the collaboration with the computer-controlled party members, the

project team has created a single player game that feels like a multiplayer game; the

player would not have to worry about allies acting unfavorably.

1.2 Design and Development

Lilium was created over the timespan of a year by a team of three tech members,

two artists and an artist/sound/producer member. Preproduction began almost

immediately after the creation of the project team in early May 2011. Production during

the school year began in late August 2011 and wrapped up in late April 2012. The project was overseen by two advisors, Professor Britton Snyder for art and Professor Charles Rich for tech. Over the course of the project there were temporary additions of an artist and an artist/sound member. The sound member was overseen by a sound advisor, Professor Keith Zizza.

The most influential goal of *Lilium* was to create a fun and interesting game with a party-based squad mechanic. The largest technical goal was the creation of the AI that would drive the actions of the three party members and the individual monsters that the player would fight against. The main art goal was to make an aesthetically pleasing 3D game with high-resolution characters, environments and a cohesive art style. Together these would lead to the creation of the final product: *Lilium*.

One of the initial parts of the project that helped determine what direction the project was headed toward was the game design. We discussed at length the backstory for the characters and universe and what kind of game we were aiming to make. Through the lengthy brainstorming process we pared down the main aspects to the inclusion of party roles, multiple enemy roles, encounter-based level design and the dimension-shifting mechanic. We also determined the win/lose conditions: defeat the enemies presented in the level and activate the beacon to move forward. If the player dies, they will be respawned at the last saved point.

The art team began the project with concept images of environments and characters. It became easier to finalize design and begin working on assets once the entire team was able to zone in on style and gameplay features. Initially, characters took

priority over environments because of the time it would take to model and animate them, but to balance out the overall product the art team switched to environments after some of the main characters were completed. After sufficient assets were created, the team began to polish the characters, animations and environments.

In the process of creating assets, we decided to experiment with some techniques used in the industry for animation. We took animation reference into our own hands and acted out movements and special choreographed fight moves .These actions were then recorded from a front and side view. The recordings would prove to be useful for reference when animating the characters because the animations could be timed to the speed of the reference materials. The positions of the animated characters could also by synced to the recorded reference. Since the goal was to achieve next-generation, high resolution graphics, we used Maya and Zbrush heavily to create assets. To allow for efficient frame rates throughout gameplay, we created efficient low-poly models in Maya while detailing the assets in Zbrush.

1.3 Tech Background

State machines are the simplest and most common form of artificial intelligence in games. Although easy to author and simple to use, they become increasingly difficult to extend, maintain, and debug as the number of states they need to manage increases. For *Lilium*, we wanted to use the AI to facilitate strategic and intelligent teamwork on behalf of the AI-controlled party members, so state machines were out of the question.

Instead, we opted to make use of hierarchical task networks (HTNs), a type of automated planning system in which goal tasks are modeled and decomposed to form

primitive actions. This would form the basis of our cooperation system, the so-called strategic AI.

Several of the technical achievements over the course of the project were the developments of the battle system, the development of the AI (both enemy and party member) and the use of strategy with experimental research technology Disco4Games (D4G). The project added a slight twist to the tech with the inclusion of the dimension-switching mechanic, which slightly affected the AI and Battle System. Dimension switching also served as an addition game mechanic to make gameplay more interesting.

One of the more overlooked aspects of the project when scoping was the tech art aspect. There was a significant amount of integration to be done with the project. In addition, we further customized the project by creating unique shaders used in many parts of the game. These shaders improved things such as the camera view or the eerie feel of the dimensions. Some aspects of the project simply had to be created from scratch in order for the game to function, such as animation events for animation blending and for sound to be added into the game.

After the project had been underway for a few months, we decided that it was time to begin working on the sound portion of the game. We relied heavily on creating our own sounds via Foley techniques (using props to create custom sounds timed to animations) and taking those sounds to be edited using sound editing software. In addition, we created music from scratch to be used in the game. After troubleshooting animation events, we were able to implement the created sounds in the game.

To bring all the different aspects of the project together, one of the members of the project acted as the manager for the team. This allowed for organized scheduling and regular meetings between all of the project group members. In these meetings the project was continually scoped, tasks were divided amongst the team, and progress was monitored over the course of the project. Google Docs, SourceForge and Dropbox served to help us to keep the assets and project organized and easily accessed.

When the project began to come together as a playable game, we began to gather feedback from players who would playtest the game. As with most games, it's often helpful to allow people with no familiarity with the games to test the game. Being unrelated to the project helps to find issues that the team members would not ordinarily notice. This was accomplished by having students play through the game and fill out a survey created for their responses. With the help of the gathered feedback, we were able to fix bugs and improve usability. For example, we switched player input from the mouse and keyboard control scheme to a more intuitive Xbox controller scheme. With the control scheme switch we saw a dramatic improvement in the ease of the play for the game.

For the last term we worked on the game, *Lilium* saw overall positive review during the various showcases we participated in (Presentation shown in Appendix J). Players from middle school age and above were able to pick up the game and immediately begin playing. Some players wished there were more content to the game after playing through the prepared demo. The journey to make *Lilium* was a long but enlightening

experience. With the school sanctioned portion of the project coming to a close, we

plan to continue work on *Lilium* after graduation.

2. Game Design

The gameplay and design of *Lilium* was heavily influenced by a backstory fully detailed in Appendixes A and B. It affected design decisions related to combat as well as character and level design.

2.1 Premise

The story is set in a nameless metropolis being besieged by a nameless, chronic illness. The disease can be cured, but the cure is difficult to obtain for most citizens. It also requires an inordinate amount of energy to produce, driving the price to nearly unreachable levels. This theme of desperation helps drive certain characters to make hard decisions and motivates the final acts of the game.

The game takes place in an alternate near-future in which technology has advanced far enough to allow for travel between parallel planes of existence (referred to as dimensions). This was proven rather dramatically five years ago, when a nameless research and development lab botched an experiment. A rift was accidentally created between dimensions, allowing beings from another world through. These extra-dimensional invaders, referred to as Outsiders, are now straining past the containment fields set up at ground zero. In addition, the Outsiders spread decaying damage from the dimensional rift. The disaster zone is surrounded by three levels of containment fields, the outer two built in rapid succession as the initial field inside began to break. The only way to liberate the area and cleanse the city is to first clear the areas of demons and then activate dimensional stabilizer beacons in the area. This serves to

wash away the blight that was allowing the Outsiders in. The Lab realizes they have to

act quickly and seek help in order to save the

city.

The player assumes the role of Lily, the

teenage daughter of the head scientist who

led the botched experiment. The lab director

recruits Lily to stop the extra dimensional

incursion with the thin promise to clear her

Figure 3: Lily meets the director

father's name. However, his reasons for needing her in particular aren't immediately

elaborated. Figure 3 is a still from the introductory scene where Lily meets the director

after she tenuously agrees to help him and acquires a special lab testing suit.

Lily is given charge of an experimental AI headset that enables her to stay calm and

calculating in combat. One by one, she meets her new team. The first teammate she

meets is Watson, a boy genius whose brain is connected to the lab's supercomputer. He

is granted immense computational power, allowing him instant recall power and the

ability to control certain machines. Next she meets Violet, a brash but strong girl with a

large hammer, a hidden agenda and chip on her shoulder. Finally, she is introduced to

Doc, an unnerving scientist whose face was trapped in the other dimension after an

experiment gone wrong. The four teammates gear up and get ready to clean the

outsider infestation from ground zero.

2.2 Gameplay

The majority of *Lilium* is played fighting along-side AI teammates with their own skills and abilities that impact the battlefield in a unique way (detailed in Appendix D).

2.2.1 Party Roles

The player controls Lily. Her role in the party is to be the leader of the team. She has two pistols for acting at range, but can freely switch to using swords for melee attacks. As the user of the headset, she can switch dimensions to chase down enemies hiding in the other world, many of whom can attack her allies regardless of dimension. In addition, she has the ability to set the stance of the party (offensive, defensive or cowardly) to tell her allies how aggressive she wants them to be a in a battle. Lily, along with her two weapon options, are shown in Figure 4.

Figure 4: Lily and her weapons

As the character the player controls, Lily was built to be able to support multiple combat styles. Since different players tend to play games in different ways, we wanted to allow the player to perform equally well when charging into combat or taking a more reserved approach. This also allows the player to switch combat styles on the fly if need be. However, Lily does not have the individual

focus that her AI controlled teammates have; a sacrifice needed in order to obtain the required flexibility.

The second member of the team is Watson. Watson acts as the main ranged attacker of the party as well as the person in charge of dispatching weaker enemies with area-of-effect attacks. He uses a machine gun and a grenade launcher capable of firing off a number of different grenades. Watson is also the only character that can induce the powerful "stun" status effect, which prevents enemies from acting for a certain length of time. Figure 5 shows Watson with his gatling gun.

19

Violet acts as the group's main tank. She uses powerful melee attacks and has high defense against the enemy. She has the ability to taunt enemies into focusing their fire on her and can then knock them back a distance with a swift blow of her hammer. Figure 6 shows Violet with her hammer.

Figure 6: Violet and her hammer

Kevin acts as the healer as well as saboteur. He is capable of healing and increasing the stats of the party with his green fist as well as poisoning and decreasing the abilities of troublesome enemies with his red fist. Figure 7 shows Kevin, as well as a simple diagram outlining the differences between the functions of his fists.

Figure 7: Kevin and his fists (weapons)

2.2.2 Enemy Roles

There are eight distinct enemy types in the game with different

skills (see Appendix E for details):

Figure 8: The Sniper

1. The Sniper (Figure 8): The Sniper is a ranged enemy with
   slow, powerful attacks. Snipers are capable of attacking
   across dimensions. Snipers used the default Jellyfish model and
   textures.

2. The Juggernaut (Figure 9): Juggernauts are large
   enemies with strong knockback attacks and huge
   amounts of health. Juggernauts use the default
   Juggernaut model and textures.

Figure 9: The Juggernaut

3. The Kamikaze (Figure 10): Kamikazes are small, weak
   enemies with unimpressive attacks. When they take
   too much damage, they start a fuse. If they are not
   killed before it goes off, they explode, dealing
   massive amounts of damage anybody nearby. Kamikazes
   use the default Kamikaze model and textures.

Figure 10: The Kamikaze

4. The Ninja (Figure 11): The Ninja is an enemy

   capable of attacking and using a powerful poison

   through dimensions. Ninjas can also shift dimensions to

   escape the player. Ninjas use the Crawler model with

   alternate textures.

Figure 11: The Ninja

5. The Sentry (Figure 12): The Sentry is a ranged debuffer with

   many attacks capable of lowering the abilities of the party as

   well as dealing damage. Sentries use the default Jellyfish model

   and textures.

Figure 12: The Sentry

6. The Crawler (Figure 13): The crawler is a small, weak

   enemy that appears in large numbers. Crawlers use

   the default Crawler model and textures.

Figure 13: The Crawler

7. The General: Generals are melee enemies capable of attacking from both dimensions. They have the ability to buff their allies, and to switch between dimensions when threatened by the player. They also have the devastating Aether Blade attack which, unlike most attacks, deals full damage across dimensions instead of partial damage (see Dimensions, below). Generals use the Juggernaut model with alternate textures.

8. The Doctor: The Doctor is a melee enemy capable of freely switching between dimensions, healing and buffing other monsters, and poisoning. Doctors are not implemented.

2.2.3 Dimensions

Gameplay takes place in two parallel dimensions. The dimension colloquially known as the "normal dimension" or the "real world" contains Lily's team and most enemies. The other dimension is reserved for small numbers of enemies as well as the few enemies that can shift between the two at will. One of Lily's unique gameplay abilities is to switch between the normal dimension and the dimension of the outsiders. As the only member of the team capable of switching Lily must be the one to eliminate all enemies there, as the rest of the team is cannot attack or defend against them. All beings in the dimension opposite the player appear as hazy, transparent outlines. This also applies to items in the other dimension.

Some enemies have the ability to attack between dimensions. With a single exception, all attacks that cross dimensions do less damage if the target is in the other dimension. Nevertheless, these enemies will continue to harass the party until the player switches dimensions to take them out.

Dimensional gameplay mechanics were put forth as an idea fairly early in development, but it wasn't until later that we recognized their importance. During our early playtesting sessions, players commented that they felt overshadowed by the AI controlled players; they didn't feel like a leader. Dimensional mechanics give the player a unique ability that is key to the survival of the party, emphasizing the player's role in combat and making the player feel more crucial to the party.

2.2.4 Technical Gameplay

The game is played as a third-person, real-time action game in which the player controls Lily, one member of the four person team. All actors (the party, and all enemies) interact with other actors by performing actions on them. This makes all interaction discrete and thus makes the game easier to model than some other types of real-time gameplay.

Every entity has the following statistics: a defense value, a dodge value, and an agility value that controls their move speed. In addition, every entity wields one or more "weapons", although some weapons are innate, such as claws or fists. A weapon has an attack value, a critical rate, and an accuracy value. Every different action has a base damage associated with it.

The chance for an attack to hit is the attack's accuracy divided by the target's dodge rate. The maximum chance for an attack to hit is "1," if the accuracy is equal to or greater than the enemy's dodge. The damage dealt by an attack is the action's base damage multiplied by the weapon's attack, which is then divided by the target's defense. In addition, every attack has a chance to deal double damage equal to its critical rate. All entities, weapons, and actions were stored in XML files that were loaded when the game was launched, making modification simple.

2.2.5 Win/Lose Conditions and Goals

Lily's goal for every level is to defeat all enemies. Enemies will start to spawn based on a trigger, such as Lily walking into a certain area, and continue to spawn until the encounter is defeated. A level contains one or more encounters inside it. After Lily

reaches the end of a level she can activate the beacon (shown in Figure 14), open the

blast door and progress to the next level.

Figure 14: The beacon

When one of Lily's allies reaches zero health, they "die" and are removed from the

encounter. However, between encounters Lily can approach one of the beacons on a

level and use it to recover all party members to full health.

When Lily reaches zero health, the game automatically ends and can be reset from

the last save.

2.3 Evaluation

The most prominent area of note at the end of the project is that of the story. The entire story was removed from the game, which made the game effectively a sampling of levels from the middle of the fully planned game. In addition, a selection of planned features such as upgrades was not implemented due to time constraints. Overall, the story was overambitious and did not take into account the development time and effort for a game with a complicated art style in a 3D game engine.

3. Art

Lilium is a 3D science-fiction themed game. For a visual style, we wanted to focus on creating highly detailed assets along the lines of many current AAA titles, and we used Maya and Zbrush for all of our asset production. Although connections can be drawn, no single game inspired the aesthetics for *Lilium*. We chose to use a semi-realistic art style with believable human proportions but with painted textures for a less photorealistic feel. In addition, we wanted to make the world interesting through the use of brighter, more vivid color schemes. To add the final touch for our sci-fi feel, we added many small details on our characters that would glow.

3.1 Character and Enemy Pipeline

All of the characters and most of the enemies were based off of initial concept art or rough sketches (see Appendix C for concepts).   With the exception of one enemy and character, we created base meshes in Maya and sculpted details in Zbrush. The models were then exported back into Maya with normal and diffuse maps generated from the Zbrush sculpt. The advantages to this workflow include the ability to set up custom UVs toward the beginning of the process as well as starting with a low-poly base mesh that is game-ready. The major disadvantage is that if the overall shape of the mesh is altered significantly during the sculpting process, which is very common, then it becomes necessary to rebuild the low-poly game mesh (through the process of retopologizing) and throw away the original once the sculpt is finished, thus eliminating the advantage of starting with a game-ready mesh. This method has the potential to

Figure 15: Low-poly game mesh wireframe, low-poly mesh with normal maps, and low-poly mesh with diffuse and normal maps

save time later in the process, at the expense of conforming our sculpted meshes strictly to the original shapes we built in Maya. Figure 15 shows from left to right: the low-poly mesh, the low-poly mesh with the normal map generated from Zbrush, and the final game model with normal and diffuse maps. For this particular model, the original body was not altered but the head needed to be rebuilt.

Watson and the Crawler were modeled using a slightly different workflow; they were sculpted in Zbrush, then a low-poly mesh was created to match the high-poly sculpt through retopologizing. The low-poly mesh was given UVs using the UVMaster plug-in in Zbrush and exported to Maya. While this method eliminated the restrictions on sculpting and is a more natural choice for organic sculpting, it raised the problem of retopologizing, which is often a frustrating process.

Each workflow had its unique set of advantages and disadvantages, though each artist chose his or her workflow based on personal preference and we never implemented a specific protocol for how to create assets. Ultimately, both processes resulted in a low-poly model which could be animated and would function equally as well in the game.

3.2 Texturing and Generating Maps

Texturing our characters was primarily handled within Zbrush via polypainting. Polypainting involves painting the mesh directly in Zbrush and is advantageous over traditional UV painted textures because painting on a 3D model in 3D space is much more intuitive. The drawback to polypainting is that the resolution of the generated diffuse map (color) is often dependent on the resolution of the high poly model. The higher the polycount, the clearer the diffuse map will be. We primarily used polypainting for texturing our models but took the generated diffuse maps into Photoshop to touch up the maps, either making certain details clearer or tweaking contrasts or filters. From the diffuse maps we were able to generate specular maps for shine as well as self-illumination maps for glow.

Texturing environments was much the opposite of characters. The traditional UV map painting in Photoshop (which involves painting a flat representation of the model) was much easier because of the simpler UVs. Organic UVs are more difficult to texture because the layouts of the UVs are often less intuitive. Early renditions of the environment had some photorealistic textures, but later during development we updated to painted textures to match the characters.

3.3 Rigging and Animation

After the modeling process, all of the characters were then rigged using eRig, a biped character rigging tool created by WPI alumnus Elliot Borenstein[1]. While eRig is

---

[1] http://www.elliotb.com/Tools/eRig.html

designed primarily for bipeds, we were also able to use it to rig several of the monsters including the Crawler and the Juggernaut. The main advantages to using eRig were spending less time rigging and having a fully functional rig with many specialized controls that we probably would not have included had we rigged each character from scratch.

We animated each of the characters and enemies by hand using keyframes. For the human characters, we used reference material that we filmed ourselves to capture some of the unique actions for each character. We set up two cameras, front and side, and filmed each other performing character-specific actions including sword attacks and hammer swings with stand-in props as weapons. We then took this footage and played it side by side while we animated in Maya in order to recreate realistic animations (Figure 16). Not all of the animation reference we captured was used in the game and not all of the animations in the game were referenced, but it was a valuable exercise in studying human movement and weight.
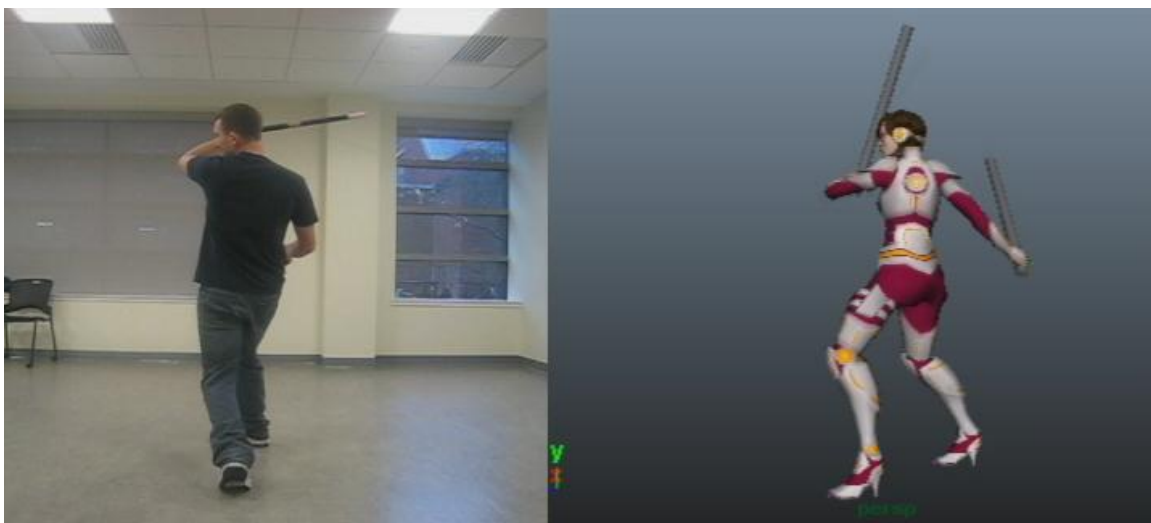
Figure 16: Animation reference (Graham) and final animation

In general, we used two different workflows for animating characters. The first method was to animate each individual action in separate files. We initially thought this was the optimal way to animate, but it turned out that it was actually more work during the integration process in Unity. However, this was still a viable workflow because it was easier to stay organized with a separate file for each animation and individual animations could be passed off to someone else so animations could be edited simultaneously. We wanted to combine all of the animations into a single file for easier integration, so we used the Trax Editor and Character Sets in Maya to accomplish this.

