Playing with Emotions: Biosignal-based Control in Virtual Reality Game *Project H.E.A.R.T.*

Erin M. Gee, Alex M. Lee, Sofian Audry

Université de Montréal, Clarkson University, Université du Québec à Montréal

Montreal, QC Canada; Potsdam, NY USA

erin.gee@umontreal.ca amlee@clarkson.edu prof@sofianaudry.com

Abstract

Project H.E.A.R.T. is an interactive, virtual reality-based installation which probes the 'militainment' video game genre as a satirical starting point for exploring pop culture, mediated violence, empathy, automation, and quantification of emotional engagement. *Project H.E.A.R.T.* invites the viewer to place their fingers on a custom biodata gathering device, and then summon their enthusiasm to engage a holographic pop star as a form of "combat therapy." The emotional labor of the viewer is quantified through biosensing technologies, giving the viewer indirect emotional control over artificial agents. The narrative of the work implicates the viewer in military violence through their affective participation in entertainment technologies, highlighted in VR through the voyeuristic gaze. The incorporation of physiological metrics into artificial agents fosters a liminal situation between the VR user's corporeal body and virtual space. In an era of self-help apps and biometric devices for controlling one's emotional state, *Project H.E.A.R.T.* embodies a dystopic and satiristic interpretation of these technologies, as well as the limits of technologically mediated empathy and sincerity often championed as the new frontier for interaction in virtual contexts.

Keywords

biometrics, militainment, interactivity, virtual reality, affective computing, video games, avatars, vocaloids

Introduction

Project H.E.A.R.T. (Holographic Empathy Attack Robotics Team) is a satirical pop-militainment VR game that uses a custom built biosensing device to gather data from the virtual reality user relative to blood flow and skin conductance in order to facilitate a kind of emotional interactivity. A user's "enthusiasm" (detected by sudden increases in skin conductance, shifts in cardiac activity and amplitude of the pulse signal) stimulates the holographic pop star to sing in the virtual warzone, inspiring military fighters to continue the war. At the end of the experience the user is confronted with their score: how many of their soldiers were traumatized vs how many enemies were killed.

Background

The Pop-Star Protagonist: Who is Yowane Haku?

Yowane Haku, the main protagonist in *Project H.E.A.R.T.* and the player's proxy, is an officially recognized derivative of the Vocaloid character Hatsune Miku. Miku is the most famous 'vocaloid' developed by Japanese company Crypton Future Media. She, along with a host of other "vocaloid' characters, provide avatars for synthesized human voices made accessible through DAW softwares, and are also otaku-celebrities in their own right [1]. In vocaloid fandom, Haku is acknowledged as a representation of untalented vocaloid users who complain that their work never receives adequate attention [2]. Haku was selected because of her ambiguously satirical character that represents both aspirational celebrity and failure within the scope of a participative media experience. In the game, Haku appears on the battlefield ready to entertain and distract the soldiers as a hologram emitted from a Roomba, which is already a quotidian vulgarisation of military technology [3]. Haku is tasked with channeling moral support by cheering on robot soldiers in correspondence with the player's affective biodata. The player's score in *Project H.E.A.R.T.* finally quantifies how their physiological responses helped to delay the inevitable loss of morale within the cyborgian soldier team as they suffer mounting psychological trauma during battle.

The Concept and Narrative Plot: Moral Support of a Technologically Enhanced Super Soldier

The core mechanic of the gameplay of *Project H.E.A.R.T.* revolves around the moral support of a semi-automated human-mech combat team. These agents are tasked with killing as much of the technologically inferior enemy (represented as human soldiers with standard combat gear and weapons) as possible. The technological inequality

between the two sides demonstrates how the largest danger to the player's technologically advanced soldier team is not physical, but rather, the psychological trauma of violence. The VR user is tasked with supplying moral support to these advanced soldiers through their generation of quantifiable "encouragement," which is channeled by biosensors into in-game holographic pop star Yowane Haku (the details of this process will be covered in a subsequent section). As the robots go about the task of killing the human soldiers, their morale diminishes. The Haku character automatically hovers to the soldier in need of the most moral support, ready to for the user to cheer them on with an enthusiasm-triggered song and dance. In order to gauge the morale of the soldier team, each soldier vocalizes platitudes or complaints between one another, providing clues to the VR user about the overall state of the team. As the overall morale of the team diminishes, increasing amounts of negative platitudes are relayed to the VR user. If the user does not sufficiently provide physiological evidence of her excitement to the biosensing technologies of *Project H.E.A.R.T.*, eventually all robot soldiers suffer from emotional breakdown and ceasefire. When this happens, a flying drone picks up the Roomba that is housing Haku, and the game transitions to the end stage that displays the player's score: a quantification of traumatized soldiers on her team, as well as the total death toll of enemy soldiers killed on the battlefield.

