5-2019

Narrative and Environmentally Based Character Expression System For Gameplay-Centric Video Games

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NARRATIVE AND ENVIRONMENTALLY BASED CHARACTER
EXPRESSION SYSTEM FOR GAMEPLAY-CENTRIC VIDEO GAMES

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Fine Arts
Digital Production Arts

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by
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May 2019

Accepted by:
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ABSTRACT

As technology progresses, so too does our ability to create visually stunning and incredibly immersive gaming experiences. With the power some consoles possess today, cinematic games have pushed the envelope of technology to deliver heavily animated, character driven stories not possible years ago. However, more "game-centric" games, in an effort to focus on gameplay and player projection, tend to neglect the possibilities of providing the same character driven experiences. In this paper, we present an animation system that would allow characters in traditionally gameplay-driven games to show the same amount of depth and growth as characters in other mediums. Our approach makes use of Unity's animation and avatar masking systems as well as blend shapes to manage animations for a character based on where they are in their story, local environmental factors, and the characters own personality. In this way, we create a more dynamic character who creates player immersion not by being a blank slate, but by being an engaging and believable character to watch grow.

ARTIST STATEMENT

In creating gripping stories, it is important to create an emotional connection with your character. Characters with engaging personalities help create unforgettable stories that people will empathize with for years to come. In interactive media such as video games, I believe developing personality within the main characters will add deeper value for the player and create a more rewarding and enriching experience. My goal is to create a system of animation that would allow a character to have their own personality, so that we may experience the world through their eyes as we control them with our hands on the wheel. We can feel the character grow, change, and react to the world around them in their own way apart from the player. The immersion comes not from the players sense of their own presence in the game, but from wanting to see the main character grow and succeed.

In video games that focus on gameplay, it makes sense that story and character would take a back seat. The draw and focus are the mechanics and level design at play, and the world around it is simply a framing device, such as in the *Super Mario* series. However, sometimes the story is given a little more weight and bearing on the game itself, leaving room for more investment in the world of the game past viewing it purely as a framing device for mechanics. The mechanics are a means to explore and influence the world around you, to participate in its history. While it would make sense for main characters in games like these to convey a semblance of participation in the story around them, many are made as blank slates to give a sense of immersion to the player. The character acts only as a vehicle for the player to interact with the world, not as part of the

world itself with their own history and personality. Any reactions or victories of the player are the player's alone. Therefore, the main character is given little in way of personality within their animations unless necessary in cutscenes- and even then, some stay ever emotionless.

The animation system described in this project will be used to give life to a character named "Pepper" by interchanging sets of animations based on narrative, environmental, and reactionary factors. Pepper, a provincial farm girl thrust into an intergalactic adventure, will have animation sets that seem to follow the narrative arc of a reluctant hero. Her story takes inspiration from other reluctant hero stories by Douglas Adams, Dan Harmond, and Hiroyuki Imaishi. Their use of intergalactic stories as a means of thrusting their hero into the least comfortable environment possible allows their characters to have very expressive reactions to their situations. She will similarly have reactionary animations to the world around her, based on her own personality, curiosities, and fears.

As Frank Thomas and Ollie Johnston state in their book *The Illusion of Life,* "we want our audience not merely to enjoy the situation … but really to feel something of what the character is feeling. If we succeed in this, the audience will now care about the character and about what happens to them [1]." This is the principle of audience engagement I would like to explore in creating this animation system. Having a character animated in this way – showing their feelings, showing their personality – will cause a player to connect with them on an empathetic level. As Pepper grows over time, showing

reactions to the world and events unfolding around them, The player will become invested not only in the gameplay, but also in the success of Pepper.

Pepper's design is heavily inspired mainly by the works of many animators. Hayao's Miyazaki's simple clothing designs, Yoichi Kotabe's Round, stout Character designs, and Mago and Yusuke Yoshigaki's cute, expressive character animation help to establish characters in visually striking and memorable manners. I wanted to get across that cute appeal in Pepper to amplify her ethos. Her Animations are inspired by the works of Glen Keane and Hayao Miyazaki, well known for their work in bringing life to timeless female characters like Ariel from *The Little Mermaid,* Chihiro from *Spirited Away,* and Kiki from *Kiki's Delivery Service* [2, 3, 4]. I choose their works because I want Pepper to have the same timeless, independent personality that these female characters possess.

Using these design and animation philosophies, I believe Pepper will become a character that will not just allow players to inhabit as a vehicle but will engage the player at the highest level of empathy and leave a lasting impression. This will be achieved through creating an endearing character out of Pepper, who's design is simple and streamlined, and who's animations are lively and cute.

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CHAPTER ONE

Motivation

Growing up playing video games, I never thought too hard about story- to me, games were about gameplay, and story was just a framing device; polish that made the game unique, but not necessary to the game itself. The story behind any mainline Super Mario title is just an excuse for game designers to experiment and play with new mechanics and gimmicks- you couldn't get away with only saving a princess for 30 odd years if story was the main selling point.

As such, I never thought too hard about how characters in many games I played seemed to be born for adventure. They walked, ran, attacked, and defended as if they'd been going on adventures their whole lives- even if they hadn't seen a monster in their lives.

This especially holds true for the game series that inspired this project, *The Legend of Zelda* series. For most Zelda titles, we are always introduced to a new version of Link, usually shown as someone who is somewhat lazy and sleeps in late. They have never been on an adventure, and in some cases have never even left their home village. However, as soon as the game begins, Link can do backflips, strafe, use a sword and shield like a professional, and has no reaction to the sudden appearance of monsters that that are told they are destined to fight. Link seems to always hold himself and animate with the determination and confidence of a seasoned adventuring veteran- even as a small child [5, 6]

In doing this, Link is a blank slate- a vehicle for the player to project themselves onto to put themselves in the game. As such, the player can even give Link a name of their own choosing, further demonstrating that Link is not truly a character in his own right.

Fig 1.1 Various iterations of Link, stoic and heroic [5, 6, 7]

A Character having their own personalities and apparent agency is not a foreign concept to these kinds of games, however. 2001's *Luigi's Mansion* Sees the player take control of the titular Luigi, as he explores a haunted mansion in search of his lost brother. The actions Luigi performs are ultimately that of the player, such as moving around, interacting with props, talking to characters, and fighting ghosts. However, Luigi's animations are heavily character based- he shakes and grimaces in fear in the dark and jumps at surprises yet whistles cheerfully to himself in the comfort of the light. His voice changes based on his health and whether the lights are on or off. Even though the player is making all the decisions, it all seems to be the actions of Luigi himself, because he gives off a presence of mind of the world around him. The player is not left wondering if *they* will succeed, but rather if *Luigi* will succeed [8].

This attention to detail that might not have been noticed if left out adds a whole new layer of charm to the game that leaves a memorable impression. While rarely effecting gameplay, Luigi's personality helps to bolster the games unique character and comically spooky atmosphere.