The second method was to animate all the actions for a single character within one file. This method had the advantage of not needing to be combined prior to integrating, and it kept all of the animations in one place. The disadvantages to this method are that it is often easy to change something in one animation that inadvertently affects the others, and if the file is corrupted or lost, then all of the animations are compromised.

3.4 Optimizing Content Creation

Two of the human characters, Lily and Violet, use the same base model and rig. Violet was modeled, textured, and rigged first. Then, to create Lily we simply recolored Violet's textures and modeled a different hairstyle. This saved about eight weeks of work for one person, and produced two unique characters in just slightly longer than it took to create one. They were animated separately in order to differentiate the two, and also because they only shared a few common animations.

The characters were modeled with animation in mind by modeling in pieces. While each character's body would be one solid piece, any accessories or rigid parts were attached separately, including shoulder pads, arm accessories, and knee pads which would not deform when the character moves. We also streamlined the animation process by electing not to use facial animation. In the game, the characters would usually be too far away to see their faces distinctly enough for facial expression to be effective. In addition, because the game is played in a third person view the main character's face would often be facing away from the camera.

We also optimized the hallway level for expansion by creating tilesets. By designing our level with tilesets we could quickly create new content using a set of premade building blocks rather than modeling everything uniquely. The hallway base consists of a straight segment and a corner segment which can be connected seamlessly to generate a vast number of different hallway configurations. There are also sets of props in the level including pipes, electronics, and fans which were scattered around the level to make each area feel unique and to help alleviate the repetition of the tiled wall segments while at the same time establishing continuity throughout the level.

To create continuity between levels, we reused assets like the flower logo, light fixtures, and specific texture patterns. We also adjusted the lighting in each area to blend together slightly so that even if the overall feel of each room is different, they are all still related by a few commonalities. Reusing assets also allowed us to populate our levels without creating entirely new sets of models for each new room. Tilesets and resuable assets are also conducive to further level creation with minimal new content

creation. For example, using only the pieces from the hallway level, we were able to create a short tutorial level.

3.5 2D Art

Although *Lilium* is a three-dimensional game, there are some specific two-dimensional elements, including the graphical user interface (GUI) and storyline cutscenes.
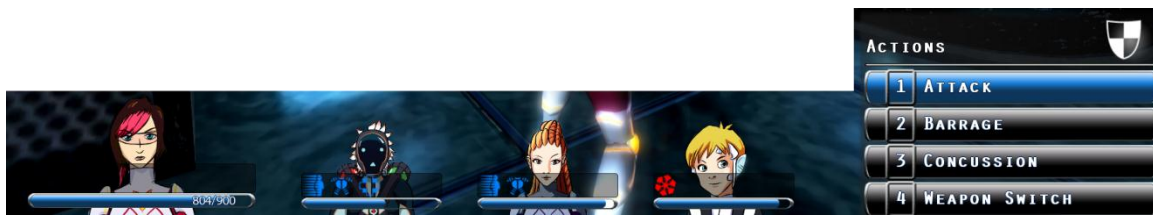
Figure 17: GUI

The graphical user interface is comprised of two-dimensional images including character portraits, health bars, and action buttons (Figure 17). There are also several icons to indicate status effects or buffs. We chose to include character portraits as a simple way of identifying each character's health and status on screen as well as to indicate which character is speaking. Character portraits also served to add additional style to the game with a thick outline and cel-shaded cartoonish feel. The user interface went through several iterations and redesigns until we were satisfied with the look and functionality of the current layout. We started with paper prototypes and Photoshop mockups of the graphical user interface designs until we agreed on an overall layout which was then implemented in the game.

Since our game was initially very story-driven, we identified the need for cutscenes to convey the story to the players. We decided that since we did not have time in the scope of the project to animate full 3D cutscenes, we opted for a completely different aesthetic with hand-drawn comic book style graphics. The only cutscene created for this project is an opening sequence which reveals the main character's history and motivation as well as introduces her three allies and the enemies in the game (Figure 18).

Figure 18: Sample cutscene stills

3.6 Consistency

We had three full-time artists working on the art for *Lilium* as well as two other independent study students helping with content creation at various points during development, which introduced five different art styles and raised the challenge of unifying all of the assets. Since each level was created by a different person, they originally started out with vastly different aesthetics; they each had their own individual color palettes, and some used photograph textures while others were painted. Eventually all photographic textures were replaced with painted textures, and we re-textured several areas using combinations of existing patterns and color palettes to help tie everything together. Tweaking the lighting to add color hues to the levels also helped to unify overall but distinguish the different levels. The hallway level also became a

motif for connecting different areas; the generator room initially seemed disconnected from the rest of the game, but we added hallway segments leading in and out of the room to visually join the two areas. Refer to Figure 20 and Figure 19 for a comparison of the old and new designs for the hallway and generator rooms, respectively.

Figure 20: Old vs. new hallway level
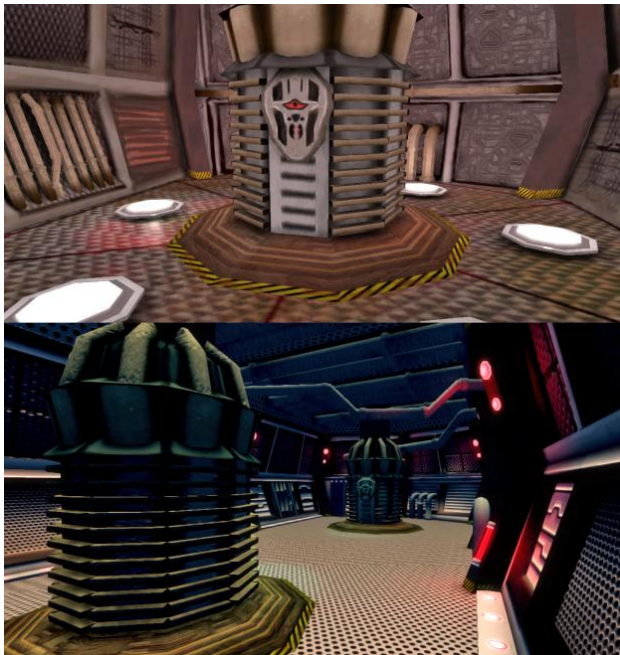
Figure 19: Old vs. new generator room

4. Engineering

The core technical challenge we tackled in creating *Lilium* was to create computer-controlled allies who acted both autonomously and intelligently without requiring micromanagement on behalf of the player. To that end, we drew inspiration from multiplayer co-op games, where each player must rely on their teammates without being able to control them (or knowing what they're doing). To accomplish this, we created a division of labor between the AI of individual agents and that of the team as a whole as shown in Figure 21.
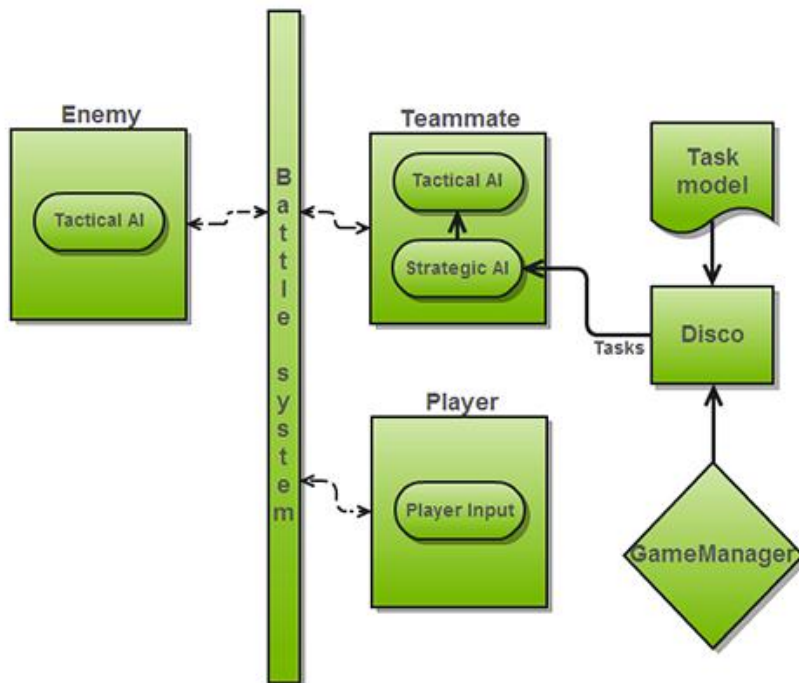
Figure 21: Technical Diagram

There are three types of actors who engage in battle: the player, the player's teammates, and enemies. The simplest actor is the player, who provides the game with input which the player character interprets and executes as commands. Enemies are controlled by a simple state machine AI. The most complex actors are the player's

teammates, who are controlled by a two-tiered AI system: the tactical AI and the strategic AI.

4.1 Strategic AI

The team-level collaboration is handled by a high-level system known as the strategic AI (Figure 22). The strategic AI coordinates the combined efforts of each of the teammates' individual tactical AIs (Appendix F). The strategic AI operates as a hierarchical task network (HTN), with each of the tasks being a "strategy," a sequence of commands for the team mates which, combined, constitute a coordinated effort analogous to a football play.
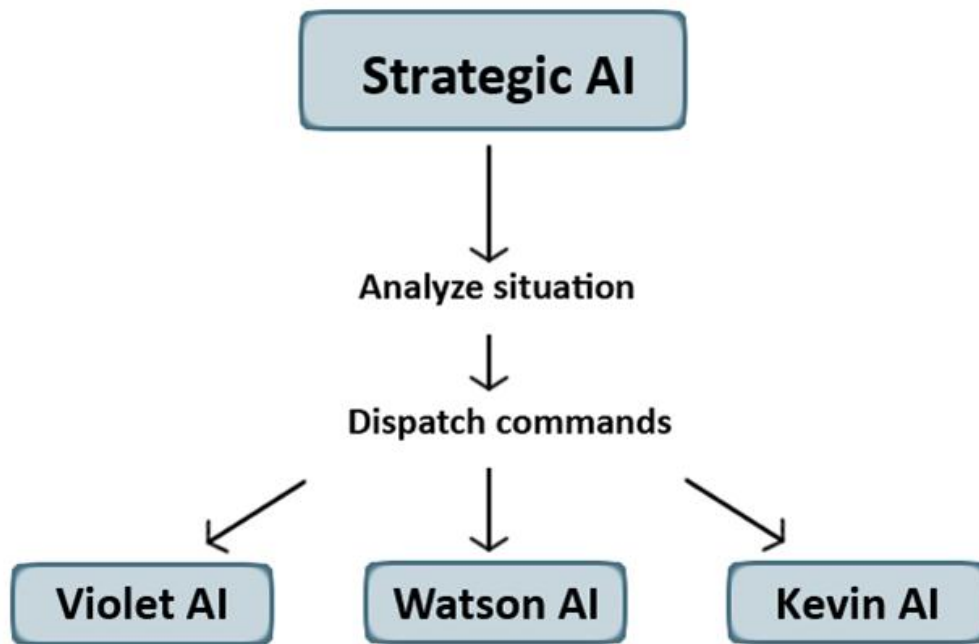
Figure 22: Strategic AI diagram

To build the strategic AI, we used a piece of experimental software called D4G (Disco for Games)[2]. Disco is a declarative language used to define AI behaviors in the form of hierarchical task networks (Figure 23). Put simply, the system defines a single "goal" which has a number of conditions which must be satisfied for that goal to be considered achieved. The goal is then decomposed into a number of tasks which work toward accomplishing the goal, each of which can optionally be decomposed into subtasks, and so forth. Tasks can be decomposed multiple ways based on conditions, which increases the flexibility of the system. Individual tasks can also have their own preconditions, which cause the task to halt until they evaluate to true, and postconditions, which determine when the tasks are completed.

---

[2] IEEE Computer, Vol. 42, No. 8, August 2009.

```
101       </subtasks>
102      </task>
103
104      <task id="FocusFire">
105          <precondition>
106              elitePresent() &amp;&amp; !clusterPresent()
107          </precondition>
108          <postcondition sufficient="true">
109              !elitePresent() || clusterPresent()
110          </postcondition>
111          <subtasks id="TargetLocked" ordered="false">
112              <step name="violetTarget" task="ChangeState"/>
113              <step name="watsonTarget" task="ChangeState"/>
114              <step name="kevinTarget" task="ChangeState"/>
115              <step name="wait" task="Wait"/>
116              <binding slot="$violetTarget.who" value="DiscoView.Character.Violet"/>
117              <binding slot="$violetTarget.state" value="DiscoView.StateToUse.Attack"/>
118              <binding slot="$violetTarget.target" value="DiscoView.Target.Elite"/>
119              <!---->
120              <binding slot="$watsonTarget.who" value="DiscoView.Character.Watson"/>
121              <binding slot="$watsonTarget.state" value="DiscoView.StateToUse.Attack"/>
122              <binding slot="$watsonTarget.target" value="DiscoView.Target.Elite"/>
123              <!---->
124              <binding slot="$kevinTarget.who" value="DiscoView.Character.Kevin"/>
125              <binding slot="$kevinTarget.state" value="DiscoView.StateToUse.Attack"/>
126              <binding slot="$kevinTarget.target" value="DiscoView.Target.Elite"/>
127          </subtasks>
128      </task>
129
130      <task id="CriticalInjury">
131      <input name="who" type="DiscoView.Character"/>
132          <precondition>
133              $this.who != undefined &amp;&amp;
134              (atCriticalHealth($this.who) ) &amp;&amp;
135              !dead($this.who) &amp;&amp;
136              !dead(DiscoView.Character.Kevin)
137          </precondition>
138          <postcondition sufficient="true">-->
139              !atLowHealth($this.who) || dead($this.who)
140          </postcondition>
141
142          <subtasks id="PlayerAtCritical">
143              <step name="kevinHeal" task="ChangeState"/>
144              <step name="violetGuard" task="ChangeState"/>
145              <step name="watsonGuard" task="ChangeState"/>
146              <step name="wait" task="Wait"/>
147              <applicable>
148                  $this.who == DiscoView.Character.Lily
149              </applicable>
150              <binding slot="$kevinHeal.who" value="DiscoView.Character.Kevin"/>
151              <binding slot="$kevinHeal.state" value="DiscoView.StateToUse.Heal"/>
152              <binding slot="$kevinHeal.target" value="DiscoView.Target.Lily"/>
153              <binding slot="$violetGuard.who" value="DiscoView.Character.Violet"/>
154              <binding slot="$violetGuard.state" value="DiscoView.StateToUse.Attack"/>
155              <binding slot="$violetGuard.target" value="DiscoView.Target.Lily"/>
156              <binding slot="$watsonGuard.who" value="DiscoView.Character.Violet"/>
157              <binding slot="$watsonGuard.state" value="DiscoView.StateToUse.Attack"/>
158              <binding slot="$watsonGuard.target" value="DiscoView.Target.Lily"/>
159          </subtasks>
```

Figure 23: Disco screenshot

Due to the processor-intensive nature of D4G, the Unity version of Disco runs on
a separate thread from the rest of the program. Because of the huge amount of
computation necessary, information is only pushed to D4G every second or so to keep
the framerate from suffering. This introduced a number of problems arising from Unity's
handling of threads and the way API calls are made with them. To circumvent this, we

created an interface between Unity and D4G called DiscoGlue. DiscoGlue performs "sensing" upon the state of the game and acts as the strategic AI's eyes and ears inside the game world. It observes information which D4G cannot access directly, such as the locations of objects in the game world as well as adapts and routs commands sent from D4G to the respective object.

In *Lilium*, Disco is used to define strategies. A strategy generally consists of a set of preconditions which determine when the strategy should be triggered, followed by commands telling each of the individual party member state machines to change state. Some common strategies involve reacting to specific assortments of enemies, rearranging healing priorities on characters based on their health, and dealing with routines to be executed at the very beginning and very end of battles.

In certain situations, we wanted to override the strategy chosen by D4G and have the AI perform a manually-chosen interrupt strategy. This system allows for scripted events to force a specific strategy to activate as well as to create a priority list of special strategies (such as emergency healing). These strategies automatically override the general-purpose behavior and continue running until completion, at which point the default behaviors take over once again. Any strategy can be called as an interrupt strategy, including special purpose strategies which aren't part of the default behavior loop.

The ability to call interrupt strategies lends itself to another interesting mechanic: location-based strategies. By having a trigger activate an override strategy when the player reaches a specific point on the map, characters can be given specific

behaviors based on where the player is in the game. Such location-based strategies could cause characters to attack specific enemies, seek cover or high ground, or initiate flanking maneuvers in reaction to the space around them. Since default behavior automatically reinstates itself once the override behavior is done, battle still flows smoothly.

4.2 Tactical AI

Each of the player's teammates possesses an individualized tactical AI. The tactical AI is the low-level AI and equates to the kinds of AI commonly found in other games. The tactical AI is a state machine which is custom-tailored to each of the teammates to suit the individual needs of the role they play in battle.

The tactical AI (Figure 24) governs the moment-to-moment actions of the actor. Based on its current state, the tactical AI determines which action to perform and instructs the actor to move to the proper location to execute that action.
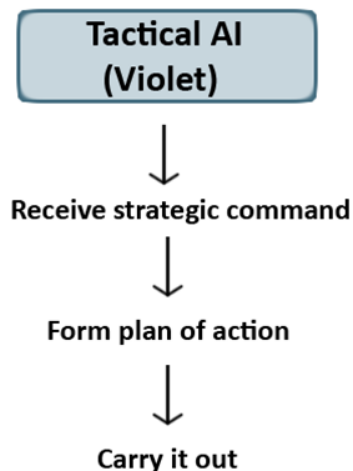
Figure 24: Tactical AI

Commands sent by the strategic AI are received by the tactical AI, which formulates a plan of action on how to accomplish that task given the actor's location and the actions available to it. For example, when a command to attack is received, the tactical AI will look through a weighted list of the offensive actions that it can perform and decides which one to execute. Because actions, once performed, require a certain amount of time to pass before they can be performed again, the tactical AI is responsible for predicting how frequently to use powerful abilities in order to ensure that they will be cooled down to use when the need arises. This behavior can be altered to some degree by the player, by indicating whether the AI should act aggressively or defensively.

In most situations, the strategic AI does not specify a target for an actor to attack. Along with the specifics of which attack to perform, determining the target of the attack is the role of the tactical AI. Once the target and action to perform are decided but before they are executed, the tactical AI records the "weight" of the action, which is how desirable the action is to perform. If it is the best choice out of many undesirable actions, it may have a weight of 1, 0, or even negative; on the contrary, if the AI thinks that this action will single-handedly decide the course of battle, it may return a weight of 10 or higher. The tactical AI then uses this weight to determine whether the move is worth performing and if so, it executes it.

While this is the general behavior for how the tactical AIs behave, there are a number of exceptions. For instance, the action weighting system is not used by Kevin's Heal state or the Buff state, as they require nuanced analysis of party situations that

ended up being mostly written directly into the code for their states. In addition, Violet

has the ability to enter a beserking rampage, in which she will automatically choose and

perform actions without validating their desirability. Other tweaks and variations on the

concept also exist in the game, but in general all of the tactical AI behaviors are built

atop this basic model.

Because D4G only updates once a second or so, the tactical AI had to be

designed with a certain degree of autonomy from the strategic AI. In the absence of a

fresh command from the strategic AI, the tactical AI will continue to act on the last

command it was given, which allows it to continue acting smoothly even if D4G starts to

lag behind.

4.3 Enemy AI

As enemy behavior was not the main focus of this project, the enemy AI is fairly

standard and is analogous to the team member tactical AI. All enemies use the same

base criteria for determining which player should be deemed "most important" to

attack. This data is used by the individual enemy AIs to decide which of the enemy's

skills they should use. In most cases, the enemies simply prioritize certain skills over

others, only making simple checks to decide whether the ability is worth using. For

example, one enemy might prioritize its poison skill, and check whether the highest-

priority hero is poisoned, and whether the ability is available to use. It would then

choose to use the poison ability if the character was not poisoned and the ability was

available; otherwise it would attack.

Some enemy AIs also include simple state machines to determine which behaviors it should use. This is the case for long-range enemies, which move towards their target if they are outside range, but move away if the target is too close, creating the strafing behavior of the Sentry and Sniper enemies.

