

FRED's Happy Factory

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1. Introduction

The primary driver of the recent resurgence in virtual reality has been video gaming, and while VR games are becoming an increasingly saturated market, they are likely to linger as the field's prime mover for several years to come. Additionally, the availability of development tools such as Unity and Unreal, which allow professionals and novices alike to design and build games easily, means that the spring whence VR games issue will not soon be stanch. It is up to game designers and software engineers to map out the frontier that this medium opens up and, moreover, to do so with a careful eye toward not inundating the user in mishmashed sensory overload.

In pursuit of these ideals, we have designed a game for the HTC Vive. The player takes control of a diminutive robot named FRED, who is deemed incapable of making people happy but comes to realize self-fulfillment by spreading cheer to those around him in ways not always initially obvious. We combine this positive theme with a lighthearted tone and use the result as a backdrop for techniques we have not frequently seen in VR. Among these are the use of immersive sound, the ability to defy gravity by walking on walls, and the incorporation of heads-up-display elements in a VR-friendly way.

2. Target Audience

This year marks the first time that ICAT-EGVE submissions will be open to the public, so the demo needs to be both suitable for a general audience and interesting to the virtual-reality elites in attendance. Since we are developing this game for the HTC Vive, it should further be accessible to the VR gamers most likely to own this device. To these ends, we have decided on an overall aesthetic that appeals to children and scenarios that are not too difficult for them to solve but also not too easy for adults. Additionally, we include a few subversive jokes and references for the adults that should bypass most of the children entirely. The result is a game with something of the feel of cartoons like *Rugrats* and *Adventure Time*: "made" for younger audiences but appealing to both genders in a wide age range.

3. Story

You are FRED (Friendly Robot Emoji Dude), the latest cuddly robot companion to come from the R&D lab at Grinnovative, Inc., and you have just been brought to life for your unveiling before the company's almighty Investors. However, all of the employees,

including your creator, are other robots, and they have yet to figure out what appeals to humans. The Investors do not find you cuddly at all: your metallic body is not squishy, you speak in beeps and boops, and most egregiously, you have only one working arm and therefore cannot hug. They insist that you be tossed into the robot shredder, but first, they step out for a fancy lunch.

Seizing your opportunity to escape, you sneak past the Investors—busy voraciously gorging themselves on baked goods—and head for the elevator, but a tearful junior Investor blocks your path. Not being a senior member, he was not allowed to attend the unveiling or the fancy lunch, and he wishes desperately that he could at least have some food. You retrieve a baked good for him, and he quits crying, moving aside and noting that your kindness has filled him with joy. Taking insight from this interaction, you realize that you may yet be able to prove your worth by making people happy in ways that have nothing to do with being cuddly. Luckily for you, the building is replete with sad robots who could use your help.

4. Aesthetics

In order to produce a lighthearted feel, we have selected fairly cartoony models and animations. While realism is not strictly bound to gloom, it demands a level of verisimilitude that does not fit our story and mechanics; furthermore, while the Vive's 1080x1200 resolution per eye is currently impressive in terms of technology, its close viewing distance creates pixelation that detracts from realistic models and textures.

Also salient to our endeavor is the use of sound. Many VR applications employ stunning visuals yet fail to make use of binaural and localized sound in order to heighten users' sense of presence. These effects can be used to attract the attention of the player without the use of contrivances that potentially make the environment less believable. The fifth-generation release of the Unity game engine facilitates this with the integration of Digital Audio Workstation-styled mixing and three-dimensional sound capabilities.

Most of the nonplayer characters are robots. This affords us a more whimsical tone than would be possible with an all-human cast because robots can be excused for behaving in socially awkward and overly logical ways. For example, a robot may be perplexed by how to turn on a light because it thinks it needs to power the bulb directly. An anthropoid design, however, allows the robots to exhibit human emotions and remain believable; this trait is key for our theme of spreading happiness through the factory.

Certain actions and situations produce vibratory haptic feed-



Figure 1: *Walking on walls.*

back from the Vive's controllers. We have not attempted to employ gustatory or olfactory components.

5. Mechanics

The game is contained within the closed space of the factory, which primarily consists of separated rooms. The main action occurs on two floors—one for office space and one for research and development—with an elevator serving as the transition space between them. There are also secret areas to find. Interactable objects obey physical laws similar to those of the real world.

The goal of the game is to spread happiness by helping as many people—including robots—as possible, and helping individual characters is rewarded by the unlocking of new areas. The game is won when everyone has been helped. There are no true loss conditions, but poor performance in one task or another may cause setbacks such as falling back to an earlier point or being required to repeat a task by another character.

The player is able to move about the environment but cannot jump. (This restriction is in part because we do not want people trying to jump in real life while their vision is obscured by the Vive's headset.) FRED is equipped with one large wheel rather than legs, so players have a reason for not using their own legs to walk around, and we increase mobile freedom by allowing them to move not only on the floor but also along special magnetic sections of walls and ceilings (Figure 1). FRED's right arm is equipped with a "cannon" that fires low-speed orbs for interacting with distant or unreachable objects. His left arm functions as a flashlight to provide limited visibility in darkness (Figure 2). He can also speak with characters and read from various in-game items such as papers; this feature brings up a heads-up-display-like text box in the virtual space so that players can read along (Figure 3).

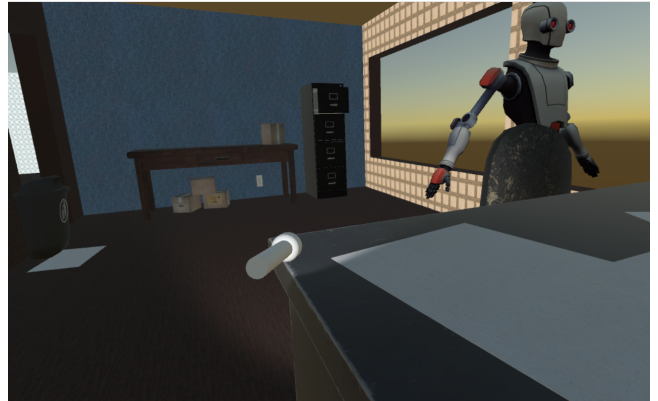


Figure 2: *Flashlight tool.*

6. Technology

The game is designed to be played on the HTC Vive, which includes a head-mounted display with an approximately 110-degree field of view and two handheld controllers; all of these are tracked for position and orientation by two "Lighthouse" photosensors within an area of roughly fifteen by fifteen feet, though the play area is configurable. In addition to the Vive, we use a pair of stereo headphones in order to immerse the player in further. The virtual world is built in the Unity game engine using a number of custom assets as well as ones attained through its Asset Store. Customized scripting is done in C#. Object models are developed in Autodesk 3ds Max and SketchUp. Prefabricated animations are provided by Mixamo.



Figure 3: *HUD-like text box.*