Fig 1.2 Screenshots from Luigi's Mansion demonstrating Luigi's demeanor change when the lights are off and when they are on [8]

Luigi's Mansion is limited however in scope- The game is set in one location with one overarching atmosphere. The *Zelda* series in contrast is set in many locations of various atmospheres, with a story that varies in tone as it progresses. I want to create an experience that expands the same marriage of character and gameplay found in *Luigi's Mansion* in the context of the adventurous, exploratory gameplay and sprawling worlds found in the *Legend of Zelda* series. By introducing that same amount of character into a larger adventure, we can add so much personality to a game.

CHAPTER TWO

Concept, Past Works, and Inspirations

2.1   Introducing Pepper

The expression system we introduce in this paper is exemplified with the player controllable character, Pepper. Our system is built around animating Pepper to match where she is in her story, showing character progression through the game. But to understand where to start, we need to pin point the story Pepper experiences, and her personality.

Pepper is a young woman, comfortable in her life- she has grown in a peaceful world, and in turn is peaceful herself. She's happy, content, and has never dreamed of life outside her small town and farm- much less outside of her world. However, one night, a UFO comes crashing down into her home. The surviving alien kidnaps her dog, flying off in an escape pod. Feeling a rush of adrenalin to rescue her dog, she chases after them in the remaining pod. She follows them to the mothership, and suddenly the adrenaline ears off- she is overcome with fear. In the end, she rescues her dog, fighting the dognaper with the knife skills she learned on her farm. Before she can get herself home, however, her dog takes command of the pod and leads them to his home planet. He reveals he was sent to Pepper's planet to find a worthy hero, and he has decided Pepper is that hero. Pepper faces a moral dilemma, torn between two feelings. As this quest is not her responsibility, she can just go home. But she also feels an obligation to offer her help, and a crippling desire not to disappoint others- least of all her own dog. She decides, against all prudence, to accept the quest, and thrust herself into adventure. In the face of these new,

daunting, otherworldly challenges, her originally carefree personality is overtaken by her fear and insecurity- but overtime, she becomes more confident in her abilities, curious and interested in the new wonders around her, and eventually becomes just as comfortable among the stars as she ever was at home- though, she would still take lying in the sun in her quiet fields over exploring other planets any day.

Pepper's apprehensiveness is relatable; the player can empathize with her situation and form a connection with her- Everyone on earth can imagine it would be hard to adjust to suddenly finding themselves in the middle of space. Much in the same way a blank slate character lets the player connect themselves to the world through projection, Pepper's everyman persona allows the player to connect with her and the world, but on a deeper more emotional level.

2.2   The Reluctant Hero

Character's in stories throughout history tend to follow patterns in their personalities. These patterns have been created and used in stories throughout history and are referred to as archetypes. Archetypes were popularly described by Psychiatrist Carl Jung as tropes that derive from human history's collective unconscious [9]. These archetypes have influenced how characters are given personalities. In journeys such as Pepper's, characters tend to fall into the role of the hero archetype. There are many types of hero archetypes, and Pepper's everyman personality and hesitation and outright fear toward grand adventure puts her in the role of the "reluctant hero".

Reluctant heroes are heroes who are called unwillingly to adventure, and long to return to normalcy during their quest- they may be on the quest out of a sense of obligation, a drive to return to their old life, or by pure force. The Reluctant Hero trope can be found as far back as the bible. Jonah, called to action by God to preach, refuses the call and tries to flee from the journey. He is subsequently swallowed by a whale until he accepts the call and go onward to preach [10]. The Main Characters of J.R.R. Tolkien's *The Hobbit* and *The Lord of the Rings* series, Bilbo and Frodo Baggins are humble Hobbits who are thrust into adventures that hold consequences for their entire world [11, 12].

`In the world of film, a famous example of the reluctant hero is Bruce Willis' character John McClane from *Die Hard,* who being in the wrong place at the wrong time, is the only one able to fight terrorists who have taken over a building [13]. Reluctant heroes can be found in many animated shows, such as Jackie Chan's archeologist-turned-secret-agent character from *Jackie Chan Adventures* or Gohan from Dragon Ball Z, who would rather live quietly and study than save the world [14, 15]. Each character is forced to face and conquer challenges they don't really want any part in.

In many of these stories, the Hero learns to come to terms with their new lives or even embraces it. Bilbo longs for new adventure, Gohan embraces his status as a protector of Earth, and John McClane keeps being in the wrong place at the wrong time for four more movies [13, 15]. I want to show this growth of characters from their reluctant selves to their realized potential in Pepper.

Below, I will look at Reluctant hero stories that show this growth in a way that parallels Pepper's own personality and intergalactic Journey, as well as other works that

inspire her design and animation.

2.3   Inspirational works

A Reluctant Hero story in literature that best exemplifies the ordeal that Pepper faces is Douglas Adams' Novel Series *The Hitchhiker's Guide to the Galaxy.* Arthur Dent is a normal man living in normal rural England, who is whisked away on an intergalactic journey the day the Earth is destroyed to make way for an intergalactic bypass. He is constantly bewildered and discontented with the situations he finds himself in, lost without a guide to help him traverse the universe. As the novels progress, however, he finds a new life in space, where he can traverse on his own and start a new life on a new planet [16].

In a similar vein, Dan Harmond's show *Rick and Morty*'s titular character Morty and his sister, Summer, are constantly dragged on interdimensional adventures by the titular Rick. Both Morty and Summer, though they begin the series confused and terrified of the situations they often find themselves in, over the series' lifetime they have each become jaded and capable toward the fantastical situations they are forced to deal with [17]. While the cynicism in the show goes against Pepper's personality, the ability of the show to keep personality of its characters consistent over the changes they go through is inspirational in itself.

Another contemporary animated show that stars a normal young girl thrust into intergalactic adventure is Hiroyuki Imaishi's short anime series *Space Patrol Luluko.*

Luluko tries to live a normal life as a middle school girl in the middle of Earth's intergalactic immigration hub, but soon finds herself a part of space patrol, a space related police force. She begins her work with hesitation and fear, but eventually finds herself getting used to the work, and eventually accepting her role in the space force and coming into her own. Luluko's character design, big eyes, and cute expression over the course of the series (a product of anime artists Mago and Yuske Yoshigaki), giver her a feel of innocence [18]. This is a big inspiration for Pepper's personality and expressions.

Fig 2.1 Screenshots from Space Patrol Luluko that show Luluko's change in character over the course of the show[18]

I feel these space travel stories are interesting because they explore the last true area of exploration, the final frontier- outer space. Hapless, everyday characters like ourselves are thrown into increasingly odd and fantastical situations, the limits of which seem neither tethered by the laws space, time, or physics. Stories of intergalactic proportions explore basically any possibility and will always leave an audience member just as on the edge of their seat as the protagonist.