4.4 Battle System

The abilities which actors can use are represented by actions. Actions have two main purposes: firstly, they contain all the data about the abilities they represent, such as who it can target, how many seconds it takes to cool down, what special effects it triggers, and, of course, what it actually does. Secondly, the action contains the functionality needed to set the target, determine if the action is successful, and apply the effects of the action. Thus, an entity's AI needs only to select an appropriate action and set its parameters correctly. Since all actions use the same functions to apply their effects, once the initial parameters have been set it becomes irrelevant which action is actually being performed; the process for performing any arbitrary action is the same.

4.5 Dimensions

As discussed in the Gameplay section above, the player has the ability to switch between two "dimensions:" the physical world, and the other world from which the outsiders come. Technically, the primary challenge behind this mechanic was organizational in nature: how do we represent the dimensions and dimension switching in code? Do we use a centralized system to keep track of which objects are in certain

dimensions, or does each entity keep track of its own dimension? How do we know

how things should react when something switches?

Eventually, it was decided that an observer pattern should be used in this case,

in which the player has an "observable" that other "observers" can register to, and

receive messages from. Each enemy and AI controlled player has an observer that

registers it with the observable unit attached to the player. When the player switches

dimensions, it sends a message to all concerned entities that calls a handler, passing in

data about the dimension the player is currently switching into. Since each actor also

keeps track of the dimension it's currently in, it can compare this value to the value

passed in to determine how it should react.

4.6 Evaluation

By creating the party's tactical AIs as a controller overseeing a state with a target

and a stance, it allowed for many different behaviors within each character through

different use of states to respond to different situations. For instance, Watson's AI has

only an AI controller, and a single state: Attack. However, through this he can be told to

attack targets of opportunity (Target threats to self), kill bosses (Target Boss), clean up

small enemies (Target Mook), guard any one of his allies (Target threats to Lily, Kevin, or

Violet), or run away (Stance Cowardly). Kevin, whose cascading states allowed him to

choose from wider and wider pools of actions until one was found to be beneficial, was

the most versatile, able to switch from healing to poisoning an enemy to giving

defensive buffs with no lag time and no input from Disco.

Disco is an incredibly powerful system, but it is also extremely difficult to use. A great deal of time was spent simply trying to comprehend how to use the system, and integrating it with Unity was also quite difficult. In addition, while Disco's format made it fairly simple to add new strategies, we found that we weren't using many of Disco's powerful features, such as its ability to create complex trees of actions. Finally, even when run on a separate thread, we found that Disco still caused *Lilium* to lag significantly. Even with these problems, we still believe that Disco has potential for future use. However, it would be much better suited for turn-based games, which don't rely on quick timing, yet could still benefit from its strong points.

5. Tech Art

Technical artists act as a liaison between artists and programmers. They typically work on tasks such as integration, scripting, and writing shaders.

5.1 Integration

In our project, the technical artist was mostly responsible for the integration of art assets, including sound.

5.1.1 Audio Integration and the Sound Controller

When the integration of audio began, we became concerned about how we would synchronize sound effects to animations. For example, how could we ensure that when a character's foot comes down upon the ground that a footstep sound effect plays at that moment? Fortunately, we discovered that Unity provides a convenient feature called animation events that made this task trivial. Animation events allowed us to bind a function call to a frame of an animation such that the given function is called whenever that frame is played in the game.

We ran into an issue with using animation events almost immediately. All of the animations which we had imported from Maya in .mb format were acknowledged by Unity as "read-only" (Figure 25). This meant that they could not be edited in Unity's animation view, which is the interface for creating animation events.
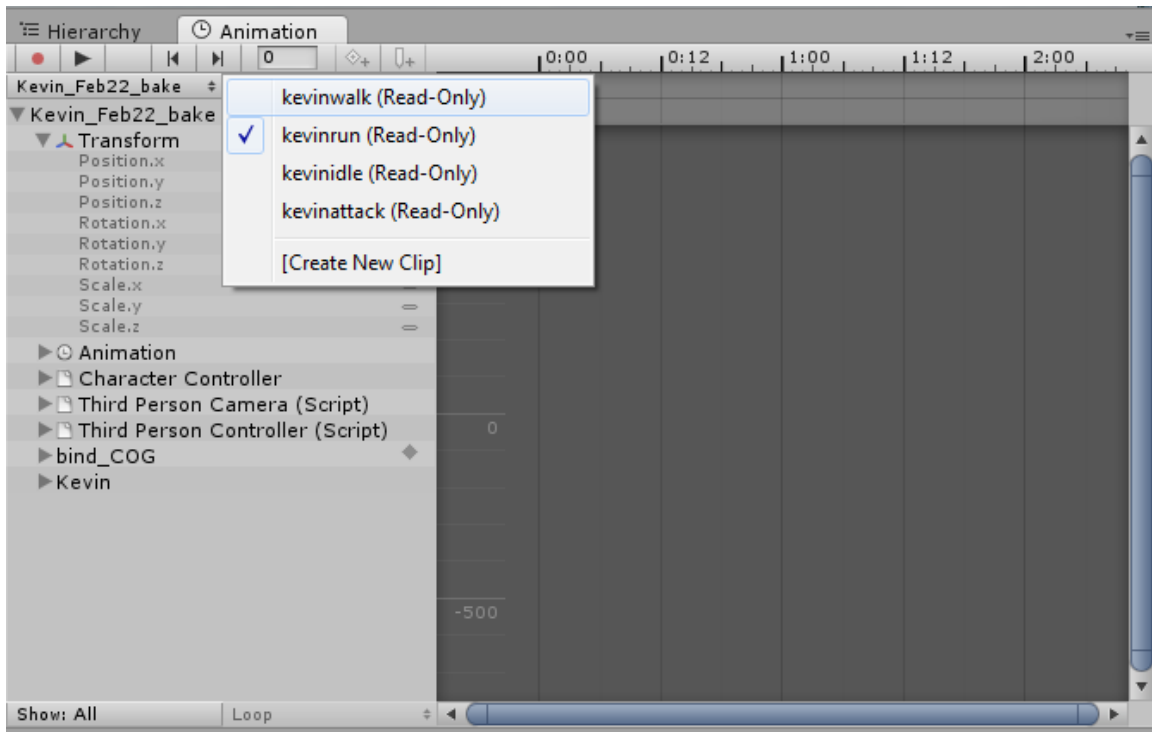
The only solution we could find was to duplicate all of the animations in Unity, which converted the animations into Unity's .anim format. More importantly, this removed the read-only flag and allowed the animations to have animation events assigned to them. Although inelegant, this solution was simple and allowed us to proceed with creating animation events.

To provide a convenient API for the artists handling audio, we created a sound controller component which was attached to any entity that had sound synchronized to animations. The sound controller takes in an AudioClip (should it be capitalized like in Unity?) and plays the sound at the location in space of the entity to which it's attached.

Although this worked at first, problems arose after our first playtesting sessions with audio intact. Playtesters noted that certain sound effects, such as attacking sounds,

played too frequently and sounded repetitive. To fix this, we decided to make certain sound effects be playable at a random pitch to create variety.

The task of adding a randomly varying pitch to the sound controller seemed simple. The initial design was to modify the sound controller such that its sound playing method would take in three parameters: the AudioClip to play, the lower bound for the pitch, and the upper bound for the pitch. Then, it would randomly select a pitch between the lower bound and the upper bound and play the sound with the modified pitch.

However, an unfortunate limitation of animation events presented us with an obstacle. A function called from an animation event can only be passed a single parameter. That one parameter must be used for the AudioClip we want it to play, since the alternative is making a variant function for each possible sound effect and calling that.

Since it was unfeasible to use anything but the AudioClip to play as the one parameter, we needed some way to provide a random pitch range without passing in a parameter for it. We compromised between flexibility and usability by creating four different functions which could be called, one which would play the given sound effect at a random low pitch range, one at a random medium-low pitch range, one at a medium-high pitch range, and one at a high pitch range.

5.1.2 Animation Blending and the Animation Controller

The naïve approach to creating an animation controller was to have it play the entity's idle animation while it was motionless and its running animation while it was moving, unless an override animation was playing. An override animation is any animation which can be initiated externally and takes precedence over whatever animation was playing before. As an example, when an entity attacks, they enter their attack animation even though they were in their idle animation before. Then, when the override animation is finished playing, it would revert back to its idle animation.

In this model, the update loop of the animation controller would determine whether or not to transition back into the idle animation by checking if the currently-playing override animation had completed. However, a problem with this model arose in implementation: we could find no way in Unity to determine whether or not an animation had completed.

Without the ability to check in code whether or not an animation has completed playing, this model quickly fell apart. To circumvent this, we took a new approach using animation events. For each override animation, an animation event was called on the last frame of that animation which set the animation to the idle animation.

This approach solved our problem, although it did present some overhead each time an animation needed to be re-integrated, since doing so required the animation events to be set up again. Although it worked in the general case, in playtesting, we found that sometimes, the animation event would not be triggered, resulting in an

override animation playing indefinitely. At the time of writing, we have been unable to

find a solution to this problem.

6. Sound

In keeping with the high standard set by the art and tech of the game, we wanted to make *Lilium* sound excellent. To achieve that goal, we used Foley recording and wrote original music to a unique sound library custom-tailored to match the game's aesthetic.

6.1 Process

The process began by creating an asset list for every possible sound the game might need and organizing them by the method in which they would be created. Most of the sounds fell into the "record" category, so we got to work recording early on. During a recording session, we would bring various props such as ground beef, vegetables, and metal pipes to a sound lab to record using a Zoom H2N microphone. We also recorded environmental sounds for ambiance by finding interesting and relevant sounding rooms to record in. For example, the basement of Fuller Lab on the WPI campus served as an excellent place to record the ambiance for laboratory hallways. Once the raw recording was complete, we went back to the IMGD lab to edit the sounds using Avid Pro Tools, Audacity, and Apple Logic.

The third major part of the sound aesthetic we wanted to create was original music. One of the sound designers used GarageBand and Logic to write and compose original tracks that play at different points in the game. He drew inspiration from the Mass Effect series to create an alien, electronic feel with his music.

6.2 Integration

The process of integrating the sound created the most challenges for the sound team. We wanted to be able to synchronize sounds to various animations in Unity using animation events. However, we ran into problems when trying to access the animation files in Unity to add events to them, as discussed previously in the Tech Art section at 5.1.1. Once we were able to access the animation files and set events, however, the sound integration process became much easier. We simply would add an event at the precise key-frame in an animation to call the function "play sound," which would play the desired sound effect. For example, in a walk cycle animation, at each footfall, an animation event would occur that would trigger a "footstep" sound to play.

In conclusion, although the integration of the sound assets took place a lot later than expected, we were able to bring in all of the custom-recorded sound effects and music. The result was that we were able to create and integrate mostly original sound files that help to compose a cohesive acoustic environment.

7. Project Management

With a six-person team, three advisers, and two ISP students, *Lilium* began as a large endeavor with a rather wide scope. During the planning stage of the project in D term of 2011, the advisers suggested that one of the team members serve the role as project manager or producer.

7.1 Scope and Planning

Due to the large scope of the project, a good deal of pre-planning was necessary. During the summer of 2011 we would meet electronically to plan out the gameplay and narrative of *Lilium*, and went into the start of development with a good idea of what *Lilium* was going to be. The producer set the schedule for the first two terms based on the goals set during the summer and initial development meetings.

It became clear early on that the initial scope and vision for the game was too large to accomplish in the time given, even with such a large group, particularly on the art side. Initially, we had planned on having four unique environments, five main characters, and several enemies. After the pace was set in the first term of development, the team determined that there wasn't enough time to achieve the lofty goals we had set, and as such decided to scale back to be more manageable. However, with the help of the additional ISP students the team was able exceed most of the abbreviated goals and create four unique environments, four main characters, four enemies and various other miscellaneous models. Fortunately, the team did a very good job of preventing new features to creep into the schedule.

The schedule was set based on goals we determined at the start of each term. There would typically be four to five major objectives to meet each week. For example, if an engineer were assigned a feature, a prototype would be expected a week later. Task assignment was mostly preference based; if a character needed some more animations, the team member who had the most interest in animation would likely get the assignment. Occasionally an assignment would not be completed on time, causing another task to be pushed back and sometimes even cut altogether. However, more often than not, tasks would be completed on time or earlier, making it easy to continue scheduling.

7.2 Challenges

We would meet twice a week as a team, and once a week with the advisers for one hour. We adopted an "agile" management technique for discussion during these meetings, with each of us starting with a "stand-up" where we would discuss the work we had completed since the last meeting, what we were currently working on, and what we planned to work on after the meeting. This was essential for making sure everyone was aware of their assignments, which was a challenge with such a large group. After the stand-up, we would often discuss the state of current build, plans for the next milestone, or items of discussion for the upcoming adviser meeting. The adviser meetings would often be an evaluation of the week's assignments, where the artists would show off their work and the engineers would discuss the current state of the gameplay and AI. With such a large group and such an importance placed on face-to-

face discussion, it was a challenge to find multiple times during the week that the entire team could meet.

Another challenge brought on by having a large team was organizing files, not only for the current build, but also for documentation of asset lists (shown in Appendices G and H), work logs, etc. For that, the team mostly used Google Docs in conjunction with a Google site. The site contained documents all of the asset lists, the weekly objectives sheet, the work log, the project timeline, and an archive of meeting notes.

As far as actual asset files, the team used two different types of file sharing: Dropbox and subversion. For the first two terms of development, art assets were not often integrated into the Unity project. Instead, character models and animations were viewed in Maya and with screenshots. To manage these files, we used a shared Dropbox folder. The drawback to using Dropbox for storing files was that each team member had a different maximum threshold for their data. Often, one of the team members would run out of space on Dropbox. Additionally, the engineering team used a subversion client called SourceForge to share tech assets between them. During the second half of development, assets were required to be integrated much more frequently. This made it necessary that all of our file sharing be migrated to SourceForge.   Once all of our assets, be it technical or artistic, was in the same place, it was much easier for us to access, add or update any file at any time, as well as recover lost data more easily.

7.3 Evaluation

In conclusion, managing the production of *Lilium* was a challenge throughout. While having more teammates allows for more assets, it increases the complexity of scheduling and planning. Additionally, ensuring that the vision of the project is consistent between all team members is as difficult as it is necessary. There were several instances where discussions on prioritizing items were not easily resolved. While each team member was thoroughly devoted to the project, some had different views on what our valuable time should be spent doing. In the end, priorities were set based on available time, return on investment, and feasibility. As a result, the team finished with a polished, feature-complete, final product.

8. Playtesting

One of the most important aspects of game development is playtesting. Not only to make sure the game is free of (most) bugs, but to ensure that the game is actually fun and the game is communicating the players effectively. Our playtesting process got more thorough and structured as development progressed.

8.1 Methods

The first few rounds of playtesting were the least formal, where we essentially met in the IMGD lab and recruited passersby to play the game. We had several machines with the game's most recent build up and running, and we would observe the players as they played the game while taking notes on their behavior. After the session was complete, we would review the notes taken by each member and try to identify the trends in gameplay deficiencies. For example, in our first round of playtesting, almost every player disliked the control scheme.

In our second round of formal playtesting, the team developed a questionnaire for playtesters to fill out upon completing the game as shown in Appendix I. While the team members would still be taking notes, the questionnaires made it easier to track trends in certain known problem areas of the game. The results of the questionnaires were compiled into a spreadsheet for easier tracking.

8.2 Quality Assurance

In addition to the formal playtest sessions, we would also perform Quality Assurance within the group. The tech team was responsible for most of the QA during their frequent lab sessions, since they would be running the game so often to test fixes and added functionality. We also used part of the tri-weekly lab sessions as QA time, where the entire team would play the game looking for bugs and playtesting for balance.

8.3 Evaluations

Overall, much more time could have been spent on playtesting during the development of *Lilium*, both with the tests themselves and by increasing amounts of preparation and analysis. As game developers we understand the need and relevance of playtesting, and if playtesting had begun much earlier than it did, the game would likely be better overall.

9. Post Mortem

Lilium was a highly valuable learning experience for us as students and as game developers.   Most game development project experiences are reflected upon in a postmortem. We'll conclude with a reflection on our overall game development process with an emphasis on what went well and what did not. However, with *Lilium*, we found that while there were strictly successful and unsuccessful aspects of the experience, there were also some aspects that yielded mixed results.

9.1 Deficiencies

While we accomplished a lot during the development of *Lilium*, there were some key areas where we could have done a lot better.

9.1.1 Term A 2011

When production began in August 2011, the project lacked a solidified vision with regard to design and gameplay features. We had no concrete game design document, but instead had a story and general concept that drove our decision-making. This led to some of the artists getting off to a slow start in the first term of development.

Without knowing exactly what was expected of them, the artists had a hard time knowing exactly what to design and how to design it. After two weeks of development yielding little more than drawings and sketches, Professor Snyder urged the artists to simply begin modeling instead of focusing too much time on creating concepts. This method worked, and although the artists created the assets on schedule, we could have

benefitted from having a more unified design because the assets created earlier on had a more divergent style than some of the assets created later.

9.1.2 Third-Party Software

We used third-party software with varying levels of reliance and involvement in our project, ranging from allowing our AI to function to capturing footage for our trailer with varying results.

On the art side, Marmoset Toolbag[3], a real-time material editor and presentation tool proved to be immensely useful in capturing high quality renders and turntables of our game models.

However, although D4G eventually became a cornerstone and crucial part of the AI structure, it was not an easy process. A lot of time was spent trying to figure out how to use the system and integrate it into Unity. Further, once it was integrated, it caused the game to lag considerably.

A* (A-star) Pathfinding was the second piece of software that caused problems for our project. A* is a free-to-use pathfinding system for Unity3D that in most cases is powerful and easy to use. However, there were times when the software was unsuccessful. For example, when setting up the pathfinding in the Lobby environment, A* would not allow parts of the lower level to be "walkable." After countless hours spent tweaking the settings and searching for solutions, we decided to block off the unreachable area.

---

[3] http://www.8monkeylabs.com/toolbag

9.1.3 Asset Integration

Our project team quickly learned what each team member's strengths were, allowing us to properly assign tasks and plan development. However, we did have one major oversight: Asset Integration. Also known as "tech-art," or the "art pipeline," we did not plan well for this stage of development.

Firstly, the method of integrating certain assets was not considered when creating them. For example, some animators preferred to create animations in separate Maya files instead of in one scene. This caused problems when artists had to combine animation clips into one file.

In addition, we had not designated anyone in particular to be responsible for integration. Unfortunately, most of the initial integration fell onto one engineer. This took away a lot of valuable development time from his schedule; instead forcing him to focus purely on integrating assets because he was the only team member who knew how. Further, the artists continued to update assets and our advisers counseled us to be constantly getting our assets into the game, causing a bottleneck. With limited time, our one technical artist could not integrate assets as quickly as the artists were producing them.

It would have been better if we spent more time planning the integration stage. Firstly, we should have had more than one dedicated technical artist from the start. Additionally, we could have had less frequent, but more scheduled content-drops, where certain, scheduled assets would be integrated, giving the artists strict deadlines and the technical artist a more reasonable amount of content to integrate.

9.1.4 Story

Lastly, one of the more disappointing aspects of development was the lack of involvement of story in the final game. Many hours were spent crafting a unique, interesting, and deep storyline that drove the flow of *Lilium*. Most of the pre-production work consisted of crafting the story and developing the characters involved. However, due to over-scoping, almost the entire story was cut from the final game.

Instead of telling the story, the player fights through the various stages of the game until they reach the Rooftop Garden for the final encounter. While the game experience is a fun and exciting team-based game, we had initially planned for story to be much more central to the game.

9.2 Ambiguities

Not all of the mistakes the team made were purely negative, however. There were many clouds of development that did have a silver lining, having both positive and negative effects on the project.

9.2.1 Project Planning and Design

One of the most complex and important lessons learned during development was regarding Project Planning and Design. As was mentioned previously, we did not create a formal design document during pre-production, attributing to lack of direction early in development.

While this crippled some artists initially, it ended up giving the team a lot more freedom in the long run, allowing us to be more fluid in our design choices. For example, we were able to go back and forth several times regarding the inclusion of

dimension-switching abilities for the player because we weren't strictly tied to a rigid

design.

This became somewhat of a double-edged sword with respect to project

planning as well. Without an official design, we were able to schedule assignments and

tasks based on what we wanted to implement into the game. This, however, led to

over-scoping the project. Since we had no design document to follow, we ended up

wanting to do more than we could in the limited time that we had. After the first term

of development, we quickly realized that our free-form design and scope was much too

large, and we were forced to scale back significantly.