Methods

The Battlefield Environment
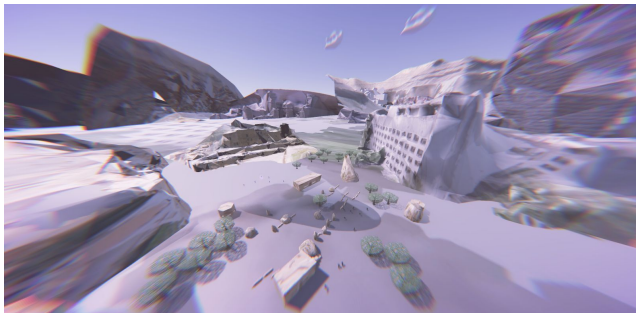
Figure 1. In-game screenshot of *Project H.E.A.R.T.* © 2017 courtesy of authors

The environment design of *Project H.E.A.R.T.* involves a method called photogrammetry. Whereas photogrammetric methods are typically sourced from direct photographs of the subject, in *Project H.E.A.R.T.* the fragmented landscape is assembled from Google Earth images. The images were gathered from geopolitically loaded locales such as Afghanistan, Syria, Yemen, and Iraq. Just as militainment often simplifies and confuses complex politics for a simple narrative of colonial good versus foreign other, the '123D Catch' software attempts to stitch together multiple

vantage points of these locales into a cohesive 3D model, but creates large sections of artifacting and noise which fragments the original landscapes. This fragmentation and abstraction alludes to how Western audiences often perceive these locales only through their mediatization- as bite-sized, fragmented, and distorted images that create backdrops to sensational narratives.

The VR user: How does biosensing detect emotional engagement?

The use of sensors to detect and quantify the affective states of a user is commonly referred to as affective computing [4]. While scientific results remain inconclusive on the specific use of physiological sensors to detect emotions particular to valence, it is generally accepted that sudden increases of skin conductance are a robust (if somewhat sluggish) indicator of a broad sense of emotional engagement in response to emotional stimuli [5]. Using Erin Gee's *BioData* library for Arduino-compatible microcontrollers [6], each player's skin conductance is sampled and conditioned with low-pass and high-pass filters in real time during the three minute introductory sequence of the work. After the introductory sequence has passed, gameplay begins. When skin conductance surpasses a predefined threshold, the system labels this event as sufficiently indicative of enthusiasm, and a song response is triggered from Yowane Haku on the battlefield. Complimenting this physiological mechanic, the cardiac activity of the viewer is obtained through photoplethysmography, and filtered over a window of time. When the cardiac activity indicates higher levels of overall arousal, this will similarly increase the area of effect for Haku's song, allowing her encouragement to reach even more of the player's soldier team. These are very rudimentary methods for determining one's affective state, however the game itself is purposefully vague in its references to the emotion needed of the viewer in order to stimulate its engagement algorithms. By using language like "enthusiasm, energy" or "arousal," this allows the system to respond to any number of emotional states that might broadly fall under these linguistic categories of emotion, and integrate them into the algorithmic logic of the virtual battlefield. While the integration of affective sensing into this system might make it more "humane", the ironic potential for interpreting negative emotions broadly—as "enthusiasm"—is not lost on the authors.

In Free Fall: Virtual Reality & Vertical Perspective

There are visual and conceptual maneuvers specific to the medium of virtual reality which are embodied in the game. Verticality is a visual maneuver which repeats itself in various stages within gameplay. The intro sequence has a

moment in which the verticality of the user is heightened by a lack of ground plane. This serves to create variability in the player's biodata by eliciting a physiological or emotional response to the verticality, preparing the sensor calibration for later gameplay.

This perspective of free fall references the social and political dreamscape of geopolitical war as seen from the detached position of technological power. Recalling the critical poetics of Hito Steyerl as she speaks about verticality in technological media, falling can imply a new certainty falling into place, or also grappling with an inevitable force of gravity that propels us into an agonizing present.[7] The place we are falling toward in the game is shifting and dynamic. The movement of the camera in the VR game itself predicts the player's influence on this environment that they are thrust into, a technologically mediated super position that is simultaneously once removed, smooth, and removed from physical harm.

Quantification of a Moral Support System

The game revolves around a complex and indirect system of control. In order to "win", the player's team of soldiers need to outperform their adversaries. However, both the soldiers and Yowane Haku are autonomous agents that cannot be controlled directly by the player. Instead, by changing the state of player biosignals through control of affect, the player activates Haku's ability to inspire soldiers to continue to fight.