Continuing with character design, Pepper draws inspiration from the works of Hayao Miyazaki and Yoichi Kotabe. Both animators are famous for their simple, recognizable character designs. Hayao Miyazaki's characters usually wear 2 tone outfits that add a little puff to a character's form. Sheeta From *Castle in the Sky for* instance has a two-tone outfit with a shirt and pants that budge out at the arms and legs [19]. Nausicaa from *Nausicaa of the Valley of the Wind* sports a pilot-style utility suit with large boots [20]. This utility design gives a futuristic sci-fi feel that I wanted to impart in Pepper's costume so that she is more believable in a space related setting.

Fig 2.2 Costume designs of Sheeta and Nausicaa from Studio Ghibli's Castle in the Sky and Nausicaa of the Valley of the Wind respectively, compared to Pepper [19, 20]

As the motivation for Pepper was a result of Nintendo games, it only makes sense for her to be heavily inspired by Nintendo's character designs. Yoichi Kotabe is well known for his designs of the *Super Mario Bros.* cast of characters. His use of rounded, squat character design added a considerable cuteness and appeal to the franchise that's been a staple of Mario games ever since [21]. As with Miyazaki's character design, most characters stick to a limited palette that helps make characters recognizable. Mario, Luigi, Princess Peach, and Even King Koopa employ memorable, limited color palettes.

Pepper also takes heavy inspiration from Yoshiyuki Oyama's character design work from *The Legend Of Zelda: The Wind Waker*. His striking work has made *Wind Waker* one of the series' most unique entries [6]. Pepper's Bandana, short hair and elf ears are made as an homage to the character that inspired her creation, Link.

Fig 2.3 Yoichi Kotabe's Mario series character Designs, and Yoshiyuk Oyama's Link designs for The Legend of Zelda : the Wind Waker, in game and out of game, compared to Pepper's design [21, 6].

Outside of Japan, Pepper takes inspiration from the famous Disney animator Glen Keane. Glen's volume of work includes character design and animation in films such as *The Little Mermaid* and *Tangled*. His use of large eyes and expressive mouths and brows give his characters a cute appeal and innocence, and his use of somewhat realistic proportions gives his characters a more realistic presence, allowing the audience to connect to them more easily [2, 22].

Keane and Miyazaki are both known for creating memorable female characters who go on emotional journeys. Keane's facial animations for Ariel and Rapunzel in *The Little Mermaid* and *Tangled* respectively show a wide range. Rapunzel's expressions especially are a heavy inspiration to Pepper, as her demeanor evolves throughout the

story[22]. Miyazaki's Work on Chihiro in *Spirited Away* and Kiki in *Kiki's Delivery Service* shows girls thrust into unfamiliar journeys. Both characters utilize body language as a means of expressing their inner emotions. Both have moments where their body language shows uncertainty, timidness, as well as resolve [3, 4]. Of the two characters, Chihiro especially influences Pepper because of her evolution from a timid outsider to a hero who can hold her own.

Fig 2.4 Chihiro's progression through Spirited Away [3]

When choosing a protagonist, gender can play a big part in audience response to a character. It can also play a part in how a creator, like myself, builds a personality for a character. I find that in fictional media, girl characters tend to be more expressive, and their stories to be centered more around their emotional state and growth. In creating a cute design, especially in an adult character, it felt more appropriate to create a female protagonist. In creating Pepper's expressions, I felt with a girl character I had more freedom to create exaggerated full-body emotions that didn't come off as comedic as they might for a male character, and instead create a level of sympathy. Making Pepper a girl

also adds a level of emotional engagement to the idea of combat. As Miyazaki stated in an interview about *Nausicaa*: "When a man is shooting a handgun, it's just like his is shooting because that's his job, and he has no other choice. It's no good. When a girl is shooting a handgun, it's really something [23]."

As an additional touch, Pepper's large elf ears can be moved like a cat's to accentuate her expressions. Tom Bancroft's work animating Mushu for Disney's *Mulan* is a treasure trove of expressive ear movements that only serve to add to the emotional impact of the character's movement [24].

Fig 2.5 Mushu's ears serve to accent his expressions and enhance his on-screen personality [24]

CHAPTER THREE

Quantifying Character Expression

3.1   In Relation to The Character's Self

Pepper's Personality, unlike in games such as *The Sims,* is a fixed entity [25]. Her personality is planned beforehand, and the underlying being that constitutes "Pepper" is consistent, even as she grows as a person through her journey. As such, quantifying character traits in game like "charisma", "aggressiveness" and "cockiness" is not possible. Her Joint driven animations are set in stone. However, Pepper's expression of her set personality can be quantified though her facial animations. Pepper's model takes advantage of multiple blend shapes, allowing us to blend her geometry into different expressions. We therefore quantify each facial expression though the set of values (predefined, interchangeable, blend-able lists of floats) needed to blend the face, eyelashes, and eyebrows into the desired characteristic- surprise, anger, fear, disgust, curiosity, happiness, smugness, and everything in between.

3.2   In Relation to the Narrative Arc

As we are using the reluctant hero archetype, it is best to use one of the most common narrative arcs in history, the hero's journey. Luckily for us, this arc has already been quantified into 12 distinct, common steps by (author) in his book, *The Hero with a Thousand Faces* [26]. For our purposes, I will be consolidating the 12 steps into a more

workable 5. Below, I will outline each step and their respective overlap on the traditional 12 step list, as well as how they fit in Pepper's story.

1. Ordinary World

The first step of Pepper's journey is the same as any hero's journey- in her world as it is. She's grown in it, she's comfortable in it, and is the master of her domain. She walks with a carefree bounce, runs without destination, and can be found humming to herself in an idle moment.

2. The Thrust

The second step encompasses the Call and Refusal steps of the hero's journey. Pepper is suddenly thrust into a strange, unfamiliar, and potentially dangerous situation. She stands nervously, looking around her environment- she walks with a timid demeanor, taking careful steps as to not draw attention to herself. When she runs, she keeps low to the ground, her tense arms denoting her discomfort. Her eyes are smaller, and appear more focused on anything she looks at.

3. & 4. Finding Footing

This step encompasses the next three steps- meeting the mentor, crossing the threshold, and tests, allies, and enemies. Once Pepper has made it through the ordeal that thrust her into the situation, she reluctantly begins her quest. She begins with the same timid demeanor as before, but as she progresses through her tests, she gains a new-found

curiosity in the world - if she must live with the new world open to her, she must learn anew to live in it. She may begin with an aimless walk, taking in the world around her as before, constantly looking around. However, her arms will swing freely beside her as she becomes more open to the new experiences. She looks at new sights with vested interest, and overtime even grows accustomed to them. As she progresses, her walk gains more bravado- she feels more and more like a hero, gaining somewhat of a false confidence. She runs in the manner she *believes* a hero would run- directed, with strong arm swings, and a hardened expression. She may stand with a bit of pride- but every now and then, she may believe the fact that she's still very unsure about the whole ordeal.