9.2.2 Sound

Developing audio for *Lilium* was fun and rewarding, but also frustrating and

disappointing. We decided the only way to implement sound into the game was to

synchronize the sound effects to animations using Animation Events. However, this

meant we could not fully integrate sound until the Advanced Animation Controller and

all character animations were complete. This led to the sound team having to wait

longer than was desired, and having only one technical artist to integrate. As a result, a

considerable amount of the sounds we made were not included in the MQP.

However, the sound team was able to record and mix an impressive sound

library that included original and unique sound effects, ambiance and music to be used

in a more complete version of the game as well as other projects.

9.2.3 Polish

During development's final push, there arose a difference of opinion on what should be prioritized. The two options were to polish and integrate two previously designed environments, or to cut the lesser polished environments and focus on polishing the GUI art and all character and environment texture maps.

The overall team decision was to focus on polishing the two existing environments over the GUI and texture polish. The decision was made based on a group decision that favored lengthening the game while avoiding scrapping months of work. While we ended up adding two levels to the game, we lost out on universal polish. Overall, it would have been better if we had set earlier deadlines for feature and asset freeze such that we would have had ample time for tweaking and polish.

9.2.4 ISP Artists

Having ISP artists on hand for the project was mostly positive but with some negative aspects. With two more artists we were able to create much more content because we effectively doubled our artist manpower. We divvyed up more tasks amongst the artists which lightened the workload on everyone involved. In addition, we were able to have a greater spectrum of creativity and skillsets.

Some of the negative aspects of having two more artists were just that: having two more artists. Scheduling in two additional people (and one additional advisor) was very difficult. Some terms we needed to compromise our schedules and have meetings where one person was unable to make the advisor meetings. Another aspect of having an ISP artist was that because the ISP guidelines are so freeform, we encountered some

ambiguity on how much work the ISP artist needed to do to fulfill the requirement for their grade. Another somewhat negative side effect of adding on more people is that with every person added there is the potential for the group dynamic or chemistry to shift. When the group got larger, it took longer for some conflicts to be resolved, and compromises often had to be more extreme. The negative aspect specific to WPI only is that artists are more scarce than tech students, so when our team took two artists that potentially could have worked on other projects, there was some resentment expressed from other project teams. Lastly, with additional work from ISP artists, there was less potential for the main team member art to stand out.

9.2.5 Game Design

Overall, the game met our goals. We achieved an artistic look that was overall quite polished, and our tech worked well. When we showcased the game to other people, we had overall positive feedback. Game design might have gone smoother had we implemented the dimensions mechanic much earlier in the design process. It was a major mechanic that fell to the wayside until about halfway into the production of the game. Had we implemented dimensions earlier in development, we likely could have achieved more interesting gameplay and had the opportunity to playtest it more.

9.3 Achievements

Although *Lilium* was not short of disappointments and learning experiences, we experienced much more success than we did failure.

9.3.1 Large Group Collaboration

One of the most notable characteristics of our development team is its size. The team was formed at the end of the 2011 academic year as a six-person group with three artists and three engineers, and took on two ISP students during development. There are many benefits from working in such a large group. Understandably, the team can produce more content because we have more people working. Also, individual team members can benefit from having a wide range of opinions for critique and criticism of work. But these benefits do not come without challenges; challenges that our team met and faced admirably.

Often in sports, one of the most underrated attributes of a good team is its team chemistry. From day one to completion, the team got along very well on a personal level. Teammates were able to enjoy each other in a social setting while also being able to get down to business during work sessions. Teammates were always able to bring up ideas to the group for discussion, and expect sound criticism and critique. Most importantly, however, each and every team member was fully devoted to the success of the project. We all recognized the great potential that our project had and gave 100% effort to realize that potential.

9.3.2 Art

Simply speaking, *Lilium* looks and sounds excellent. From environments to character models to animations and sound, *Lilium* is an artistic achievement for an MQP. Not only is there a large quantity of art assets in the game, but also the level of quality is mostly consistent throughout.

One may think that having more artists is purely an advantage, but it also raises some interesting challenges, including maintaining a consistent style in all assets. The team had to work at it, but we were able to achieve this consistency and cohesion despite having up to five artists working on the project.

9.3.3 Tech

In addition to being artistically proficient, *Lilium* is a highly advanced technical game. Our AI system uses research-level software in D4G to interface between our two levels of AI: Strategic and Tactical. What makes it unique is that it is built to have actors perform as a team, in a coordinated effort, opposed to simply controlling independent AI bots.

It is in this aspect that the development team and Lily's in-game team share a common theme: the presence of teamwork at the core of what drives us. In the end, *Lilium* was an experiment in exploring Collaborative AI Systems, but each group member was able to learn valuable lessons about what it takes to be a part of a successful, productive, collaborative team (Figure 26).

Figure 26: Collaboration!

10. Works Cited

Rich, C. (2009). Building Task-Based User Interfaces with ANSI/CEA-2018. IEEE Computer. 42:(8) 20-27.

Appendix A: Plot

Prologue

The player begins in control of Violet, who breaks protocol to steal the AI headset (nicknamed Prometheus) and enters the contamination zone to battle outsiders alone. After defeating a few enemies she attempts to use the headset to shift herself into the other dimension. However, the headset begins malfunctioning and Violet glimpses a startling vision of apocalypse before passing out.

Day 1

In a cut scene, the player is introduced to Lily as she is called by the lab's director at her apartment. He explains to her that by helping him she may be able to clear the name of her father, the scientist whose blunder caused the dimensional rift to appear. After Lily begrudgingly accepts the Director's offer to help drive away the outsiders, she's transported to the lab's skyscraper in the city center. There she meets Watson, the young mechanical genius in charge of looking after the headset she dons. She is briefed by the director about the outsiders and sent to battle. However, before they can leave the building she is accosted by a slightly wounded Violet, a violent teen known for getting privileges as the director's daughter. Violet decides that the two will be friends, but first they have to fight. Confused, Lily is forced into battle. After one of them is defeated, Violet congratulates her on fighting well.

After arriving at ground zero, Lily is given a short primer on how to activate beacons to stabilize the area. Shortly thereafter, the whole group runs into Doc. He introduces himself and joins the group, all the while unnerving Lily and instigating

Violet. The group clears the third ring and defeats a large monster in front of the blast

door to the next area, picking up energy dropped from defeated enemies. After finishing

the battle, Watson insists that they retire back to the lab for the day. When they arrive,

the Director takes Lily into his office to show her the AI's vision of apocalypse

Day 2

The next day, the group heads to the second area. After an unusually large gap

between beacons, Watson mysteriously stops in his tracks and stops responding to Lily

until they manage to set up the next beacon. The group clears out rest of the level

leading up to the next blast door without incident. In this time Lily learned that Doc was

released from prison after the Director made a deal with the government to use his

talents for good.

That night, Lily tells Watson how worried she was about him when he blacked

out. He brings her into a restricted access area of the building and shows her how a

server cluster connects wirelessly to his head, explaining that it stores his knowledge

and memories.

Day 3

As the group penetrates deep into the final area and approaches the center of

ground zero, they come across a mysterious piece of technology in front of a locked

door. Doc identifies it as a prototype dimensional gun capable of transferring matter

between dimensions, if were still functional. Meanwhile, Watson finds a message on a

nearby computer from Lily's father. The video contains her father tearfully apologizing for what happened to her. Confused and disturbed, Lily turns the video off.

The group finally reaches the room containing the generator suspected of providing power to the rift. Once inside, they discover that they cannot see the generator. Watson repairs the dimensional gun and Lily prepares to shift the generator back so it can be destroyed. Violet unexpectedly urges her not to do it, as the energy gained from defeating the outsiders could save the world. Regardless, Lily and Watson destroy the generator and the blight vanishes.

The group heads back to headquarters. Once there, Lily gives the director the dimension gun and he congratulates her on her victory. Lily says that she'll be heading out soon, but Violet insists that the two have a rematch tomorrow before the leaves. That night Lily can't sleep, her thoughts full of a million small suspicions about Violet. She recruits Watson somewhat unwillingly and the two break into the Director's office to find out what Violet's been hiding. The pair discovers that Violet is listed as the second clone of Lily. The first clone is named Rosa, whose information is locked in a file tagged "obsolete." Lily worries about what would happen if Violet were to also become obsolete and resolves to talk to Violet about it tomorrow.

Day 4

The next day, the entire lab is celebrating. Lily, tired after her late night breaking and entering, goes to turn in her headset. Shortly after meeting with Watson, the lab is suddenly attacked by outsiders materializing.

Weaponless and without her headset, Lily urges Watson to swipe her through some restricted access bulkheads to safety. However, he can't break protocol to let her in. Doc eventually arrives and convinces Watson to let both of them past the barrier. It is here that Lily stumbles upon a room with a comatose girl labeled "Lily" hooked up to a computer system. Doc reveals that he was actually a spy for the government and had been looking for evidence of illegal cloning activities, which he just found. He explains that "Lily" forms the core of the AI, but because she is comatose, the lab needed clones of her to use it. He also reveals that the player character's name is actually Rosa. Because Rosa is a clone, all of her memories before coming to the lab were merely transferred through the headset from the comatose Lily's brain to her own. However, Doc's cover has been busted and if either of them wants to make it out of the lab alive they'll need to fight. He hands her the headset.

The group fights through the halls to the director's office. They assume it was he who set them up. However, when they arrive they find that he's been murdered. Violet reveals herself, now with the new and improved headset. She tells them she was the one who killed the director for the dimension gun and unleashed the outsiders in order to collect enough energy to stop the plague. She asks if Lily will join her side. At this point, the player is given a choice. If the player chooses to join with Violet, the two go through the lab destroying all outsiders they find until they encounter and defeat a large boss outsider. The game then ends as they use their headsets to shift into the other dimension together to bring back more energy for the cure. If the player

chooses to oppose Violet, the player (alongside Doc and Watson) battle and defeat her.

They then stabilize the rest of the lab to end the game.

Appendix B: Script

Day 1: Boundary of Reality

Scene 1: Enter Violet

First person, showing the boot-up sequence of the headset from Violet's perspective. Two techs are speaking in a room, unaware that a microphone is open to Violet's headset.

Lab tech 1 (voice): Starting boot sequence. Now loading Violet's profile and beginning start-up diagnostics.

Lab tech 2 (voice): Are you sure about this? I thought the activation test wasn't until next week.

Lab tech 1 (voice): Violet said the test was moved up.

Lab tech 2 (voice): I'm not so sure about this. Does she have the director's approval?

Lab tech 1 (voice): Hell if I know.

Lab tech 2 (voice): You mean you didn't ask?

Lab tech 1 (voice): Remember what happened to John? The last time he tried to verify her clearance, she said "here's your clearance" and broke his legs with a baseball bat.

Violet (voice): How's the startup procedure coming along?

Lab tech 2 (voice): Uhh, coming along great, Miss Violet!

Violet (voice): That's what I like to hear!

Lab tech 1 (voice): You're up to 40% now. Try walking around.

Camera shifts to regular third person and player gains control of Violet.

Violet: Yeah, yeah, I'm walking around. Hurry up and get to the part where I'm busting faces.

Lab tech 1 (voice): Sorry, but we've got to walk you through the diagnostic. It's protocol.

Violet: Screw protocol, I'm bored! I've been sitting through these stupid tests all week.

Lab tech 1 (voice): Uhhh, right, right! Okay, I'm turning your weapons online.

Violet: Yay! That's a good boy.

Lab tech 1 (voice): Okay, there should be a security checkpoint ahead on your right. The passcode is--

Violet: Don't worry, I've got the passcode.

The player is instructed to beat the door down.

Lab tech 2 (voice): Be careful. You're in the enemy's territory now.

Violet: No, they're in mine.

The first encounter begins! The overpowered player makes short work of them. After a certain point, the remaining enemies flee into the other dimension.

Violet: I won't let you run away! It's playtime, and forfeits aren't allowed.

She shifts to the other dimension and takes them out. The player is then instructed to shift back, introducing the mechanic.

Lab tech 1 (voice): Violet, status report.

Violet: It got quiet. I think they're hiding.

Violet: But it's okay. I can play that game, too.

The player explores a quiet, seemingly empty section of the dungeon. As they walk around, Violet talks to herself.

Violet: The itsy bitsy spider crawled up the waterspout... (and so on)

Finally, she stumbles upon where the demons have been gathering.

Violet: Boo!

She runs into the room and dives into combat.

Violet: Round two, fight!

This is the last encounter, in which reinforcements continue to come but the player is able to make short work of them. After a certain point, the player's vision begins to break up with static and flashing imagery.

Violet: What the...?

Lab tech 1 (voice): What's going on in there? You're taking damage!

Violet: They did something to my display!

Lab tech 2 (voice): Get out of there! It's too dangerous!

Violet: I just got here... There's no way I'm leaving now.

Violet: I was born for this!

Eventually, high-level demons start spawning and take her down. Fade to black/static.

Lab tech 1 (voice): Violet!

/Scene

Scene 2: The Call

Lily is in her home. Since this is before she receives the headset, it's arguable whether or not this scene actually happens. Maybe something isn't quite right; something that suggests that not is all as it appears.

The phone rings. The screen on the phone indicates that there are 17 missed calls. Frustrated, Lily picks up the phone and immediately hangs it up again. She goes back to her business (what is/was she doing?).

The phone rings again. This time, she picks it up.

Lily: Learn to take a hint. I'm not interested, so stop calling me.

Director: Lily, hear me out.

Lily: There's nothing you can say that will change my mind. Do I have to call the police?

Director: It's about your father.

Lily: …

Lily: You have thirty seconds. Go.

She looks at the clock as he speaks.

Director: The contamination left over from the accident five years ago is spreading. We've tried everything in our power to contain it, but so far we've only managed to slow it down.

Lily: Clean up your own mess.

Director: If it isn't stopped, a lot more people are going to be hurt.

Lily: Why do you need me?

There's a silence. His time is up. Lily moves to hang up.

Director: Your father might still be in there.

Lily: My father is dead.

Director: Even so, whatever he was working on at the time of the accident must still be in there. You might find something that can clear his name.

Lily: …

Director: Please, Lily. We need your help.

Lily: I'll do it, but not for you. It's for my dad's sake.

Director: Good, I'll see you--

She hangs up.

Lily: (Resigned sigh) There's got to be something wrong with me.

/Scene

Scene 3: Headquarters

Outside view of the HQ as Lily narrates.

Lily: Five years ago, I told myself that I'd never set foot in this building again.

Lily: And yet, here I am.

Lily: I know that the very thought of it is crazy, but even still, if there's even the slightest chance that he's still alive, then I can't turn my back on him.

Lily: Even if he is dead, then maybe I'll be able to find out what he was thinking that drove him to do what he did. Maybe then, I'll finally be at peace.

Cut to the interior as Lily enters. She's greeted by Watson.

Watson: Oh wow. You really do look just like her!

Lily: Just like...who?

Watson: Oh! I mean, the pictures! You look just like you do in the pictures! (Nervous laugh)

Lily: Is that supposed to be surprising?

Watson: No, no, that's not what I mean. I mean, um, you're Lily, right? I've heard a lot about you.

Lily: Nothing good, I'm sure. You're a little young to be working here, aren't you?

Watson: Well, my circumstances are...special.

Lily: You and me both. What's your name?

Watson: Oh. My name, right. Around here, they call me Watson.

Lily: Well, it's nice to meet you, Watson.

Watson: You mean it?

Lily: Um, yeah. Listen, I need to talk to the director.

Watson: He's busy right now, but I can walk you through the diagnostics.

Lily: The what?

Watson: Come with me.

He leads her to the room with the headset equipment. This might be a "navigating the lab" mini-tutorial. Watson opens the case containing the headset.

Watson: This is the newest prototype of the Augmented Awareness Perception Elevator, codenamed the Prometheus Beta.

Lily: It's a prototype? You mean it's not finished?

Watson: Well, it's more finished than the Alpha was. It has double the processing power and its combat modeling interface was expanded to include support for tracking up to three dozen concurrent hostile groups. Oh, and the onboard power supply was...

Lily: (Laughs) Okay, okay. I get it. But it is...safe, isn't it?

Watson: We've worked out most of the bugs from the Alpha, so there shouldn't be any problems.

Lily: That's not exactly reassuring...

Watson: Don't worry about a thing. They're sending me with you, just in case something goes wrong.

Watson: Well, what are you waiting for? Go ahead and try it on!

Watson: ...Oh, I forgot. You'll have to suit up first.

Lily: "Suit up?"

Watson: It's protocol. You're not allowed to wear the headset without the suit. It's for your own protection.

Lily: Protection from what?

Watson: It's protocol.

Lily: You've got to be kidding me.

Watson: Is something wrong?

Lily: ...No, forget it. Do you mind leaving the room so I can change?

Watson: Huh? Oh, uh, sure.

He does so. Cut to Lily in the suit and headset.

Watson: Well? What do you think?

Lily: It's sure…snug.

Watson: Yes, it is.

Lily: …?

Lily: What's that sound?

Watson: What sound?

Lily: It sounds like a voice, but it's very faint.

Watson: Oh! That's the onboard AI. It's giving you subliminal instructions. You'll get used to it.

Lily: Oh, great. Don't mind me. I just have a voice in my head telling me to do things.

Watson: It'll help you get adjusted and give you advice in battle.

Lily: In battle? Wait, you want me to fight those things?

Watson: Well, not exactly… But it's what the director wants, so there's no helping it.

Watson: …

Watson: Speaking of the director, he's ready to see you now!

The player is directed to go to the director's office.

/Scene

Scene 4: Meeting Violet

The player arrives in the director's office.

Director: Welcome, Lily. It's been a while.

Lily: Not long enough. Get to the point.

The director has a big screen in his office. It displays a model of Ground Zero, along with its projected growth.

Director: This is Ground Zero, the temporal anomaly created during the accident five years ago.

Director: We've made several attempts to contain it, but it still continues to grow. We have no choice but to stop it at its source.

Lily: What is the "source?"

Director: The outsiders. Whatever space they inhabit becomes corroded. The more unstable the space becomes, the more outsiders are able to cross over.

Lily: And the more of them that cross over, the worse it gets.

Director: We're running out of time. Using the Prometheus, you can fight them.

Lily: So you need me to be your exterminator, is that it?

Director: We have no other choice. The prototype of the Prometheus is keyed to Violet's specs, and you're the closest match to her parameters.

Lily: Who is Violet?

Director: Violet was the one originally chosen for this job, but unforeseen circumstances have forced us to change our plans.

Lily: So I'm the backup, huh? All right. When do I start?

Director: You'll begin immediately. Proceed to the lobby. Your transport is waiting for you there.

Lily leaves. When she goes to the elevator to go down to the lobby, the doors open and Violet emerges.

Violet: You must be Lily.

Lily: And you must be...?

Violet: I'm Violet. Let's be friends!

Lily: Um, sure.

Violet: But before I can trust you, I have to beat you up, okay?

Lily: W-W-What?!

Violet flourishes her weapon.

Violet: I won't go easy, so don't hold back!

Lily: Hold on a minute! I can't fight you.

Violet: Why not?

Lily: I...uh... I'm unarmed.

Violet gives her a sword.

Violet: Now you're not. Now, let's play!

Battle time! They fight.

Violet: Not bad! You're just lucky I'm still recovering.

Violet: You're fun. I like you. Let's be friends.

Lily: Well, I sure as heck don't want to be your enemy.

Violet: Good! Then it's settled. Let's get going.

Lily: You mean, you're coming with me?

Violet: Yup. Got a problem with that?

Lily: No, no! Not at all. The more the merrier, I guess.

System: Violet has joined the party.

They arrive in the lobby, where Watson is waiting.

Watson: Are you ready to go?

Lily: No time like the present.

They depart for Ground Zero.

/Scene

Scene 5: Ground Zero

Lily, Watson, and Violet arrive at Ground Zero.

Lily: [Comment about appearance of area]

Violet: [Sarcastic Remark]

Lily: [Witty Comeback]

Watson: [Misunderstanding based on literal interpretation]

Scene 6: Beacon Tutorial

After clearing out a section of outsiders...

Lily: Looks like that's all of them.

Violet: [Something something find more squishy things]

Watson: Wait! First, we have to set up the beacon.

Violet: The what now?

Watson: We can set beacons to maintain the structural integrity of the surrounding spacetime.

Lily: Uh...Come at me again?

Watson: An area with a beacon in it is safe from the outsiders.