5. The Fall

Coinciding with the approach to the innermost cave, Pepper finds her fragile self-confidence shattered by the reality of the true evil her adventure is leading her to face. No matter what she had faced before, the true threat of her antagonist is too much for her to bear- she stands nearly still, slightly swaying in her weakness, she ambles slowly, unable to run. Nothing can capture her attention anymore, and nothing but a cutscene will probably snap her out of it.

6. A True Hero

Pepper's final step coincides with the Ordeal and Reward steps of the hero's journey. She has found a second wind to battle her adversary, with a true understanding of bravery. She walks tall, with determination in her eyes. She runs as herself, determined and

directed, with a grace in her movement showing the true strength she now possesses. She stands with poise, ready to fight at moment's notice.

Within each step, we can parse out common actions needed for each animation set: A few idle animations, a walk, and a run. With these basis animations, we can already begin to show a character that appears to grow overtime. The animation sets can be set up in various layers, switched between by a single variable keeping track of the step in the story. This same variable can be used to alter what facial animations to call within a body animation, and as in the case of step 5, alter player control and character speed completely.

3.2   In Relation to The Environment

Some animations within these steps that are brought on by environmental factors might require a little more nuance. These animations might have a basis on the step Pepper is currently on but will have more of a basis in pure exposure and re-exposure to certain external elements. While sudden sounds will trigger a narrative reaction, visual cues trigger reactions based on factors of familiarity and strangeness; pleasantness, grotesqueness, and fear; and relative size.

Objects in Pepper's Environment are at a top level within two categories: noticeable and not-noticeable. Only noticeable objects will be recognized within Pepper's noticing-range, and she can only look at things within 100° on either side of her forward direction.

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As pepper is a being that could be considered "only human", she can only look at one thing at a time. Determining what pepper should pay attention at a given point if many objects are in her viewing wedge could easily be decided by relative distance- closest object has priority. But what if the closest object is a quarter, but the object a few feet further away is a $20 bill? She can see both, but one is much more tantalizing than the other. At a distance, she might have noticed the bill first. What if next to those there's a giant spider that she's terrified of? How would she react to each of these things when she did focus on them?

By adding "meta-data" to our noticeable objects, we can help prioritize Pepper's focus and invoke the proper animation as a reaction. Each object has three things that dictate priority.

1. Familiarity and Strangeness

The first step in deciding priority for an object is its strangeness factor- a float between 0 and 1. This factor acts as a multiplier to the next set of classifications, amplifying its overall priority and effect on Pepper's animation. By editing the familiarity as Pepper sees an object multiple times, she can "remember" objects she's seen before and react appropriately. This number is stored in a list in Pepper's "memory", allowing her to carry associations with similar objects over the course of the game.

2. Pleasantness, Grotesqueness, and Fear

The second step in deciding priority for an object is whether it has a pleasant, grotesque, or fear inducing quality. Using these qualities as categories, and using an effect float, we can decide Pepper's reaction and the size of the reaction she has. We can decide priority by multiplying the effect float by some category-based multiplier. For instance, scary objects have a higher multiplier than gross objects, which have a higher multiplier than pleasant objects. I decided to create the hierarchy in this way (fear > grotesqueness > pleasantness) to emulate Maslow's Hierarchy of needs. Fear encompasses opposition to both physiological and safety needs (such as a fear of losing resources and a fear of bodily harm), while grotesqueness might only encompass opposition to safety(sickness, health). Pleasant sights might satisfy more psychological needs and stimulation, that aren't necessary for physical existence. Using the familiarity multiplier, we can change how the priorities and reactions are processed. A strong pleasant value causes Pepper to view an object with a happy demeanor, a strong Grotesqueness value causes Pepper to view an object with distaste, and a strong fear value causes Pepper to view an object with fear. Weaker values cause weaker reactions. A fourth category of generic objects leads Pepper to react with generic curiosity. Generic-ness has the same priority as pleasantness.

3. Relative Size

The last step in deciding priority is size. If we take all the visible object sizes and multiply each objects priority value by their size as a weighed portion of the total sizes,

we can give bigger objects higher priority. The larger an object is, however, the more likely it is to end up with a 0 value in familiarity early on as to let pepper focus on other objects in the scene.

Altogether, the priority value of an object is decided by the following equation:

*(category multiplier * (effect * familiarity)) * (size/(sum of all visible sizes))*

While the effect of an object on Pepper is decided simply by

*effect * familiarity*

CHAPTER FOUR

Methodology

4.1   Pepper : From Concept to Unity

The idea for Pepper and her universe originally started as an offshoot of the Zelda timeline, set in the future. The future setting was inspired from scrapped concept for work for *The Legend of Zelda: A Link to the Past* showing that a part of the game would take place in the future, as seen in the *Zelda* artbook *The Hyrule Historia* [27, 28].

Fig. 4.1 The "futuristic" Zelda image from the Hyrule Historia *and the initial images of Pepper that it inspired [28]*

At this stage, her personality was less that of a reluctant hero than a naïve, child hero. She would still go through a period of growth, but she would not be thrust into her adventure and would willingly accept the task. She would still be timid and unsure at times, but with a spirit of determination behind her to see it though.

Fig 4.2 Various expression and progression concepts

Eventually, to steer clear of properties that already exist, her design and backstory were reworked- and given her name, The large tufts of hair, pointed bandana, and Large pointy ears were kept as to points of secondary animation to add more bounce and cute appeal to her animations. Her ears were designed also to move independently like an animal, allowing her to express emotions with them as well. Because they stick out so far, this helps the player read her emotions, even from behind. Her space uniform was traded in for overalls and a button up, and her space boots traded in for work boots. She now was a farmer on some unspecified planet, skilled with a knife not because of battle, but because of her work. As her life was now more homely, rural, and quiet, it made more sense to envision her now as a reluctant hero who isn't initially geared for adventure- and to strengthen the disconnect between the life she knows and the life she's about to live.

The Sci-Fi aspect was also brought over for Pepper's story, where her dog being kidnapped by aliens would be the reason she ends up in space. Her dog turns out to be an

alien himself, looking for a noble warrior to save the universe, and chooses her as his champion. Without a way to return home (and not wanting to disappoint her dog), she reluctantly agrees to go on his quest.

Fig 4.3 Pepper's initial redesign to a more rural character- maintaining some earlier characteristics

As her design was iterated upon, it became necessary to make sure her costume design could fit nicely both in a rural setting as well as futuristic space settings. Her initial designs with overalls, knotted up button ups and T-shirts worked well for a farm, but clashed with the *Halo* series alien aesthetic I had in mind [29].

Fig 4.4 A concept sketch of Pepper's farmhouse, along side a covenant ship interior from the Halo *series- though the locations were vastly different, Pepper had to be able to fit in both [29]*

Taking inspiration from Hayao Miyazaki's costume designs, I designed Pepper's clothes to have a more utility/ mechanic type look. This helped keep her design geared toward handywork while also giving her a sleek, sci-fi fashion.

Fig 4.5 Various passes at Pepper's design, focusing on palette and costume

I took the designs around and Gathered opinions on which designs worked best. The most popular choice by far was a brown skinned Pepper with a red top and blue shorts. This choice became Pepper's default design. From here, I started creating a Pepper sculpture in Zbrush to get a base model to build her geometry on.

The first pass had a few issues in terms of proportioning. Her waist was too small, her face was too wide, and her boots were off model. I originally put in long side strands, but ultimately decided against them, as they were also off model and distracting. While the body and clothes were made from more traditional sculpting techniques and were going to require retopology, I decided with the hair strands, brows, and eyelashes (created using Zshperes and the topology brush) to start with low poly assets to save time.

Fig 4.6 Various stages of Pepper's initial sculpt

The second pass saw her with better proportions and correct boots. I also added color to test the most popular design. After The base sculpture was to my liking, I took each piece of her- head, hands, legs, boots, torso, pants, and each bandana piece- into Topogun for retopology. I then re-imported and amalgamated every piece into Maya, where I created a mouth bag for Pepper's head which I took back into Zbrush for smoothing. I created new low poly half spheres for eyes that sat correctly in the face as the ones from Zbrush were too high poly. I then had to go and tweak Pepper's eye lashes and eye lid geometry as to make sure I could create blinks later on when I created her blendshapes. I grouped each body piece by material – hair, skin, clothes, and eyes- and took the groups into Headus UV Layout for initial unwrapping, before bringing the groups back into Maya for Layout tweaks. While I softened most all of the edges, a few select places were given hard edges to give the feel of creasing.

Once the model was complete and everything was set for rigging, I gave a copy to a supporting artist, Kira Foglesong, to create a rig. Working concurrently with her giving

direction on the ways Pepper should be able to move and deform, I took a copy of the model to create the texture maps in substance painter and shaders in unity.

Originally, Pepper was going to be more customizable for the final product. A player would not only be able to enter a name, they would be able to set the custom color palettes of Pepper's eyes, skin, hair, top, pants, and boots. To achieve this, I created custom shaders for each material that Pepper needed that satisfied how I wanted the customization to work. Pepper's eye shader takes a grey scale map and overlays a specified color on top using the overlay blending operation found in programs like photoshop. Pepper's clothes all follow a single general rule: a base color is specified. At any given point, that base color is multiplied by the color given by the linear interpolation between the base color and white by some mix value, decided by a separate greyscale texture map. If the mix value is 1, multiply the base color by white to get the base color. If the mix value is 0, multiply the base color by itself. This allows us to specify consistent value changes over any given color. Each section of clothing is given a mask that decides what base color to use. The various mix maps, normal maps, and specular maps were all created in substance painter.

Fig 4.7 Pepper's low poly model in Maya, her color masking maps in substance, and her final look in

Unity

Pepper's skin shader was the most complex. I originally wanted Pepper's shader

to be based on the shader as described by Alan Zucconi in his article *Fast Subsurface*

Scattering in Unity Part 1 & 2. Following his tutorial, I managed to get a little bit of

subsurface like behavior in pepper's ears and fingertips, but the effect isn't as striking as

Zucconi's example [30]. This still left Pepper looking a little bland color wise. In most

games, skin tones, warmth, and subtleties are usually accomplished on the texture. But

since Pepper's colors were more procedural, I needed to find a way to get the warmth

through the shader itself. To achieve this, I lower the blue and green values on her skin

surface as her skin falls out of the light using the value of the dot product to the light

source as a scalar. Pepper's various freckles, as well as her lips, follow the same process

the clothes take. The base color is multiplied by the linear interpolation between the base

color and white by some mix value, as specified by a texture file. The various mix maps,

normal maps, and specular maps were also created in substance painter.

Fig 4.8 Pepper's shader without and with redshift, to add extra warmth to her skin tone

Pepper's Hair teeth and tongue, all solid colored objects, were either UV'd automatically or not UV'd at all, and instead given default unity materials.

As I was given iterations of the Pepper rig for review, I would create static pose tests to play around with in Unity. Some of these tests utilized Pepper's Knife, which was planned to be implemented as a weapon for her to use. For this project's purposes focusing on the character's reaction and story animation and not combat gameplay, Attack animations and functionality were not implemented.

Fig 4.9 Various test poses for Pepper's rig placed into Unity

Once I was handed the final rig, it was time to start creating Pepper's blendshapes. I decided the necessary parts of her to create blendshapes for was her eyebrows, her eyelashes, her eye lids, and her mouth. For each eyebrow, I created a sad, mad, stern, and surprised shape, as well as an up and down position on the face. For her eyelids and eyelashes, it was a bit of a challenge to get the expressions to work as needed since the eyelids are separate from the head model. Luckily, Maya allows for editing blendshapes in mid mix for any necessary tweaks. I created 3 eyelid shapes for each eye-A normal eye close, a wink, and a half-lidded shape. Shapes for pepper's mouth were harder to conceptualize on the same utilitarian, modular level that her eyebrows and eyes were. Her mouth needed to be able to contort into more unique shapes that couldn't quite be captured applying multiple shapes over her mouth at the same time. I created what I felt like were the most useful expressions that could carry multiple purposes.

Fig 4.10 Various expression tests using blendshapes created in Maya for

Pepper's skin and hair meshes

Because Pepper's eyes are squashed semi-spheres, rotating them to change Pepper's focus is not possible. To achieve eye direction, the texture offset of each eye is instead adjusted to move the texture across its surface, simulating rotation. Each eye holds an empty object that points at given focus point. The focus point is set to follow given anchor points- it will follow either a fixed point in front of Pepper, an animatable joint that can be rotated around for preplanned eye movement, or a target object in the environment that Pepper can notice. The fixed point makes her focus when walking look realistic, while the head joint allows us to incorporate eye movement into her animations- for instance, if her eyes need to dart in fear.

Once a healthy amount of blendshapes were in place, I imported the final Pepper model into Unity. From here, I built the reaction and narrative based expression system in tandem with creating animations. By developing each part back and forth, I was able to parse out a modular system to handle all the many parts that go into Pepper's expression per step: Her animation sets, her facial expression sets, and her voice sets, her eye shape, and even her movement speed.

For each animation, while the joints were animated in Maya, some additional tweaks needed to be added within Unity. Unity allows other attributes to be added to an animation and keyed. This way, I was able to take control of her ear and eye positions within Unity, which I was not able to bring over using the humanoid IK avatar definition that Unity has built in. To get Secondary motion in Pepper's hair, ears, and bandana, I implemented a Unity plugin from the Asset store called "Dynamic Bone" created by Will Hong [31]. This gave her actions more bounce and appeal, making her feel more dynamic and real.