System: Set beacons to establish safe zones. You can save the game at beacons as well as return to the lab. You can also return to any previously-established beacon.

Scene 7: Meet Kevin

The party comes across Doc, looking closely at a small artifact in his hands. He pockets the object when he realizes he's not alone.

Watson (excited): Doc!

Watson runs up to Doc.

Doc: Aah!

Lily: What was that he was holding..?

Violet (aggressively): What are YOU doing here?

Watson: Lily, this is Doc! he's here to help us.

Violet: You shut up.

Lily: Why is he wearing a mask?

Doc: Violet! I'd hoped to gift my subjects another week of life. Has your clearance been granted at last?

Violet: I'm here as support for her. (gestures)

Doc sees Lily, and executes an elaborate bow.

Doc: My queen! I'd not been informed your hour was upon us. Here with prometheus, to liberate our fair land from incursions most foul.

Lily: Why was I the last person to find out I was coming here?

Watson: As a lab member, Doc was also prepped for your arrival.

Violet: I said shut it, [insult]. Lily, don't trust this guy. We're all just lab rats to him.

Doc: I'm afraid I don't conform to Violet's expectations of a proper target.

Lily: Guys, can't we try to get along? Don't we have a world to save?

Doc: Too True! Lead on, fair queen!

Scene 8: Boss 1

The party reaches the end of phase 1. Suddenly, the dimensional distortion increases in severity.

Lily: What is that? What's happening?

Doc: The miasma thickens, but fear not! There is no reason for undue alarm.

SUDDENLY GIANT DEMON

Watson: Look out! This one's huge!

Violet: If you're scared, feel free to run.

Lily: What's this thing supposed to be, the boss?

Violet: Whatever it is, it's in the way!

They fight the boss. Violet marches on toward the door it was guarding.

Violet: Now, let's see what it was guarding.

Watson: We're supposed to return to headquarters after setting the beacons.

Violet: There's a big, ominous door in front of all sorts of mystery and adventure and you're going to ignore it because you're supposed to?

Watson: (Timidly) But...it's protocol...

Lily: Let's go back. It's been a long day.

Doc: Yes, let us make for the confines of our

Violet: (Groan) You guys are boring.

/Scene

Scene 9: The Vision

After returning to base...

Watson: Before you go to bed, the director wants a word with you.

When the player goes to the director's office...

Director: It seems that your first foray into Ground Zero went well.

Lily: As well as being thrown into a haunted city with a bunch of monsters can go, I suppose. What do you want?

Director: I want to show you what's at stake.

He indicates the screen on the wall of his office, which begins showing the footage taken from Violet's headset.

Lily: What is this?

Director: Footage taken from Violet's headset during the Prometheus Alpha activation test. For reasons that are currently unclear, the onboard AI showed her these images.

Lily: What's this supposed to be, some kind of prediction?

Director: Judging by the phase of the moon, this is projected to occur approximately four days from today.

Lily: …

Lily: How can the AI possibly know this?

Director: The headset is designed to connect to the other dimension. It could be that the enemy knows something that we don't.

Director: As it stands, we can't afford to ignore this warning.

Lily: No pressure or anything.

Lily: All right, I get it. You don't need to try to guilt me into helping.

Lily: Unless you have another apocalyptic vision to show me, I'm going to bed. I've got a date with monsters in the morning.

She leaves. Doc is standing out in the hall near her room when she moves to go to bed.

Doc: My queen.

Lily: Can you stop calling me that?

Doc: We're no longer in peril. Rest a while, and put aside Prometheus.

Lily: I think I'll keep it on. It makes me feel like the main character.

Doc: If you're the main character, what does that make me?

Lily: In my way. Can I go to bed?

Doc: Sweet dreams, sleeping beauty.

She goes to bed.

Scene 10: Dream I

I forgot what we were doing with this.

Day 2: Boundary of Humanity

The player is able to enter the second phase of Ground Zero. There's an unusually large gap between the entrance of phase 2 and the first beacon. The next scene is initiating by entering a certain trigger.

Scene 11: Watson Needs to Upgrade to 4G

Lily: This place just keeps going and going. It looks a lot bigger on the inside than the outside.

Violet: If you're getting tired already, then go take a break. More monsters for me!

Watson: A building can't be larger on the inside than the outside. The interior dimensions are--...

Watson suddenly trails off and stares distantly into space.

Violet: Are...what?

Violet: Hellooooo?

Violet walks around the silent Watson and waves at him.

Violet: I think he's busted.

Lily: Watson? ...Hey, is something wrong?

Watson: …

Doc: [Something]

Violet: …!

Violet: That's right! Lily, how's the reception on your headset?

Lily: Let's see... (pause) It's pretty weak here. Is that a problem?

Violet: We should hurry and set the next beacon. It's got a wireless thingy in it that--

Watson: Repeater.

Lily: ?

Watson: It's a wireless repeater. We're outside the range of the HQ's network, so the beacons have wireless repeaters that relay the signal to us.

Lily: (What was that all about? Well, it seems like he's okay now...)

/Scene

Scene 12: Server Side

After clearing phase 2 and returning to the lab...

Lily can find Watson standing in front of a window in the HQ.

Lily: Watson? You're up late.

Watson: Oh, hello. Do you need help with something?

Lily: Just wanted to make sure that everything's all right. You kind of scared me earlier today.

Watson: Did I do something...frightening?

Lily: No, dummy. I'm talking about when you blacked out. I was worried about you.

Watson: You were worried...about me? Why would you do that?

Lily: Well, you're a comrade, aren't you? I'm counting on you to watch my back when we're down there, and I need to know if you're going to go blacking out on me in battle.

Watson: I see... Well, I'll do my best not to let you down.

Lily: Good to hear. Well, we've got a long day ahead of us. I'm going to get some sleep.

She starts away.

Watson: Um! Lily?

Lily: Hm?

Watson: Can I show you something?

Lily: Um, sure. What's up?

Watson: Would you mind coming with me?

He leads her to a restricted room, which he unlocks with his ID. Inside is the server room where his knowledge base is stored.

Lily: What is this?

Watson: The LySys P1-G3 computing cluster.

Watson approaches one of the devices and places a hand against it, looking up.

Watson: In other words, me.

Lily: What're you getting at? You're a computer?

Watson: Not exactly. My brain is connected to the cluster by a wireless transmitter which was implanted in the back of my head.

Watson: All the information vital to staying alive is stored locally, but everything else is kept on the server.

Lily: Is that what happened back there? You lost the connection?

Watson: Yeah... It happens sometimes when I get too far from the headquarters.

Watson: (Quickly) It's nothing to worry about, though! I can still function adequately without a connection.

Lily: (Concerned) Adequately? Wait a minute, Watson, what happens if the power goes out here? Are your memories stored here, too?

Watson: Like I said, it's nothing to worry about... There are offshore backups of all the data, so even if there's an outage, it can all be restored.

Lily: Is that really okay with you? This is your mind we're talking about here!

Watson: Well, it's... (Meekly) I guess it's just part of who I am.

Lily: …

Lily: (Keeping someone's thoughts and memories locked up in a computer… What's with these people?)

Watson: (Feeling self-conscious) I guess that makes me pretty weird, huh? …Still, I didn't want to keep it a secret from you.

Lily: You think you're weird? Look who else we've been hanging out with. Compared to Doc, you're actually pretty normal.

Watson: …Yeah, you're right. Thanks.

Lily: Don't be ashamed of who you are, all right?

Watson: (Relieved) Understood!

Lily: That's more like it. Now, I'm going to bed. For real this time.

Watson: I'll see you in the morning.

Lily: Goodnight. Get some sleep. …You do sleep, don't you?

Watson: When I'm idle for long enough, I go into hibernation mode.

Lily: You do what?

Watson: (Laughs) I don't really.

Lily: …Watson, did you just make a joke? This really is the end of the world.

Watson: Goodnight, Lily.

Lily: Seeya.

/Scene

Day 3: Boundary of Truth & Lies

In the morning, Doc can be found trying to get into one of the restricted rooms (the room where Rosa is kept), but the guards don't let him in. The player is free to proceed into the final phase of Ground Zero at any time.

Scene 13: Dear Daughter, I'm Sorry I Orphaned You

After conquering the third phase of Ground Zero, the player finds a something (the dimension gun) lying on the ground, obviously lost in some kind of struggle (maybe a trail of blood leading toward/away from it). The room is connected to a bulkhead guarding the generator room, where the final guardian fight will take place.

When it is found, a cutscene is triggered.

Lily: What is this? Looks important.

Watson: It's (LABNAME) technology, but there's no entry for it in my database.

Lily: They were probably working on it here. Do any of these computers work?

Watson: Let me take a look.

Watson tries to operate the computers in the background.

Doc: It appears to be a prototype targeted dimensional shifter. (points it at Violet and fires) Sadly nonfunctional.

Violet: Point that at me again and I'll give you something to be sad about...

Watson: Got it!

Watson: Let's see here... You're right! It is the prototype for a dimension-shifting mass transfer device. How did you know?

Doc: Intuition.

Watson: What else have we... There's a recording here from [NAME].

Violet: Her father?

Lily: Yeah, he was... You knew?

Watson: Whatever it is, it's marked high priority.

Lily: Play it!

Watson presses a button on the computer.

Lily's Father: [Goal: he has to say that ???]

Scene 14: The Last Guardian

The player and co. advance into the last boss room of the dungeon. Suddenly, a giant demon blocks their way!! Roaarrr!!

Watson: Look out! It's another guardian!

Violet: Surprise, surprise.

Lily: Let's take it out!

They fight the boss and thus gain access to the rogue generator.

Watson: It's just like the message said. The generator isn't here.

Lily: It must be in the other dimension. Watson, do you think you can repair that gun we found?

Watson: I'll do my best.

Fade to black.
Fade back in.

Watson: I think that should do it. Give it a shot!

Lily takes aim at the place where the generator should be.

Violet: Wait!

Lily: Huh?

Violet: I don't think you should do it yet. Maybe I should talk with Father about it first.

Lily: This is what we're here to do. The sooner we take this thing out, the sooner this place goes back to normal and the sooner I can go home.

Violet: Just think about this for a minute!

Lily: There's nothing to think about. As long as that thing is still here, this battle will never end.

...The world is still under attack.

Violet: As long as that generator is active, we're still saving it. Or did you forget about the [name of drops]?

Lily fires the gun, pulling the generator back into this dimension. She then destroys it (with her gun?). The dimension distortions disappear.

Watson: ...Is it over?

Lily: If the pretty fireworks are any indication, I'd say that's a safe bet. Let's pack up and head back to base.

Fade to black.

Lily (Narration): ...Finally. It's all over.

After returning to base...

Director: We were able to confirm the spatial normalization of Ground Zero. Congratulations on a job well done.

Lily: We found this prototype for a dimension switching gun. I thought you guys would want to hold onto it.

Violet: I suppose that means you'll be heading home tomorrow, right?

Lily: I suppose it does. I've had about enough of fighting otherworldly monsters for one lifetime.

Violet: Don't be in too much of a hurry to leave. I'm supposed to be in top shape again tomorrow, so I want a rematch. This time, no handicaps!

Lily: I guess I can stick around long enough to beat you up again.

Violet: Ooh, I'll wipe the floor with that smirk of yours.

Lily: I look forward to it. Until then, I think I'll get my beauty sleep.

Director: ...Thanks again, Lily. We couldn't have done it without you.

Director: I can have you flown out tomorrow, if you'd like.

The player regains control and can do last-minute stuff in the HQ.

Scene 15: Record of Obsolescence

After the player goes to bed...

Lily (Narration): ...No matter how hard I try, I just can't sleep. There's something that's still bothering me.

Lily (Narration): Violet...Just who are you?

She knocks on Watson's door.

Lily: Watson, get up! It's Lily.

Watson: (Groan) Huh? What are you doing awake at this hour?

Lily: Just come out here. I need your help.

Watson joins her in the hall.

Watson: What do you need?

Lily: I need your help to break into the director's office and access some of his files.

Watson: What? I can't do that!

Lily: You can't, or you won't?

Watson: We could get in a lot of trouble.

Lily: Something about Violet just bothers me.

Watson: What makes you say that?

Lily: Why does she know so much?

Watson: She's the director's daughter.

Lily: If she matters that much to him, then why did he throw her into so much danger?

Watson: Well, maybe he... I'm sure there's a good reason.

Lily: And we're going to find out what it is. Come on.

Cut to the interior of the director's office.

Watson: This is such a bad idea...

Lily: Come on, Watson! Where's your sense of adventure? Now get to hacking into his computer.

Watson: ...Right.

He does so. Lily stares at the screen projected on the wall.

Watson: All right, I'm in. What next?

Lily: Pull up Violet's file.

Watson: Got it.

Most of the file is blacked out. One part that can be distinguished: "Second clone of Lily."

Lily: What is this? Watson... What is this?

Lily: That can't be right... She's a clone of me?

Watson: It says that she's the second clone. Do you mind if I look at your file?

Lily: ...Yeah, let's see what they've got.

He pulls it up. It's also mostly censored. Something something experimental device prototype neural interface. Something something cloned twice, as Rosa and then Violet.

Watson: There were two clones, Rosa and Violet. Who's...Rosa?

Lily: Pull it up.

Watson pulls up the file on Rosa, which is labeled "obsolete."

Lily: "Obsolete"...?

Watson: She was "succeeded" by Violet.

Lily: What exactly does that mean? You don't think they...killed her, do you?

Lily: What if Violet's in danger? What if she becomes "obsolete," too?

Watson: Lily, I don't think we're supposed to know this...

Lily: Tomorrow, I'm going to have a talk with Violet. We need to get to the bottom of this.

Lily (Narration): Why would they make a clone of me?

Day 4: Boundary of Identity

Credits Montage

Lily Wakes up. What is that sound? Some people outside her room are dismantling some equipment in the hall.

She leaves goes to turn in the headset and the tech she hands it to congratulates her (some random tech, probably a creator cameo voice).

On the front of her door, or her locker or something, there's a note from Violet saying "Looking forward to that duel! -V"
Watson meets her as she's looking at it. He asks, "So, you're leaving after the fight then?"

Lily responds, "Well, if I Find Violet... And I survive... I don't know."

Lily tells Watson she's not sure if she wants to tell Violet about what they found last night. Watson asks, what does she mean?

Suddenly BAM EXPLOSIONS IN THE SKY! Credits sequence cuts out. Outsiders appear in the hallways. Watson and Lily flee through the building, both unarmed and Lily unvisored.

Lily tells Watson that they have to get behind some bulkheads. He tells her that he can't let her into them, and he won't abandon her by going himself.

Lily reminds him that life and death are on the line. He replies, "PROTOCOL!"

Eventually Either (1) Watson lets them in, (2) Doc appears behind them, running from outsiders, and throws Watson's face into a retinal scanner or (3) Doc opens the door from the inside, grabs their collars and pulls them both inside. Somehow the three are now inside the room.

The room has 3 tanks. The one at the front, with a giant neural something reaching inside, is labeled LILY. the two in the back say ROSA and VIOLET. the "Lily" tank is occupied, by a girl looking very similar, her head connected to the neural uplink.

Lily reacts poorly. <- Minimize this section to like 5 seconds.

Doc tells her that he used the confusion to break a few rules, which is how he got in to finally get condemning evidence of [the lab] performing illegal cloning experiments. However, the odds are pretty good that they noticed, so he's going to have to break back out. He hands Lily her headset back, telling her that if the two wish to ever leave again, they'll need Lily's help. (think of better wording or drop this -BK) (Somebody, probably Doc, will have to SPELL OUT that her memories are all false. It won't work well otherwise, IMO -BK)

Lily puts on the headset and immediately her demeanor changes. She announces her intention to quash the demons, which the three of them do. Doc speculates that the Director may have set them up; Watson has no data on it. The three go to the Director's office to confront him.

They bust into his office, and find that he's already dead. However, (in the doorway/behind the door?) they see Violet. She tells Lily that, sadly, they'll have to put their duel on hold. She was able to overcharge the dimension gun with the energy she got killing the demons she summoned, and now she can start porting entire demon cities into our world. Watson asks what for; Violet tells them that the [Drops] are saving the world, or did he want to catch the plague and die a slow painful death? They're the first great chance humanity has of surviving in numbers. She mentions that she was inspired by the images of the cataclysm. At this point, she asks Lily if she wants to join forces. BRANCH TIME.

- If she refuses, it's a 3v1 fight, with Violet acting as the boss. As the three brandish their weapons, Violet tells Lily that using two more people means she's admitting she'd lose the duel, but winning by default isn't nearly as fun. Then the group fights.
- If she agrees, ???

Things we might be able to cut:
Lily not being the original (Bishop will fight to keep this)
Doc's subplot (Kinda makes him random)
Lily emo-ing (we can actually cut this in-story)

Sample Dungeon Dialogues
- We need to flesh Doc, and hopefully the party dynamics, with these.

Lily: So what are the two things on your back?
Doc: The duality of the trade. While a doctor's right hand is meant for granting life to those under his care, my left serves to take it from the undeserving.
Lily: Well, that's-
Doc: Or was it the left hand that heals, and the right that kills? Hold on...
Lily: Well, wouldn't it be the green that heals?

Doc: Hold on, is this Thursday, or Friday?
-

Doc: I change it up from time to time. Keeps 'em on their toes.
-

Doc: Well, it did yesterday...
-

Doc: I thought the green was for poison?

Watson: Doc, doesn't hurting go against the Hippocratic oath?
Doc: I never signed that.

Doc: Never let common sense cloud your judgment.

Doc: Have I ever told you the story of how I lost my license to practice medicine?
Lily: Now's really not the time...

Lily: So, Doc.
Doc: Yes??????
Lily: What's - I mean.... What's the deal with... you?
Doc: Experiment with the outsiders, gone horribly different. I hesitate to say "wrong,"
since this outcome was the desired result.
Lily: Oh my god, what happened to the experimenters?
Doc: He became part outsider. (mask smiles)

Lily: Doc, you never explained what's underneath your mask
Doc: Would you like to see?
Watson: Don't do it!!
Lily: On second thought, maybe not.

Lily: Watson, how do those guns work?
Watson: My neural uplink allows me to precision target enemies spotted within 20
milliseconds in the average case. This means that I still respond twice as fast as the
average human when a full standard deviation over my normal responsiveness.
Lily: No, I mean, why do they float?
Watson: They're just falling slowly.