Each animation set, once brought into Unity as a set of FBX's, was placed within a layer on one of Unity's animation layers, generally following the same pattern, as show below.
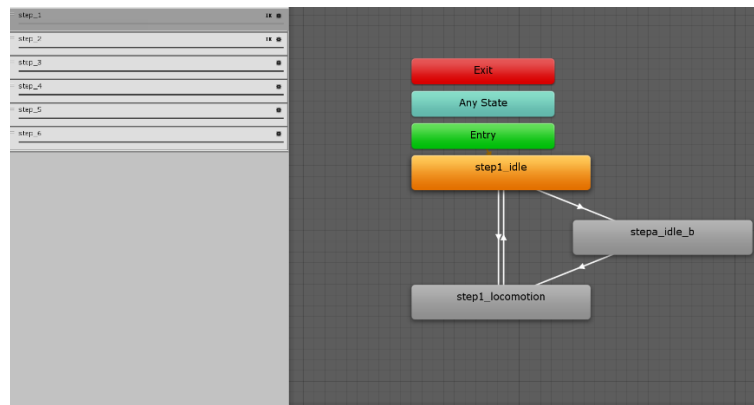
Fig 4.11 The basic animation tree for an expression set

Each layer consists of a default idle state, a second idle state, and a locomotion state. The default idle state is a Blend Tree with Pepper's still idle animation, and her still reaction animations. Her Idle animation will transition between her still idle and reaction

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idle animations based on what she's noticing. Each of the four reactions- happy, scared, disgusted, and curious, is placed within a 2D freeform cartesian graph. A script within Pepper tells us the direction to the reaction we want to an object Pepper is looking at and is multiplied by that object's reaction effect factor. Depending on the layer, we can set a mask to cull reactions to certain categories when pepper might not have a certain reaction in a situation. For example, in step 2, I turn off her ability for a happy reaction- her overall fear stops her from being able to focus on anything joyfully. In step 5, she doesn't react to anything.
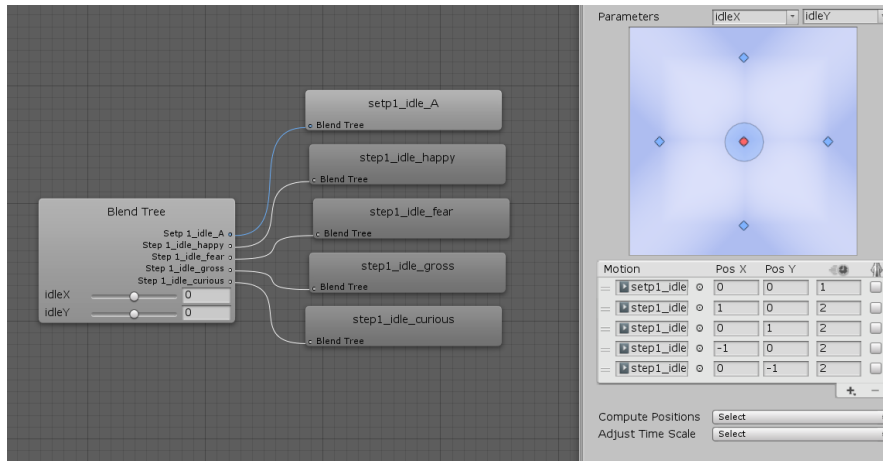
Fig 4.12 The idle animation blend tree- each animation is controlled by a 2D coordinate system

If Pepper is standing still, her base idle animation contains a callback function to increment how many times it has loops. Once the loop count has reached a certain value, the animator moves over to a secondary idle animation. Depending on the layer, this animation either loops until Pepper moves, or loops once before returning to the base idle animation.

If Pepper begins moving, the animation moves over to the locomotion blend tree. The locomotion blend tree is made of a walk animation and a run animation. The blend of the animation is controlled by a 1D linear mix blend. The blend doesn't take place however until the control stick magnitude has moved past 0.5. This allows the walk animation to have more visibility at lower moving speeds. The Speed of the overall animation is controlled by the stick magnitude as well, generally doubling the animation speed at full tilt. To assure that the running animation and walking animation matched up, the running animations were animated on 16's. this allowed a blend between the walking and running to fit perfectly together.
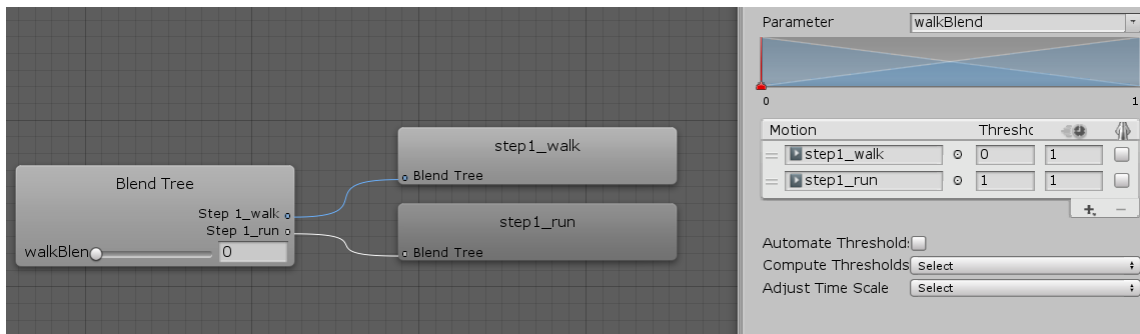
Fig 4.13 The Locomotion Blend tree

Blending between animation sets is done by adjusting the blend setting on any layer above the first layer. By setting a given Layer's blend setting to 1, we completely override the first Layer. However, the overridden animations can still make animation event calls. To curb this, each animation event takes a "callback layer" identifying integer to make sure the event called matches with the set we're currently using.

Within Pepper's scripts, we signify which set we are currently on with a slidable int value between 0 and 6. If this value changes, We Switch out our Voice sound effect and Facial expression banks, set Pepper to the default expression of the bank, set the animation layer we want to 1 while setting the previous to 0, and reset the idle count. Then, we change the reaction mask, some variables for controlling animation speed and movement speed, and Pepper's eye shape based on the layer we are changing to.

Pepper has 3 basic eye shapes: normal, small, and glazed. Most of Pepper's states use her normal, large eyed state. Step 2 and 5, however, are exceptions to the rule. Step 2 uses tiny eyes to give off the feeling of intense fear and focus. For Step 5, Pepper's eyes glaze over into a simple gradient, a common Anime technique for expressing a character who feels dead inside.

Fig 4.14 Pepper's step 1, 3, and 5 idle poses and eye shapes

Pepper's animations and reactions were created to reflect her emotional state in each situation. In the following section, I will give a summary of each narrative step as described in chapter 3, and how I made choices in her animations to reflect her current emotional state within those steps.

The step 1 animation set is used to showcase Pepper in her home environment-comfortable, confident, and carefree. For Pepper's step 1 idle animation, I have weight shifted to the left, arms hanging at her side. This weight shift gives off a feeling of comfort, slouched in a comfortable standing position. Her fingers are slightly curled, neither in a fist or splayed, giving off the feeling that they are relaxed. Her head is slightly tilted, giving the same feeling that her shifted weight implies. She seems to be leaving everything to gravity, allowing her body to fall where it will. For her secondary idle in this state, I decided to go with a torso twist with a bit of a body lift. Her bouncing body and lazily swinging arms reflect her carefree nature.

Fig 4.15 Pepper's step 1 idle animations

For her walk and run, the same principle applies- her head has a side to side bounce, allowing the forces of her movement to jostle it around instead of forcing it into a focused position. She makes fists for her run, but she doesn't commit to having bent arms- as she swings her arms behind her, they lazily bend outward, only bending to giver her the minimum necessary force to move her forward. She has a slight smile on her face to indicate her content.

Fig 4.16 Pepper's step 1 walk

Fig 4.17 Pepper's step 1 run

Pepper's reactions were all based off her basic Idle animation, allowing us to time them similarly and blend more nicely together. When she reacts with happiness, her hears perk, she gets a small smile, and her eye brows raise to indicate her excitement. When she is curious, she pulls up on hand in contemplation, and alternated her brows to give off the air of vested interest. When she is grossed out, her ears point back as she holds her hands

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up and close to her, small grimace on her face. She pulls herself inward and away as to make sure she doesn't come in contact with whatever she's reacting to. When afraid, her ears droop, she holds her hands together close to herself, and furrows her brow- even though she feels safe, some things still cause her slight discomfort.

Fig 4.18 Pepper's step 1 reactions

For step 2, Pepper's animations needed to showcase a feeling of fear and dread. All her animations in this step have her low to the ground, knees buckled together so show some weakness and instability. In her default idle, her ears are down in fear. Her left arm is posed slightly out, ready to react if necessary, while her right hand is a closed, held close to her face for comfort. When she walks, she pulls her hand to her chest as if to hold her heart still, lest it beat loud enough to give away where she is. Her body sways from side to side, as if her legs give out slightly at each step. She leans far forward when she runs and bounces very little in an effort to keep low to the ground and appear smaller. In her secondary idle, she shifts left to right, her ears and eyes rotating in each direction to search

for any sounds or sights that may be a danger to her. Her eyes are small and focused, ready to pick out any potential danger- her brows are furrowed in fearful worry, and her mouth is contorted into a fearful pout.

Fig 4.19 Pepper's step 2 idle animations

Fig 4.20 Pepper's step 2 walk animation

Fig 4.21 Pepper's step 2 run animation

When she sees something curious, she slightly raises her brows, but most of her expression stays the same- the overall fear overcomes her curiosity. As such, she has no reaction at all to things that would normally make her happy- her physiological need for safety is not met. When she sees something gross, she grimaces and holds her stomach as if to trying to

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suppress a physical reaction. When she sees something scary, she holds her arms in a shocked position, body leaned slightly away, as if to try and get away from the object.

Fig 4.22 Pepper's step 2 disgust and fear reactions

In step 3, Pepper is unsure, but not terribly afraid- she has just started her adventure and is truly a fish out of water. Her weight is shifted like in step 1, but with buckled knees, gives an air of imbalance- she is timid and unsure, not stable in her current situation. Her ears are tilted in a similar manner to accentuate her emotional imbalance. She keeps her right arm on her left in an effort to comfort herself and keep closed off to a word that may try and harm her. Her head is tilted downward to keep her eyes low as to not draw attention to herself. Like step 2, her side to side motion reflects a certain weakness in her movement. When she runs, she keeps one hand close to her heart for comfort, allowing the other to swing and propel her forward. She does not run fast, as to ensure she doesn't accidently bump into someone or something she'd regret coming across. Her facial expression is similar to step 2, giving off a feeling of slight fear and worry- but her large eyes give a

more relaxed feeling, implying that her insecurity is more of an issue than a fear of bodily harm.

Fig 4.23 Pepper's step 3 idle and walk

Fig 4.24 Pepper's step 3 run animation

In step 4, we can see a marked change in her personality, as this step is where Pepper feels much more comfortable in her adventure- she's getting into it. She stands straight and tall, with her chest out. Her arms are held strongly to her sides, fists clenched, ready to face any challenge. She has her legs spread out in a powerful stance, as she now has firm footing in her adventure. Her walk and run are similar to step 1- a bit of carefree bounce and swing, but in her run, she keeps her head straight and focused. Her arms stay bent In powerful positions, giving off the feel that she is running toward a destination with drive. For step 3 and 4, her facial reactions mirror that of step 1, as she feels more comfortable in both situations to express more closely as herself.

Fig 4.25 Pepper's step 4 idle and run animations

In step 5, Pepper is dejected- she realizes that the task she has set out ot accomplish is too big for her to achieve. She feels she will let down those around her, that she can't possibly subject herself to the possible pain and anguish the situation demands of her -she wishes she never went on the adventure, but also that she were strong enough to see it though. Her knees are completely buckled, her body contorted and slouched, and her head fallen, as if the pressure of everything is crushing down on her. Her eyes are glazed over, downcast at the floor. Her whole body quivers as she breathes, indicating her fear (to achieve this, a turbulence wave was manually added to different parts of her animation, as shown below). Her arms are bent outwards, adding to the feeling of her unease. Her face is made to emulate one of someone who's focused so much on her inner battle that nothing shows on her face- save for her brows that indicate her worry. Her lids are slightly lowered to indicate her weariness. As per her other steps, her ears are lowered to further indicate her emotional state. Her controls are altered so that she can only walk in a slow drudge. Her body swings strongly from side to side, as if she's not focused on how it moves, and only has the energy to move her legs to a minimum degree, dragging her feet along the

floor. As her emotion is so inwardly focused, Pepper does not express emotion towards anything.

Fig 4.26 Pepper's step 5 idle and walk animations

In step 6, Pepper has overcome her fears and doubts, and earned her bravery- she has become a true hero, ready to tackle the large battle ahead of her with her upmost strength. She again has her chest out, head held high, but her legs give off a certain poise and grace, positioned more toward her center. Her secondary animation shows her stretching her neck, as if casually preparing her body for a fight, confident in her ability enough to treat the big threat as any other scuffle. She walks with her arms strong, and shoulders stiff; body weight constantly centered and balanced. Her head stays still, focused in front of her on her goal. Her run is an extension of her walk, Head straight and arms strong. She stays lower to the ground as if pointing her body forward to her destination. Her expression is stoic, her mouth in a default straight line and her brows furrowed and stern. Her reactions to things are similarly stoic- her resolve has her focused on her goal, and the challenge she faces has more weight than anything around her can even hope to match.