Appendix C: Concept Art

Figure 27: Initial Concept for Lily/Violet look. This concept was among the first to begin to define the overall style of _Lilium_
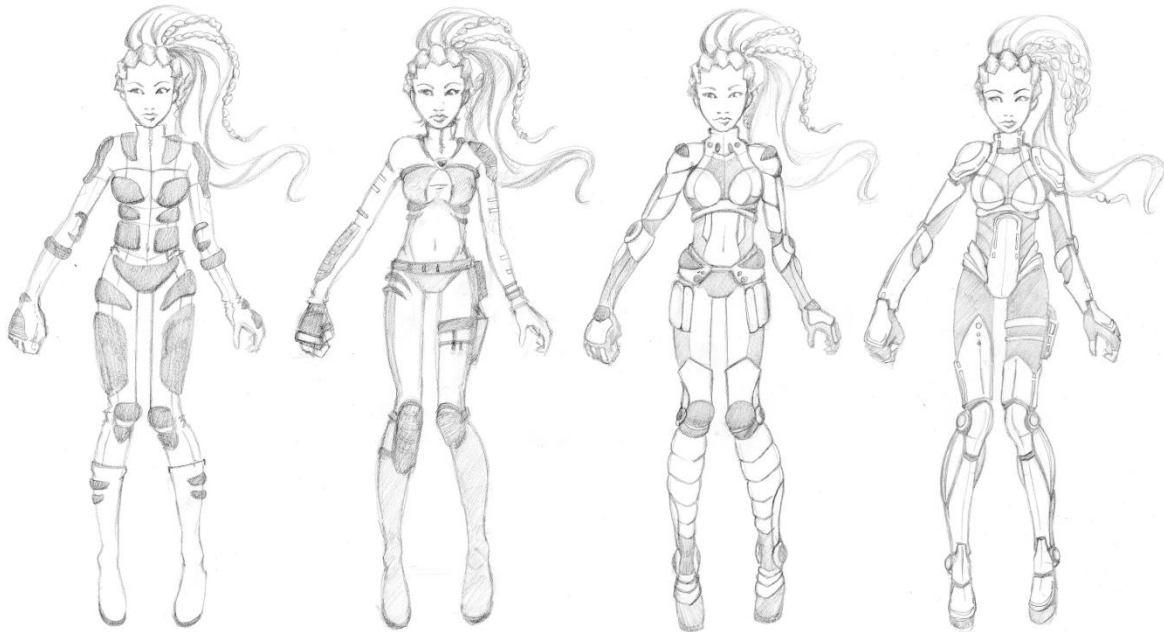
Figure 28: Three initial armor concepts for Lily/Violet: Final concept on the far right.
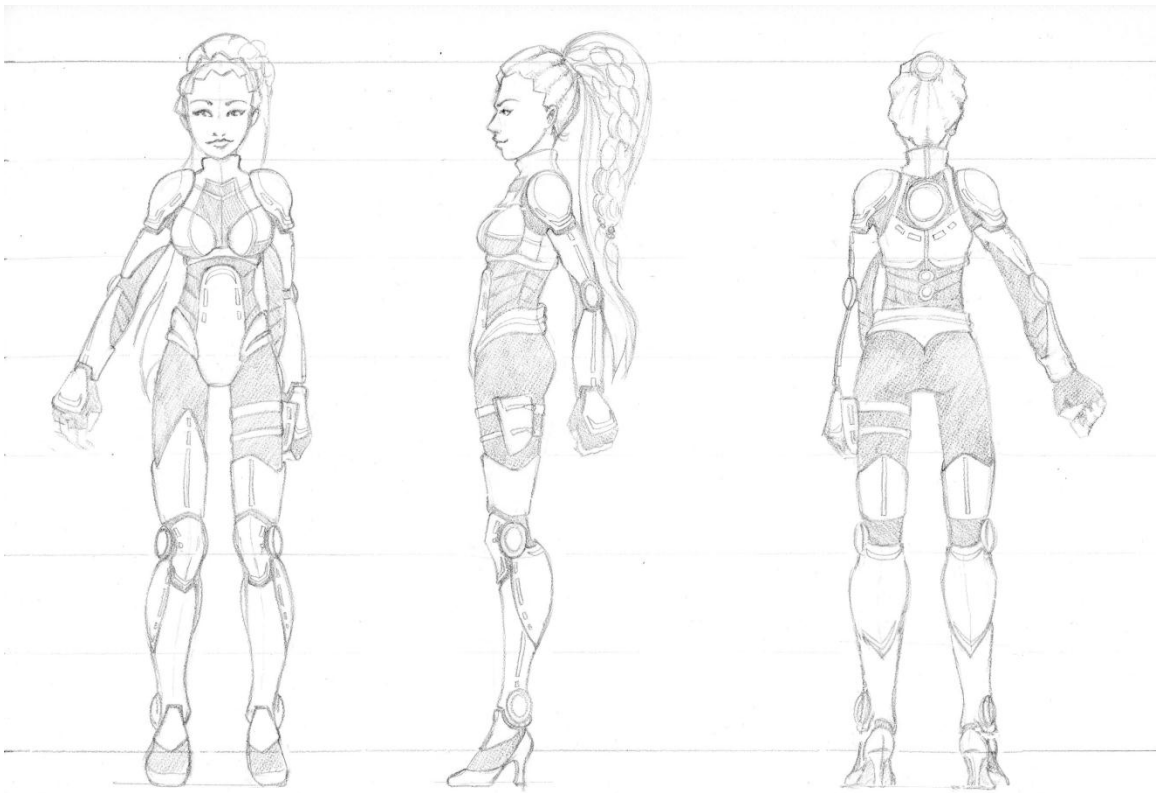
Figure 29: Violet character sheet

Figure 30: Lily armor color combination concepts
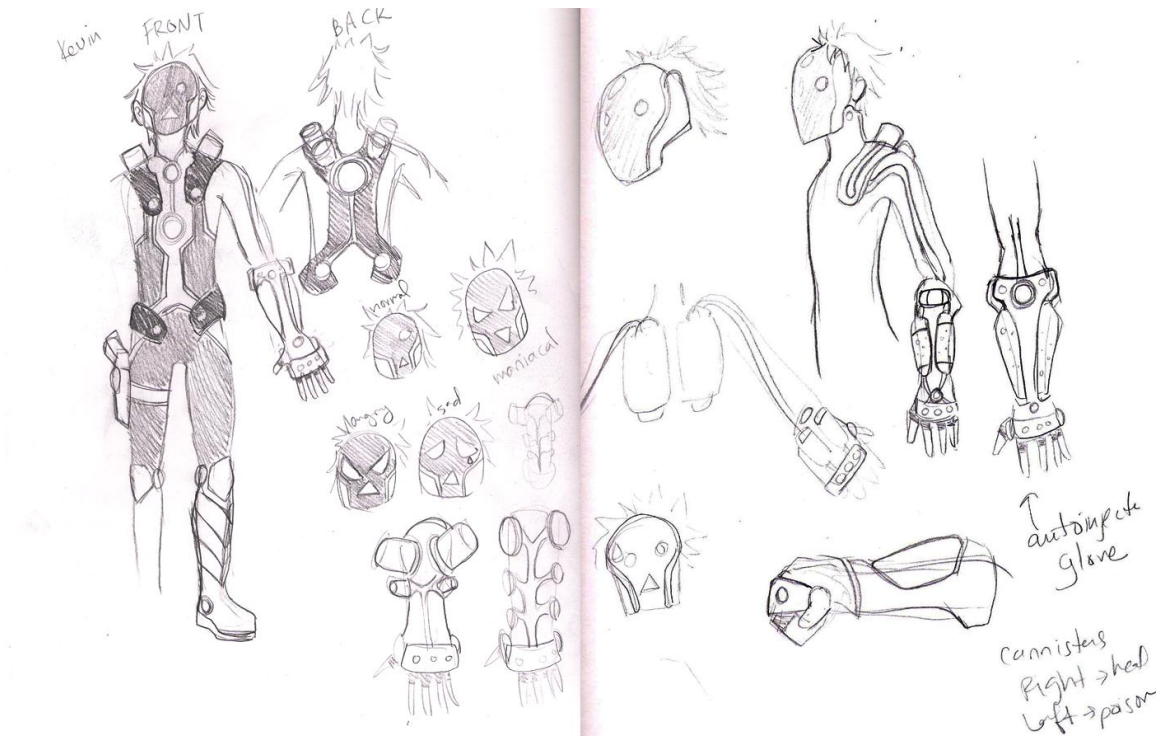
Figure 31: Initial Kevin Concepts - Note the iterations of the fist weapon. The canister theme eventually took over.

Figure 32: Kevin semi-finalized concept
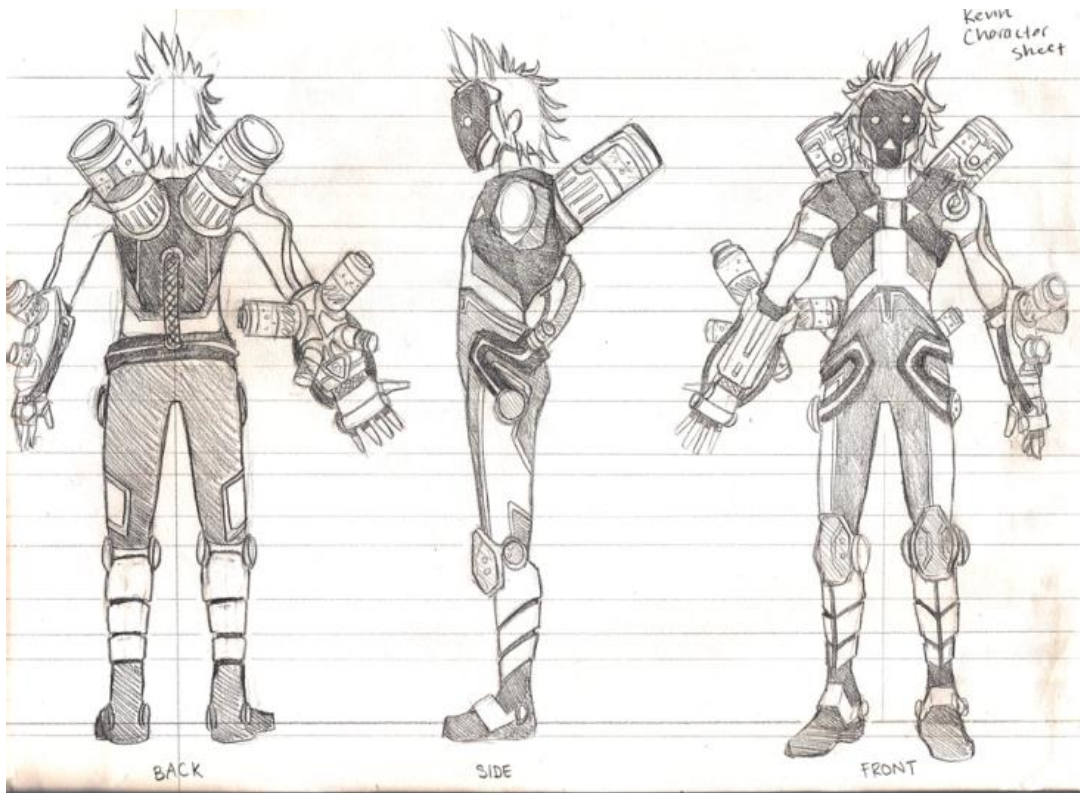
Figure 33: Kevin Character Sheet

Figure 34: Watson semi-finalized concept
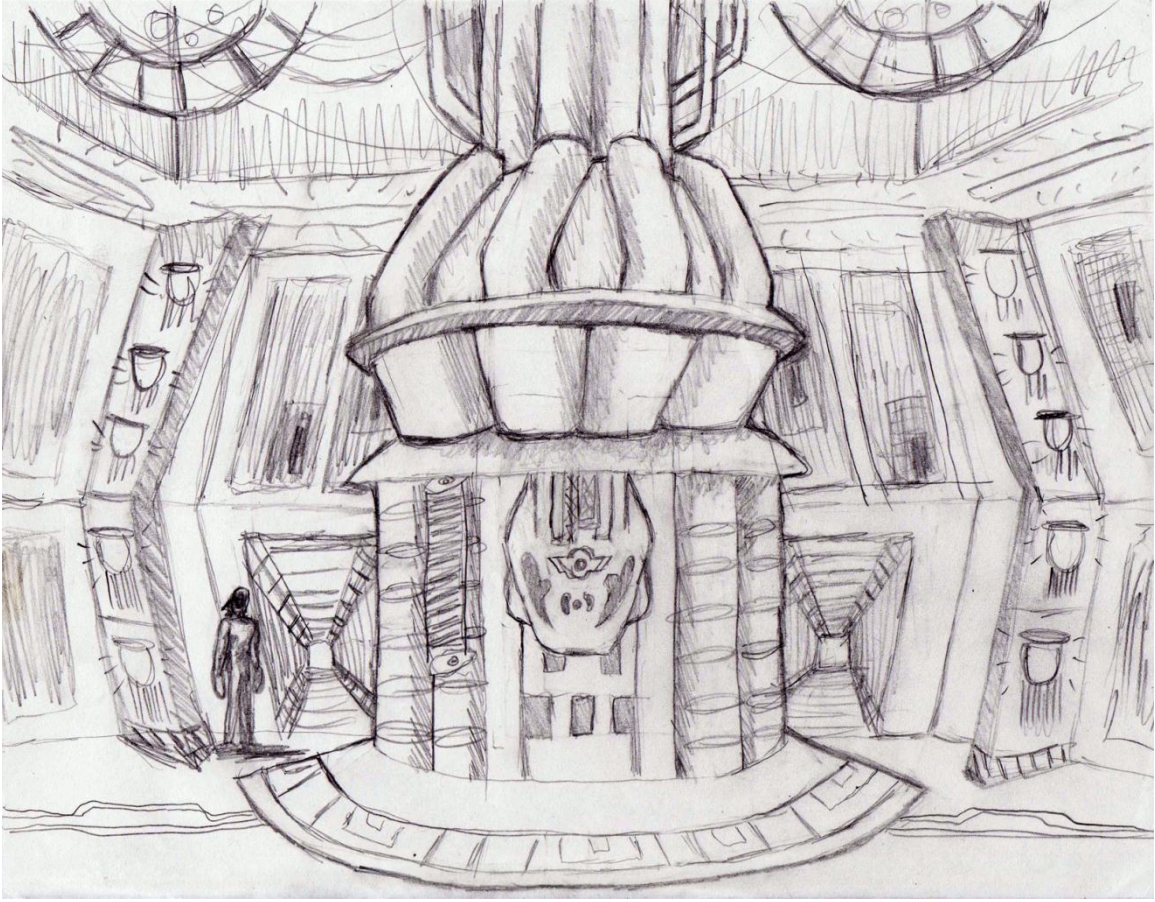
Figure 35: Generator Room Concept
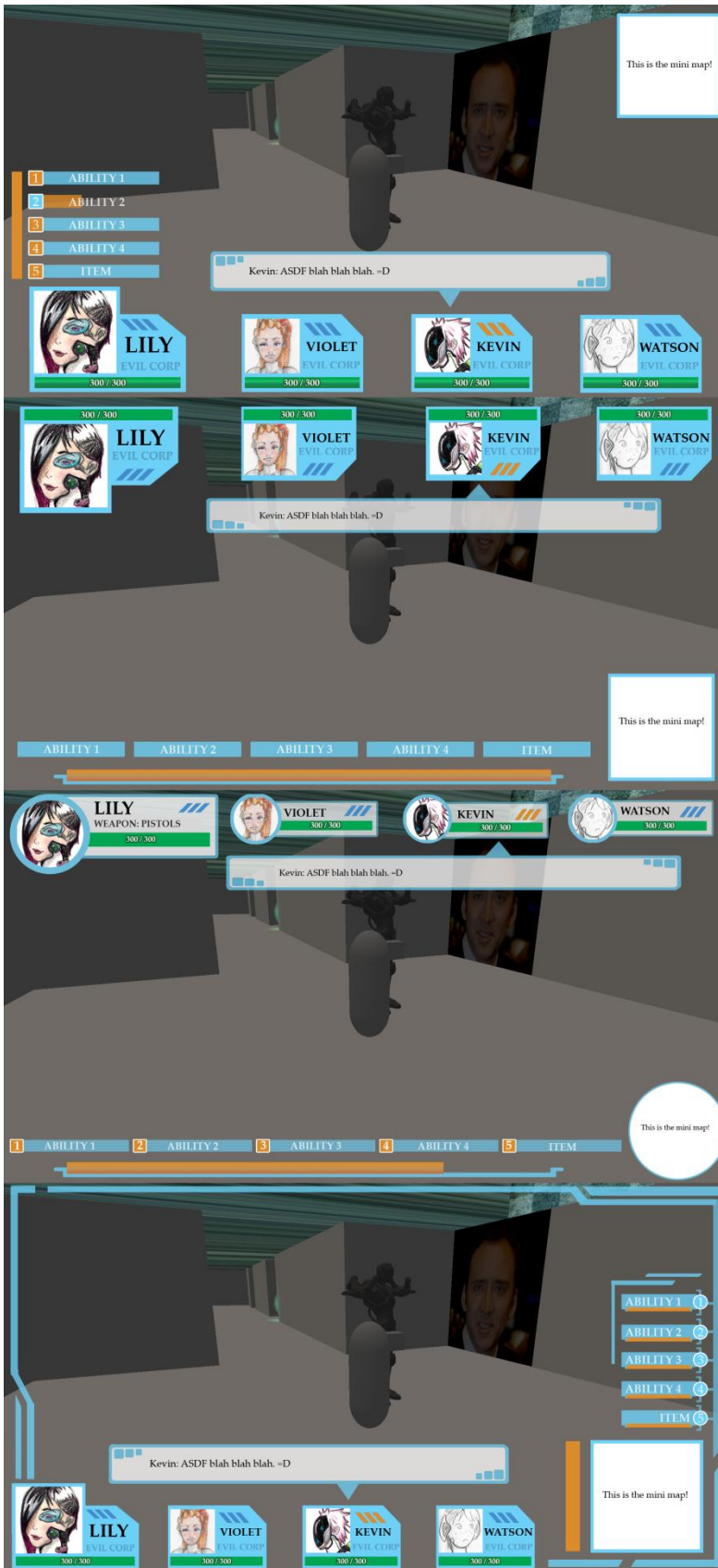
Figure 36: Several heads up display mockups. We went with a design similar to the bottom design.

Appendix D: Character Skills

User	Name	Scope	Rang	Coold	Magnit	Duration	Description	Implemented		Notes	
Lily	Gun1: Barrage	OneEnemy	7	20	50	Instant	As GunAttack, but hits 3 times	X		**Notes**	
	Gun2: Ammo Switch	Self	0	5		Instant	Swaps between physical/energy damage type	X			
	Gun3: Concussion	OneEnemy	7	5		Instant	As GunAttack, but deals double damage to stunned	X			
	GunAttack: Ranged Attack	OneEnemy	7		50	Instant	Deals magnitude damage	X			
	Sword1: Focus	Self	0	240	0	60	Boosts Weapon's Attack (upgradeable)	X		Needs refactoring once upgrades are in	
	Sword2: Prism Slash	OneEnemy	7	45	65	Instant	Teleports in front of target and SwordAttacks	X			
	Sword3: Whirlwind	AllEnemies	5	20		Instant	As SwordAttack, but hits everyone in range	X			
	SwordAttack: Melee Attack	OneEnemy	2		60	Instant		X			
Watson	Blast Attack	OneEnemy	7		50	Instant	Deals ordinary damage (Multi hit?)	X			
	Grenade	Blast	7	20	25	Instant	Deals damage to everyone in blast radius	X			
	Firebomb	Blast	7	30	25	100	Deals Magnitude damage every 10 seconds to everyone in blast radius	X			
	Stun Grenade	Blast	7	120		30	Stuns everyone in blast radius	X			
	Suppressive Fire	OneEnemy	7	10	50	30	Deals Magnitude damage and stuns target.	X			
	Smoke Bomb	Blast	7	30		30	Lowers accuracy of all enemies.	X			
	Liquid Nitrogen	Blast	7	30		30	Prevents those in range from dodging.	X			
	Second Wind	User			25	Instant	Passive; auto-activates at critical HP. Critical rate is increased by magnitude.	X			
Kevin	Punch (Attack)	OneEnemy	2		50	Instant	Deals ordinary damage				
	First Aid	OneAlly	2	10	75	Instant	Heals Magnitude HP	X			
	Regen	OneAlly	2	20	15	10	Heals Magnitude HP every second	X			
	Adrenaline	OneAlly	2	20	25%	60	Increases ATK by Magnitude	X			
	Caffeine	OneAlly	2	20	25%	60	Increases Dodge by Magnitude	X			
	Morphine	OneAlly	2	20	25%	60	Increases DEF by Magnitude	X			
	Mystery Drug X	OneEnemy	2	30	15%	60	Decreases all stats by Magnitude	X			
	Poison	OneEnemy	2	20	150	100	Deals Magnitude damage every 10 seconds	X			
	Cure	OneAlly	2	10	0	Instant	Removes all negative stat effects	X			
	Secret Formula	User			30%	Instant	Passive; auto-activates at critical HP. Reduces all cooldowns by Magnitude.				
Violet	Smash (Attack)	OneEnemy	2		50	Instant	Deals ordinary damage; deals double to frozen enemies	X			
	Rampage	User		60	30	30	Increases STR by Magnitude, only attacks one target until dead				
	Homerun	OneEnemy	2	10	10	Instant	As Smash, but knocks target back by Magnitude distance	X			
	Taunt	AllEnemies	5	20		Instant	Gathers aggro				
	Grand Slam	AllEnemies	2	120	5	Instant	As Homerun, but hits everyone in range	X			
	Guard	OneAlly	2	120		30	All damage toward the target is redirected to her				
	Determinator	User			30%	Instant	Passive; auto-activates at critical HP. All damage is reduced by Magnitude.	X			
							Note that since the Doctor's versions of First Aid, Regen, and Adrenaline work between dimensions, they're actually separate skills. If Kevin's versions are updated, the Doctor's should too.				
										Base Attack Damage:	50
										Heal multiplier	1.5
										Melee range	2
										Mid range	5
										Long range	7

Appendix E: Enemy Abilities

User	Name	Scope	Rang	Coold	Magnit	Description	Duration	Implemented		Notes	
Sniper	Snipe	OneEnemy	7	0	60	Basic attack.	Instant	X		Long animation?/Reload time	
DONE	Ethereal Sphere	User	0	0	0	Passive; immune to physical damage in opposite dimension.	Passive				
Juggernaut	Slam	OneEnemy	5	10	50	Basic attack. Knocks back target.	Instant	X			
DONE	Rejection Field	User	0	0	0	Passive; nullifies all damage below 10% of max HP	Passive	X		Implemented as status effect	
General	Rush	OneEnemy	2	0	50	Basic attack.	Instant	X			
Rob	Consume	User	0	0	0	Passive; absorbs nonphys damage when in spirit world	Passive				
	Battle Cry	AllAllies	15	240	0	Boosts all stats.	60	X			
	Dive	User	0	5	0	Shifts to other dimension.	Instant	X			
	Aether Blade	OneEnemy	2	20	75	As attack, but can hit from other dimension.	Instant	X		Need to add IgnoreDimension handling	
Kamikaze	Claw	OneEnemy	2	0	30	Basic attack.	Instant	X			
DONE	Apoptosis	AllEnemies	5	999	200	Kills self. Used at low HP. Have some kind of "fuse."	Instant	X			
Ninja	Assassinate	OneEnemy	5	0	30		Instant	X			
DONE	Poison	OneEnemy	7	20	150	Deals Magnitude damage every 10 seconds	100	X			
	Dive	User	0	5	0	Shifts to other dimension.	Instant	X			
Sentry	Longshot	OneEnemy	7	0	30	Basic attack.	Instant	X			
DONE	Frost	Blast	5	30	20	Deals damage and seals dodge.	30	X			
	Rapid Fire	OneEnemy	7	10	3	As attack, but hits magnitude times in quick succession.	Instant	X			
	Curse	OneEnemy	7	60	0	Lowers target's stats.	30	X			
Doctor	Gash	OneEnemy	2	0	40	Basic attack.	Instant	X			
Ben	First Aid	OneAlly		10	75	Heals Magnitude HP	Instant	X			
	Dive	User	0	5	0	Shifts to other dimension.	Instant	X			
	Regen	OneAlly		20	0	Heals Magnitude HP every second	10	X			
	Adrenaline	OneAlly		20	25%	Increases ATK by Magnitude	60	X			
						Note that since the Doctor's versions of First Aid, Regen, and Adrenaline work between dimensions, they're actually separate skills. If Kevin's versions are updated, the Doctor's should too.					