Fig 4.27 Pepper's step 6 idle animations

Fig 4.28 Pepper's step 6 walk animation

Fig 4.29 Pepper's step 6 run animation

A few technical tricks were used on the runs to make them fit within the system better. While convention might say to animate the runs with fewer frames than the walks, the need to make sure we have a smooth transition between walking and running means we need to animate a run at the same timing as a walk. For this purpose, runs were animated on a 16-frmae per step cycle to match with Pepper's walking animations. This solved the blending issue, but when animating the runs I noticed Pepper's position seemed a little

stiff. By adding a forward thrust and return motion to Pepper's root motion, it added a sense of power to her runs that made her runs seem more realistic.

To test Pepper's reaction system, I repurposed a few of my own models to satisfy each category; happy, scared, disgust, and curious. I used a cute bunny statue for Pepper's Happy reaction, A featureless ghost for curious, an abstract, slightly grotesque statue for fear, and a mermaid for Pepper's gross reaction. Each model is given a script that holds a name, a category value, and an effect value between 0 and 1. When an object is within Pepper's noticeable range, it is added to a list of noticeable items. Every frame, each object In the list is checked for visibility- if an object is within 110 degrees from Pepper's forward direction on either side, it is considered noticeable. Then, each object is checked for it's priority value as described in Chapter 3. The visible object with the highest priority is set as Pepper's viewing target. Using the effect value, category, and familiarity value of a given object, we can change pepper's expression and pose accordingly. Each of her reaction poses is blended against her default pose and expression, allowing us to slide between a full reaction and no reaction at all. If the reaction effect is 0.5 and below, Pepper will not vocalize her reaction. Eventually, after enough times, Pepper will merely look at an object without reacting strongly to it.
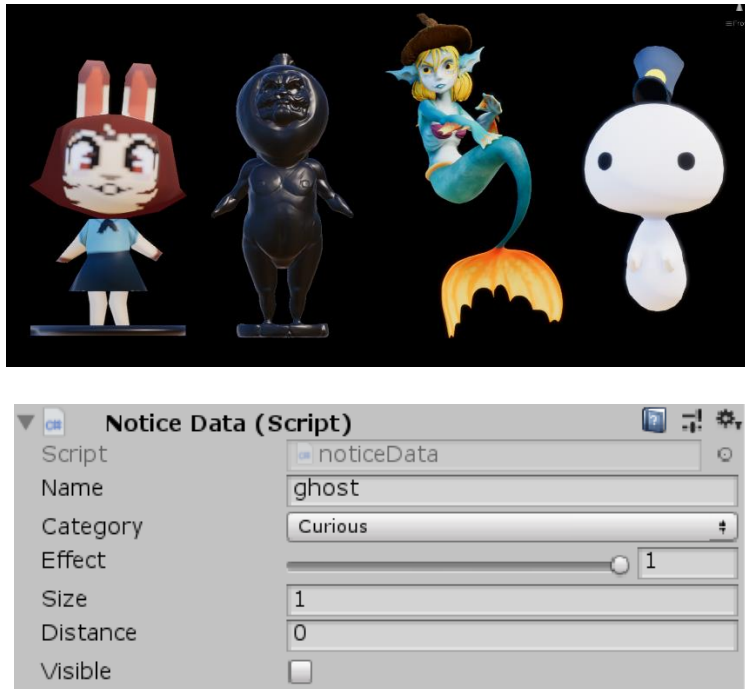
Fig 4.30 The four noticeable statues in the game, and an example of a noticeable object's meta data

Fig 4.31 Pepper's fear reaction and Happy reaction in step 1

To add a little extra depth to Pepper, I utilized sound effects for Pepper's movement and voice. For her footsteps, I downloaded a free sound effect pack from the Unity asset store called "Footsteps SFX Pack 1" by Shoni Pal. Pepper's voice samples were provided by Kira Foglesong [32].

Put all together, we have a robust, modular expression system for game characters that adds an extra depth to player character interaction and immersion. Pepper's story driven expression sets allow a player to see change, growth, and emotion from the character they have taken control of, adding a noticeable layer of empathy not possible in the traditional, 1 set style system of previous games.

CHAPTER FIVE

Conclusion

In this project, I introduced an expression system for game characters that I believe will create a connection with players on an empathetic level. I hope people who play my demo get a sense of attachment to Pepper, at a level they haven't ever had for a video game main character before. I hope this system inspires others to give as much weight to the main character and their expressions as they give to the rest of the gameplay experience, to really create something unique and memorable.

As with any production, post mortem analysis can help solidify what worked, what didn't, and what steps can be taken in the future to improve upon the techniques and systems explored within the work. In this way, we can grow the medium to its fullest potential over many iterations.

I believe I was able to successfully show this potential with Pepper and the expression system I created. She has a visible personality and incites reactions from players. Her design is simple but unique, building upon previous works to create a recognizable character. The dynamic joints within her head allow for incredible detail in her motions, adding to her cute appeal. Her reactions are believable, and her expressions are versatile.

The system is easily built upon and added to, with easily exchangeable settings and parameters, though it can feel a little heavy handed at times. Any small bugs and exceptions were easily built around and solved. The reaction system keeps it simple while

still feeling robust. While there are a few quirks with head movement, Pepper's attention at times feels incredibly realistic.

Some things could've been improved upon, however. The way pepper blends between idle and moving animations feels a little stilted at times, with linear blending causing a robotic effect in her positioning. This could be solved by adding intermediate transition animations between certain animation states, such moving to idle.

I realized that Blend trees can be nested late into the project, after I had set up the Animation sets on Layers- it may have been more prudent to use blend trees in this way to free up the layers to utilize Avatar masking. For instance, if her reactions were on a separate layer, but masked so that only the arms on the lower layer were affected, we could blend between her idle arms and walking arms to give a more believable transition between walking and standing. Once Attack animations were brought in, We could utilize the arms layer again in the same way- or even make layers for the head and torso too, allowing us more nuanced control of how her animations mix.

For a future addition, I'd like to see such changes implemented, and animations added. We could also add another blend tree in all our layers, corresponding to animations of pain- allowing us to blend between a Pepper at full health and a damaged Pepper. Other future additions could include more reactions as well, including Awe, confusion, love, and awkwardness. While most of her reactions and animations did not directly affect gameplay, additions to Pepper- such as allowing fear to keep her away from certain areas and inexperience to make some tasks harder (such as getting up after receiving a blow, or climbing up something tall in a given amount of time)- would add a

level to her animations that connect everything together. A bit of this can be seen in how step 5 of her animation only allows the player to move at a slow pace, reflecting her emotional state. As her reactions are idle animations, it might help to also expand on them. Instead of setting the face blend weights programmatically, they could be keyed to allow for more flexible facial animation.

Lastly, Seeing Pepper show expression in a sterile environment helps to isolate her reactions and put focus on her alone, but She is only half of the puzzle- Putting her in context, with multiple areas and environments, would help us further delve into her situation and world.

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