		50
Base Attack Damage:		50
Heal multiplier		1.5
Melee range		2
Mid range		5
Long range		7

Appendix F: List of AI strategies

Terminology
Elite: A stronger-than-normal enemy
Sequence: A string of actions
Cluster: Group of weak enemies

Prep
Situation: Battle start
Steps:
-Kevin uses each of his buffs on Violet, one at a time
-Violet and Kevin stay back until Violet is fully buffed.
-Watson tells you to "hold them off" or something while they prepare.
-Watson uses stuns to hold the enemies off until Violet is fully buffed.
-Violet runs in to attack.

Cleanup
Situation: Battle end
Steps:
-Kevin heals everyone
-Kevin removes all status effects

Get That Guy
Situation: Elite present, cluster present
Steps:
-Violet taunts the elite
-Violet enters rampage
-Violet uses knockbacks on the elite to keep it down
-Watson uses his AOEs on the cluster
-Kevin poisons elite

Focus Fire
Situation: Elite present, no cluster
Steps:
-Violet taunts the elite
-Watson stuns the elite
-Violet enters rampage
-Kevin poisons elite

Mook Party
Situation: Cluster, no elite
Steps:
-Watson cycles through his AOEs
-Violet knocks them down
-Violet targets the enemies with the most HP left
-Kevin stays out of range and only enters to heal someone

Heals Plz
Situation: Someone falls to half HP
Steps:
-Kevin runs in and heals them

Emergency Heal
Situation: Someone is at critical HP
Steps:
-Watson stuns nearby enemies
-The person who needs healed retreat back to Kevin

Bodyguard
Situation: Kevin is at low HP
Steps:
-Violet guards Kevin

Dead Doctor
Situation: Kevin either can't heal or is KO'd and Lily is at low HP
Steps:
-Violet guards Lily

FOX GET THESE GUYS OFF ME
Situation: Kevin is being attacked by a number of enemies
Steps:
-Violet taunts the enemies and runs away from Kevin to kite them

Pew Pew
Situation: Kevin is being targeted by ranged attacks
Steps:
-Kevin runs to cover
-Violet guards Kevin
-Watson tries to take out the ranged attackers
-Watson signals to you to help him
-Violet and Kevin stay in cover until the enemies are gone
-Kevin uses this opportunity to heal/buff Violet

Fall Back

Situation: Kevin is healing/buffing someone who is engaged in melee combat and one of the enemies targets Kevin

Steps:

-Kevin retreats

-Violet taunts whoever is targeting Kevin

No Not the Bees

Situation: Someone is suffering from a negative status effect

Steps:

-Kevin runs in and cures them

Appendix G: Art Asset List

	File Name	Description	Current Status	Notes	Who's responsible	Start Date	Due Date
1							
2			black = not started				
3							
4	HUMANS:			Rosa?			
5							
6	Lily				AMY		
7	lily.mb	Lily- Maya model	DONE	simple model done		9/8/2011	9/13/2011
8	lily.ztl	Lily- Zbrush model	DONE			10/21/2011	11/11/2011
9	lily_gun.mb	Lily's gun	IN PROGRESS			1/12/2012	3/11/2012
10	lily_melee.mb	Lily's melee weapon	IN PROGRESS			1/12/2012	3/11/2012
11	lily_run.mb	run animation	DONE			11/20/2011	12/4/2011
12	lily_idle.mb	idle animation	DONE			11/20/2011	12/4/2011
13	lily_hit.mb	hit animation	DONE			11/20/2011	12/4/2011
14	lily_death.mb	dying animation	DONE			11/20/2011	12/4/2011
15	lily_attack_range.mb	ranged attack animation	DONE			11/20/2011	12/4/2011
16	lily_attack_melee.mb	melee attack animation	DONE			11/20/2011	12/4/2011
17							
18							
19	Violet				AMY		
20	violet.mb	Violet - Maya model	DONE			9/8/2011	9/13/2011
21	violet.ztl	Violet - ZBrush model	DONE			9/13/2011	11/4/2011
22	violet_melee.mb	Violet's melee weapon	NOT STARTED			1/12/2012	3/11/2012
23	violet_run.mb	run animation	DONE			11/1/2011	11/18/2011
24	violet_idle.mb	idle animation	DONE			11/1/2011	11/18/2011
25	violet_hit.mb	hit animation	DONE			11/20/2011	12/4/2011
26	violet_death.mb	dying animation	NOT STARTED				
27	violet_attack_01.mb	melee attack animation	DONE			1/12/2012	3/11/2012
28	violet_taunt.mb	taunt animation	NOT STARTED				
29							
30							
31	Kevin				JENN		
32	kevin.mb	Kevin - Maya model	DONE			9/8/2011	9/13/2011
33	kevin.ztl	Kevin - ZBrush model	DONE			9/13/2011	10/30/2011
34	kevin_run.mb	run animation	DONE			11/20/2011	12/4/2011
35	kevin_idle.mb	idle animation	DONE			11/1/2011	11/18/2011
36	kevin_hit.mb	hit animation	DONE			11/20/2011	12/4/2011
37	kevin_death.mb	dying animation	DONE			11/20/2011	12/4/2011
38	kevin_attack_melee.mb	melee attack animation	DONE			11/20/2011	12/4/2011
39	kevin_heal.mb	heal animation?	DONE			11/20/2011	12/4/2011
40							
41							
42	Watson						
43	watson.mb	Watson - Maya model	NOT STARTED			11/3/2011	11/18/2011
44	watson.ztl	Watson - ZBrush model	NOT STARTED			11/19/2011	12/5/2011
45	watson_txtr.png	Watson - texture	NOT STARTED				
46	watson_gun.mb	Watson's gun	NOT STARTED			11/3/2011	12/5/2011
47	watson_gun_txtr.png	gun texture	NOT STARTED				
48	watson_melee_txtr.png	melee weapon texture	NOT STARTED				
49	watson_run.mb	run animation	NOT STARTED				
50	watson_jump.mb	jump animation	NOT STARTED				
51	watson_idle.mb	idle animation	NOT STARTED				
52	watson_hit.mb	hit animation	NOT STARTED				
53	watson_death.mb	dying animation	NOT STARTED				
54	watson_attack_grenade.mb	grenade attack animation	NOT STARTED				
55	watson_attack_missile.mb	missile attack animation	NOT STARTED				
56							
57							
58	MONSTERS:			type of monster determines what animations are complex			
59							
60	Small Monster						
61	smallMon.mb	Small Monster - Maya model	NOT STARTED				
62	smallMon.ztl	Small Monster - ZBrush model	NOT STARTED				
63	smallMon_txtr.png	Small Monster - texture	NOT STARTED				
64	smallMon_run.mb	run animation	NOT STARTED				
65	smallMon_jump.mb	jump animation	NOT STARTED				
66	smallMon_idle.mb	idle animation	NOT STARTED				
67	smallMon_hit.mb	hit animation	NOT STARTED				
68	smallMon_death.mb	dying animation	NOT STARTED				
69	smallMon_attack_range.mb	ranged attack animation	NOT STARTED				
70	smallMon_attack_melee.mb	melee attack animation	NOT STARTED				
71							
72							
73	Medium Monster				GRAHAM		
74	medMon.mb	Medium Monster - Maya model	DONE			9/8/2011	9/20/2011
75	medMon.ztl	Medium Monster - ZBrush model	DONE			9/21/2011	10/11/2011
76	medMon_txtr.png	Medium Monster - texture	DONE			9/21/2011	10/11/2011
77	medMon_run.mb	run animation	NOT STARTED			12/4/2011	12/16/2011
78	medMon_idle.mb	idle animation	NOT STARTED			12/4/2011	12/16/2011
79	medMon_hit.mb	hit animation	NOT STARTED			12/4/2011	12/16/2011
80	medMon_death.mb	dying animation	NOT STARTED			12/4/2011	12/16/2011
81	medMon_attack_range.mb	ranged attack animation	NOT STARTED			12/4/2011	12/16/2011
82	medMon_attack_melee.mb	melee attack animation	NOT STARTED				
83							
84							
85	Boss Monster						
86	bossMon.mb	Boss Monster - Maya model	NOT STARTED				
87	bossMon.ztl	Boss Monster - ZBrush model	NOT STARTED				
88	bossMon_txtr.png	Boss Monster - texture	NOT STARTED				
89	bossMon_run.mb	run animation	NOT STARTED				
90	bossMon_jump.mb	jump animation	NOT STARTED				
91	bossMon_idle.mb	idle animation	NOT STARTED				
92	bossMon_hit.mb	hit animation	NOT STARTED				
93	bossMon_death.mb	dying animation	NOT STARTED				
94	bossMon_attack_range.mb	ranged attack animation	NOT STARTED				
95	bossMon_attack_melee.mb	melee attack animation	NOT STARTED				
96							
97							
98	Objects						
99	beacon.mb	Checkpoint Beacon	NOT STARTED				
100							

Appendix H: Sound Asset List

File Name	Description	Current Status	Block	Notes	Who's responsible	Partly Record	Time Estimate	Start Date	Due Date	Actual Time	Delta
ACTIONS											
1 = effects (object)	2 = effects (human)	3 = ballistics	4 = environmental								
Lily											
equip_swords_1	Equip Swords 1	COMPLETED	1	Priority 2		R	1.5				
equip_swords_2	Equip Swords 2	COMPLETED	1			R	0.25				
equip_swords_3	Equip Swords 3	COMPLETED	1			R	0.25				
equip_guns_1	Equip Guns 1	COMPLETED	1	Priority 2		R	1.5				
equip_guns_2	Equip Gus 2	COMPLETED	1			R	0.25				
equip_guns_3	Equip Guns 3	COMPLETED	1			R	0.25				
BA_guns_1	Basic gun attack 1	COMPLETED	3	Priority 1			0.5				
BA_guns_2	Basic gun attack 2	COMPLETED	3				0.25				
BA_guns_3	Basic gun attack 3	COMPLETED	3				0.25				
BA_guns_4	Basic gun attack 4	COMPLETED	3				0.25				
BA_swords_1	Basic sword attack 1	COMPLETED	1	Priority 1		R	1.5				
BA_swords_2	Basic sword attack 2	COMPLETED	1			R	0.25				
BA_swords_3	Basic sword attack 3	COMPLETED	1			R	0.25				
BA_swords_4	Basic sword attack 4	COMPLETED	1			R	0.25				
barrage	Gun special 1: Barrage	COMPLETED	3	Priority 1			0.5				
ammo_switch	Gun special 2: Ammo switch	COMPLETED	1	Priority 1		R	1				
concussion	Gun special 3: Concussion blast	COMPLETED	3	Priority 1			0.5				
focus	Sword special 1: Focus	NOT STARTED	Buff sound	Priority 1		R	1				
prism_slash	Sword special 2: Prism Slash	COMPLETED	1	Priority 1		R	1				
whirlwind	Sword special 3: Whirlwind	IN PROGRESS	1	Priority 1	Anthony	R	1				
							12.5				
Violet				Priority 3							
smash_1	Basic hammer attack 1	COMPLETED	1	whoosh - skyrim	Anthony	R	1.5				
smash_2	Basic hammer attack 2	COMPLETED	1	Priority 3		R	0.25				
smash_3	Basic hammer attack 3	COMPLETED	1	Priority 3		R	0.25				
rampage	Special attack: Rampage	NOT STARTED	2			R	1				
homerun	Special attack: Homerun	NOT STARTED	1	big whoosh		R	1				
taunt	Special attack: Taunt	NOT STARTED	2			R	1				
grandslam	Special attack: Grand Slam	NOT STARTED	1	biggest whoosh		R	1				
guard	Special attack: Guard	NOT STARTED	2	Sharp "ting" sound		R	1				
determinator	Special attack: Determinator	NOT STARTED	?			R	1				
							8				
Kevin				Priority 3							
punch_1	Basic punch attack 1	COMPLETED	2			R	1				
punch_2	Basic punch attack 2	COMPLETED	2			R	0.25				
punch_3	Basic punch attack 3	COMPLETED	2			R	0.25				
first_aid	First Aid	COMPLETED	2	inhaler puff		R	1				
regen	Regen	COMPLETED	2	inhaler puff + low powerup		R	1				
adrenaline	Adrenaline	COMPLETED	1	inhaler puff + vocal reax		R	1				
caffeine	Caffeine	COMPLETED	1	inhaler puff + high powerup	Anthony	R	1				
morphine	Morphine	COMPLETED	1			R	1				
mystery_drug_x	Mystery Drug X	COMPLETED	1	inhaler puff + bubbles		R	1				
poison	Poison	COMPLETED	2	inhaler puff + acidic sizzle		R	1				
cure	Cure	COMPLETED	2	inhaler puff + "ahh"		R	1				
secret_formula	Secret Formula	COMPLETED	1			R	1				
							10.5				
Watson				Priority 2							
blast_1	Basic blast attack 1	NOT STARTED	3	gatling gun fire	Anthony		1				
blast_2	Basic blast attack 2	NOT STARTED	3		Anthony		0.25				
blast_3	Basic blast attack 3	NOT STARTED	3		Anthony		0.25				
grenade	Grenade	COMPLETED	3				0.5				
firebomb	Firebomb	COMPLETED	3				0.5				
stun_grenade	Stun Grenade	COMPLETED	3				0.5				
suppressive_fire	Suppressive Fire	IN PROGRESS	3	gatling gun + stun	Anthony		0.5				
smoke_bomb	Smoke Bomb	NOT STARTED	3				0.5				
liquid_nitrogen	Liquid Nitrogen	IN PROGRESS	3		Anthony		0.5				
second_wind	Second Wind	NOT STARTED	2			R	1				
							5.5				
Enemies											
claw_1	Basic Claw attack 1	NOT STARTED	Priority 2	Swipe sound	Anthony	R	1.5				
crawler_die_1	Crawler death 1	NOT STARTED	Priority 2	melting sound	Anthony	R	1.5				
crawler_footstep_1	Crawler footstep 1	IN PROGRESS			Anthony	R	1				
crawler_vocal_1	Crawler vocals 1	COMPLETED	Priority 2		Anthony	R	1				
crawler_special	Crawler special attack	NOT STARTED		swipe sound, straining?	Anthony						
enemy_ranged	Jellyfish fire	NOT STARTED	Priority 2	energy gunshot, slinky	Anthony						
enemy_float	Jellyfish float	NOT STARTED	Priority 2	similar to fan, whoosh	Anthony						
	Jellyfish die	NOT STARTED	Priority 3	droppin squid	Anthony						
	kamikaze attack	NOT STARTED	Priority 2		Anthony						
	kamikaze walk	NOT STARTED	Priority 1	ticking, clicking, centipede	Anthony						
					Anthony						
	kamikaze die (explosion)	NOT STARTED	Priority 2	wet explosion, splat	Anthony						
	juggernaut attack	NOT STARTED	Priority 2	stomp, head swing	Anthony						
	juggernaut walk	NOT STARTED	Priority 2		Anthony						
	juggernaut voice		Priority 2	distorted foghorn	Anthony						
	juggernaut die	NOT STARTED	Priority 2	heavy crash, dust settle, synced to animation	heavy crash, dust settle, synced to animation						
	enemy melt 1	NOT STARTED	Priority 2	pasta, mud bubble, sizzling, lobster, hot skillet dipped in water							
	enemy melt 2	NOT STARTED									
							5				
General											
footstep_HH_L_1	High heel footstep left 1	COMPLETED	Priority 1 for Lily			R	1				
footstep_HH_L_2	High heel footstep left 2	COMPLETED				R	0.25				
footstep_HH_L_3	High heel footstep left 3	COMPLETED				R	0.25				
footstep_HH_R_1	High heel footstep right 1	COMPLETED				R	1				
footstep_HH_R_2	High heel footstep right 2	COMPLETED				R	0.25				
footstep_HH_R_3	High heel footstep right 3	COMPLETED				R	0.25				
footstep_B_L_1	Boot footstep left 1	COMPLETED				R	1				
footstep_B_L_2	Boot footstep left 2	COMPLETED				R	0.25				
footstep_B_L_3	Boot footstep left 3	COMPLETED				R	0.25				
footstep_B_R_1	Boot footstep right 1	COMPLETED				R	1				
footstep_B_R_2	Boot footstep right 2	COMPLETED				R	0.25				
footstep_B_R_3	Boot footstep right 3	COMPLETED				R	0.25				
							6				
EFFECTS											
sword_hit_body_1	Sword impact body 1	COMPLETED	Priority 1	Snow shovel!	Anthony	R	1.5				
sword_hit_body_2	Sword impact body 2	COMPLETED			Anthony	R	0.25				
sword_hit_body_3	Sword impact body 3	COMPLETED			Anthony	R	0.25				
sword_hit_body_4	Sword impact body 4	COMPLETED			Anthony	R	0.25				
bullet_hit_body_1	Bullet impact body 1	COMPLETED	Priority 1		Graham	R	1.5				
bullet_hit_body_2	Bullet impact body 2	COMPLETED			Graham	R	0.25				
bullet_hit_body_3	Bullet impact body 3	COMPLETED			Graham	R	0.25				
bullet_hit_body_4	Bullet impact body 4	COMPLETED			Graham	R	0.25				
hammer_hit_body_1	Hammer impact body 1	COMPLETED			Graham	R	1.5				
hammer_hit_body_2	Hammer impact body 2	COMPLETED	Priority 3		Graham	R	0.25				
hammer_hit_body_3	Hammer impact body 3	COMPLETED			Graham	R	0.25				
player_hit_1	Player hit 1	COMPLETED	Priority 1		Graham	R	1.5				
player_hit_2	Player hit 2	NOT STARTED			Graham	R	0.25				
player_hit_3	Player hit 3	NOT STARTED			Graham	R	0.25				
player_hit_4	Player hit 4	NOT STARTED			Graham	R	0.25				
bullet_hit_wall_1	Bullet impact wall/floor 1	NOT STARTED			Graham	R	1.5				
bullet_hit_wall_2	Bullet impact wall/floor 2	NOT STARTED			Graham	R	0.25				
bullet_hit_wall_3	Bullet impact wall/floor 3	NOT STARTED			Graham	R	0.25				
beacon_1	activate beacon 1	COMPLETED	Priority 1				1.5				
door_open_1	blast door open 1	COMPLETED	Priority 1		Graham		1.5				
							#REF!				
AMBIANCE											
fan_1	fan whir 1	COMPLETED	Priority 2		Graham	R	1				
			Priority 2		Graham						
			Priority 2		Graham						
steam_release_1	steam valve release 1	COMPLETED	Priority 2		Graham	R	1				
steam	steam hiss	COMPLETED	Priority 2		Graham						
computer_1	computer beeps 1	COMPLETED	Priority 2		Graham	R	1				
computer_2	computer beeps 2	COMPLETED	Priority 2		Graham	R	0.25				
computer_3	computer beeps 3	COMPLETED	Priority 2		Graham	R	0.25				
monitor_1	monitor humming 1	COMPLETED	Priority 2		Graham	R	1				
monitor_2	monitor humming 2	COMPLETED	Priority 2		Graham	R	0.25				
swivel	TV swivel	COMPLETED	Priority 2		Graham	R	1				
							#REF!				
MUSIC											
mb_inactive_1	Background music - out of action 1	NOT STARTED	Priority 1	45 seconds	Anthony	Priority 2	1				
mb_inactive_2	Background music - out of action 2		Priority 1		Anthony						
bm_battle_1	Background music - in action 1	NOT STARTED	Priority 1		Anthony		2				
title_music	Title music	COMPLETED	Priority 1	1 minute	Anthony						
							#REF!				
VO											
	female mood sounds										
	male mood sounds										
	female battle sounds	action VO, pain, death									
	male battle sounds	action VO, pain, death									

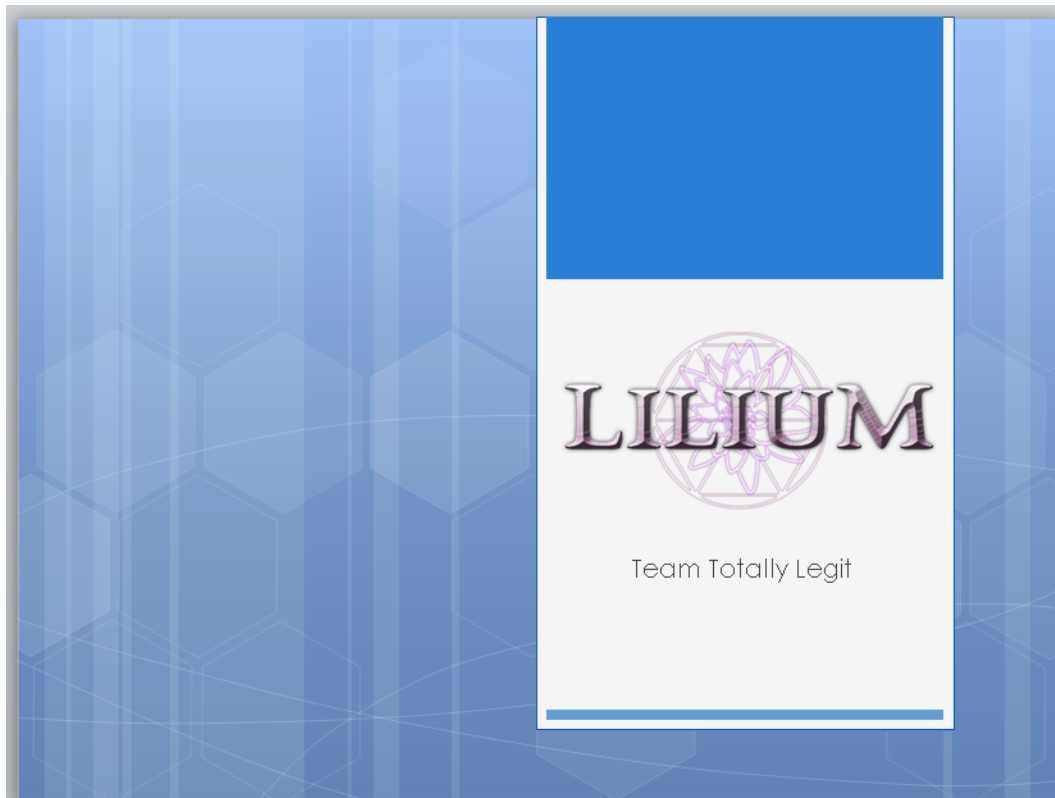## Appendix I: Playtesting Survey and Results

Playtesting Questions

1. Have you experienced any unexpected behavior or bugs during your time playing Lilium? Please write down any issues you experienced. You may use the back of this paper.

2. Are the controls intuitive? If not, what changes would you make to them?

3. Does the user interface seem hard to use? How?

4. Did the world seem immersive? In your opinion, what effect (if any) did the environment have on the gameplay (was it conducive to combat)?

5. When you attack the enemies, do you feel that you are actually doing damage? If not, what are you looking for when your character is fighting?

6. Do you feel like you are part of a team? Are your allies getting in the way?

7. Were there any times when you wanted your allies to do something other than what they were doing?

8. Do you feel that combat is balanced? Is it too easy or too hard?

9. Finally, are there any abilities you wish your character had (other than jumping)?

10. Did you have fun? =) What do you think would make the game more fun?

11. Any other comments you have not related to these questions:

Playtesting Responses

	A	B	C	D	E	F	G
1	**Playtesting Questions**	**Answers (3/21/12)**	**Answers (3/21/12)**	**Answers (3/21/12)**	**Answers (3/21/12)**	**Answers (3/21/12)**	**Answers (3/21/12)**
2	1. Have you experienced any unexpected behavior or bugs during your time playing Lilium? Please write down any issues you experienced. You may use the back of this paper.	Couldn't attack in cowardly stance (or after being in cowardly stance could not attack/switch weapon etc) dimensions didn't wor as well. Walks on skates a bit.	Fell through the floor at the end.	Walking Animation not working on ranged weapon. Enemies walking through bottom floor right side table / container.	Sentry was attacking me through the floor. Health bar still shows up on enemies a few seconds after they've died and you can still target them.	Few skating things, nothing really major.	Slow-down, but no real glitches. Enemies didn't spawn until I was in a specific place
3	2. Are the controls intuitive? If not, what changes would you make to them?	Right ctrl for changing stances seems a little far to reach	Laggy on aiming + switching weapons / selecting abilities unsure - does spacebar attack?	Yes but I would want the ability to hold down mouse button to attack. Having num 1-4 usable as well as scroll.	Mouse controls are a little squishy- my mouse can end up on the edge of the screen and then I can't click on something at the center without rotating my view.	Turning isn't tight. Would increase turning speed.	No, I would map weapons and special abilities to keys. Or lock on to a key.
4	3. Does the user interface seem hard to use? How?	Make ability selected more obious -> too dull color @ this point icons need words to say what status they are (stances as well) stance needs to be labeled in UI.	Don't know when I'm locked on.	No, just understanding what the symbols mean (which I assume would be described and learned earlier in the game)	Stances are hidden, what do the icons mean?	I WANT NUMBER BUTTONS!	The actions bar is annoying. Map that stuff to keys. I also don't understand all the icons above the health bar.
5	4. Did the world seem immersive? In your opinion, what effect (if any) did the environment have on the gameplay (was it conducive to combat)?	Some placements of close items are a little clunky to get around (the desk by the front) when running through there sometimes you get stuck	Looks good	Yes. I liked the enevironment. The haziness of the other dimension feels too big.	Scale in lobby ->tables and benches	Yes. I didn't really understand why the monsters were there, but I understand there are more.	The environment seemed to get in the way. The world seems immersive.
6	5. When you attack the enemies, do you feel that you are actually doing damage? If not, what are you looking for when your character is fighting?	Hard to tell if you are dying, had to give indication of critical HP. Maybe a glow outline of the enemy you are attacking.	No - I see numbers. Animations not good/believable.	Yes and no, but there are no animation for attacking as well as getting hit, so adding that in would be great.	Health bar is good but enemies dont react at all- its like punching a wall	No, I want more feedback. Also, a crosshair would be awesome.	No, there isn not enough feedback. The only way I can tell I'm doing damage is by the health bar decreasing.
7	6. Do you feel like you are part of a team? Are your allies getting in the way?	Kevin needs to not be in the middle of combat and dying.	No - I can tell there are other people there to help but it doesn't feel like teamwork - they're all independent.	No. That healer in the middle of the battle is annoying because you prefer not to have the healer attacked.	Not when I'm in the other dimension	Yes. No. :P	I have not really been noticing the AI. I feel like an army of one.
8	7. Were there any times when you wanted your allies to do something other than what they were doing?	Kevin healing but he was in the middle of combat...	Sometimes they just stand there and stare at me.	Helping me, but I guess they can't go to the other dimension and did fine on my own.	Kevin had no sense of self preservation =O He needs to run away when he's taking a lot of damage	Can the allies go into that spirit realm? That healing dude would be nice.	I honestly didn't notice. One was healing, but I couldn't tell otherwise.
9	8. Do you feel that combat is balanced? Is it too easy or too hard?	Pretty easy. I didn't die. Second time in offensive stance I died pretty often. It can be pretty difficult sometimes. Leans toward more difficult	Combat is chaotic, it was pretty easy.	Yes, hard at first, but easy the second time.	It's really hard in the other dimension - also hard to see	The first fight was hard.	Enemies seem to have too much health, which is frustrating.
10	9. Finally, are there any abilities you wish your character had (other than jumping)?		*Mobility, abilities. Hard to switch abilities?	Can't think of anything. Running.	N/A	Crosshairs.	None that I can think of. (Dance Button)
11	10. Did you have fun? =) What do you think would make the game more fun?	Yes :) Lily needs to be buffed. Also, spawn less enemies in alternate dimension.	Yes (sort of), needs to be more immersive. Weapon customization like Mass Effect 1	Yes. All the above. Always make it better.	CAKE!!!	YES! More feedback.	The game wasn't running smoothly, enemies had too much health, and it never really felt like I was hitting enemies. This took away from the fun.
12	11. Any other comments you have not related to these questions:	Dimensions look awesome! Pretty chaoitic battles overall.	Animations are wonky, weird collisions when walking side to side, don't know if attacks did anything, can't tell if in melee or ranged mode, too zoomed in on character?, want to see more of the screen/battle, everything is quick -> everything happens at once, walk slower - things should happen slower.	Change the avatar images in the bottom so they're more uniform in style.	I have no indication when I'm about to die**. It's hard to judge my range in melee mode. Some of the explosions are really distracting. **Crit HP idol, Red Fringe, Sound Cues	It's awesome. Great environments.	More/clearer feedback
13							

Gameplay

- Party roles
  - Defender, striker
  - Healer, saboteur
  - Marksman, controller
- Your role
  - "Leader"
  - Versatility

Lily

- Player - Leader
- Melee - Swords
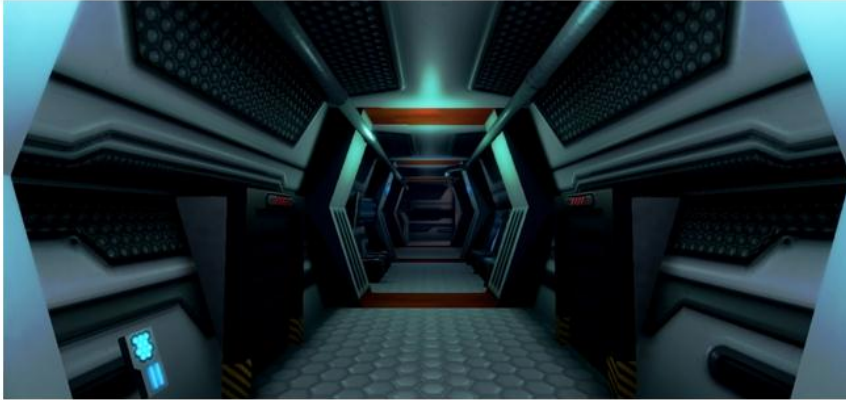- Ranged – Guns

Watson

- Marksman, controller
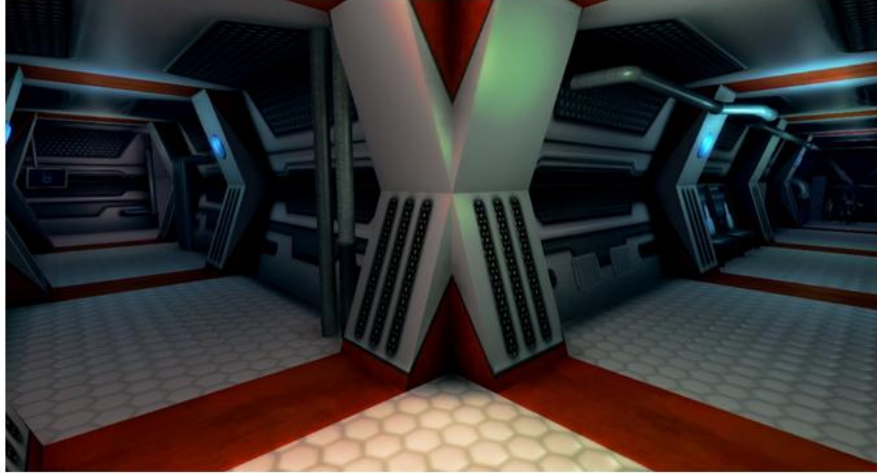- Ranged – Hovering Machine Gun

Enemies

Environment

Environment

Environment

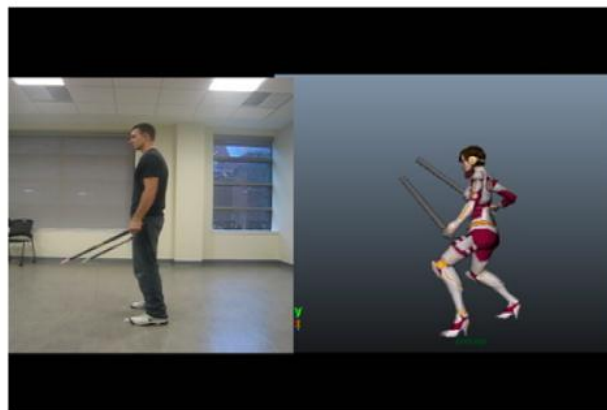
Environment

Environment

Demo Video

Audio

- Foley - industry level recording
- Original Music
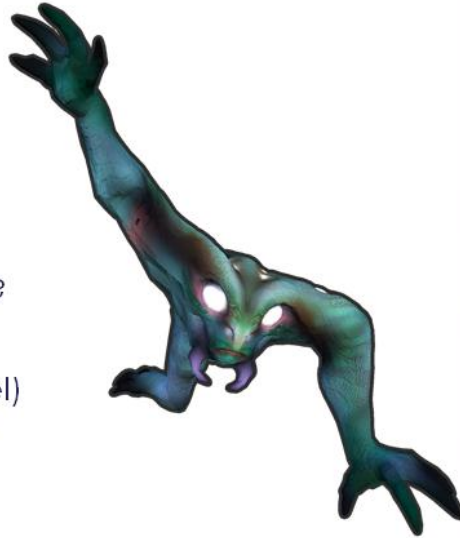- Pro Tools/Logic -> Unity

Animation

AI: Overview

- A co-op game
  - ...but single player
- How do you do that?
- Two "levels" of AI
  - Strategic (team-level)
  - Tactical (individual)

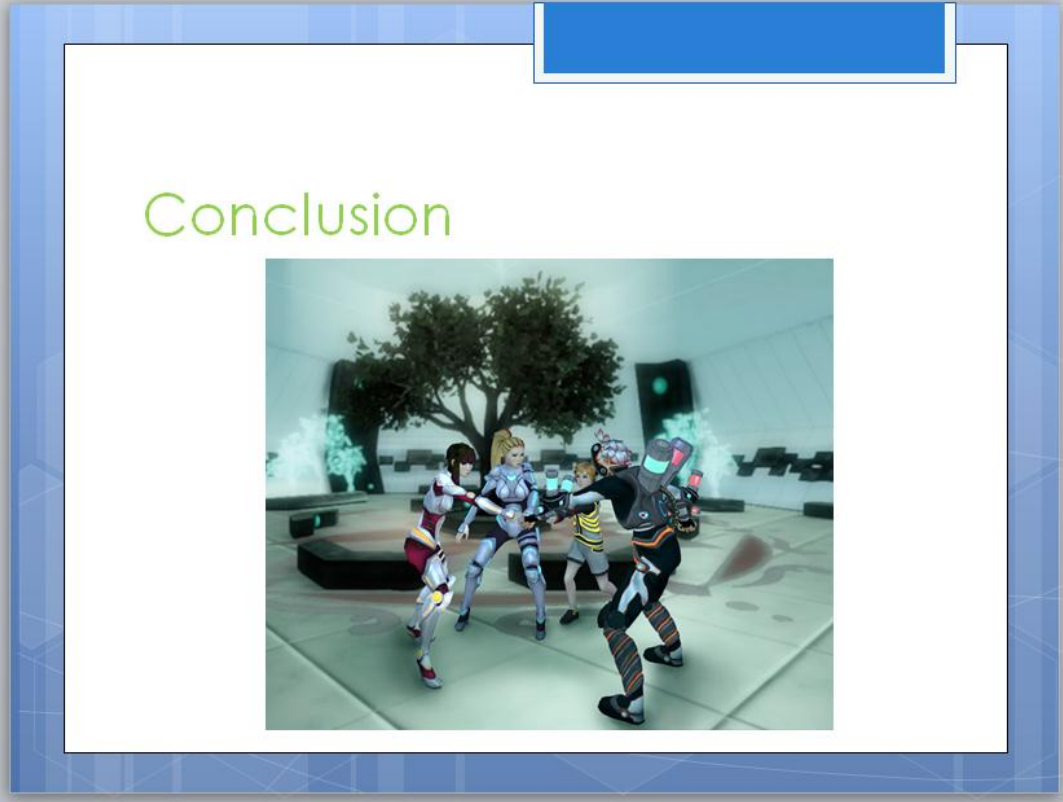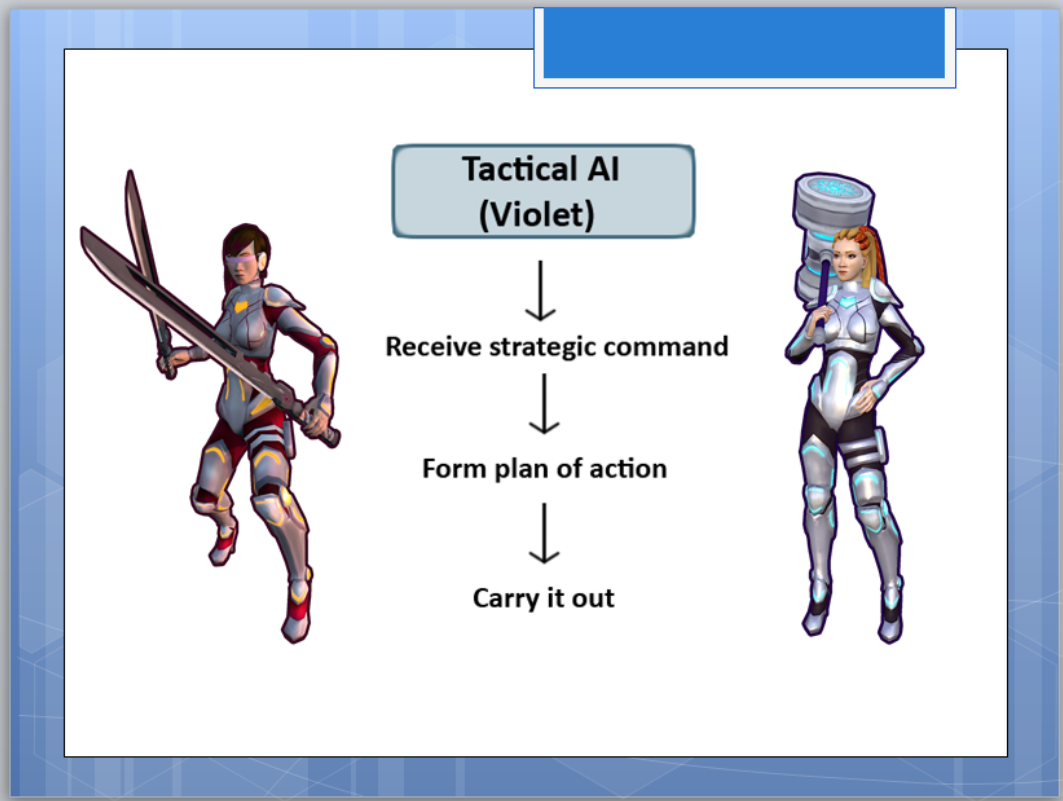Strategic AI

Analyze situation

Dispatch commands

Violet AI   Watson AI   Kevin AI

Tactical AI (Violet)

Receive strategic command

↓

Form plan of action

↓

Carry it out

Conclusion

Comments/Questions?