The algorithms in *Project H.E.A.R.T.* calculate each soldier's morale through a single numerical value which varies according to a number of in-game events and situations. Hitting an opponent slightly increases a soldier's morale, but killing or getting shot decreases morale. A soldier's morale is further influenced by the morale of their peers in their vicinity, representing the effect of group morale. When a soldier's morale reaches zero (0), the soldier is traumatized and cannot act anymore in the game.

Both the player's soldiers and the enemy soldier teams follow these mechanics; in the case of the technologically inferior enemy team, not only their morale is damaged, but they are physically harmed and die. The in-game algorithms that control the soldier teams take advantage of this mechanic, as soldiers will prefer shooting at enemies with low morale/physical state in an attempt to decrease their morale and eventually eliminate them. Furthermore, soldiers will tend to be psychologically fortified by one another's presence: a soldier that wanders off alone is more vulnerable to psychological distress.

Morale is represented in game through visual and sonic feedback. As each soldier experiences mounting psychological stress, he is surrounded by a halo of red color representing their morale. Team members also regularly vocalize platitudes that represent their state of mind.

Examples:
For the future! (high morale, happy utterance)\
If I die, it is because I didn't try hard enough. (medium morale, neutral utterance)
When will the screaming stop? (low morale, despair utterance)
My good intentions are worthless. (critical morale, trauma utterance)

The morale system is tuned to make the soldiers lose morale over time, and thus, be unable to participate in the battle, however the game provides a mechanism to tilt things in favor of the player's team through the interventions of Yowane Haku. By controlling their own body signals to meet the requirements at the right moment, the player can trigger Haku's inspirational power of song. This event is represented in-game by hearing the popstar vocalizing as musical notes appear over her head. When this happens, friendly soldiers in her vicinity experience a significant increase in morale (figure 2).
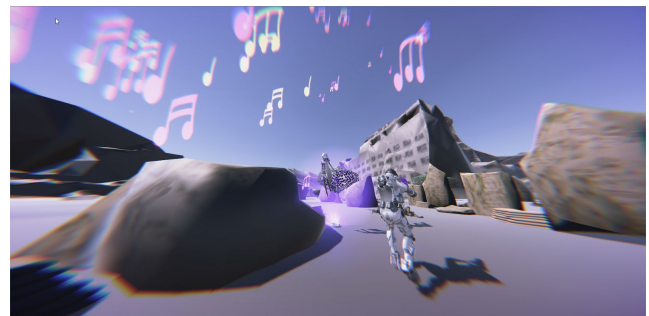
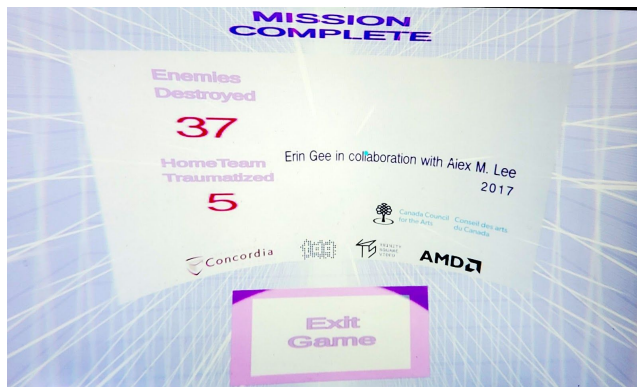**Figure 2.** In-game screenshot of *Project H.E.A.R.T.* © 2017 courtesy of authors

The holographic pop idol's movements are beyond the player's immediate control. She moves across the battlefield to get closest to the soldiers with the lowest morale. The core game mechanics rest on an artificial ecosystem where morale is a resource that gets depleted over time, but can be replenished by the player's indirect control over the main character via their physiological markers of emotional engagement.

Discoveries

The VR User: Responses

During the non-interactive, introductory portion of the work, the biosensors commonly detect increased levels of arousal at specific moments, giving the artists concrete physiological feedback about how their pre-rendered work impacts viewers. First, there is a notable rise in skin conductance when Yowane Haku dramatically enters on screen, confirming the affective resonance of this moment. This happens again when the viewer is presented to the battlefield at what's commonly known in the gaming community as 'god's eye view', which drops into 'first person perspective'[8].

Another interesting discovery highlights how some players (intentionally or not) "misuse" the sensors, rendering their scores inaccurate or senseless. The medium of the game predicts a certain amount of "hack," or cheat behavior from players; in this case players were sometimes observed to manipulate their physiological symptoms in order to amplify their scores by laughing maniacally, tensing one's muscles, moving around agitatedly, or producing sudden, sharp inhalations of breath. These physiological "hacks" are the inverse of common self-help strategies for manufacturing calm through breathing and awareness, but in this case the manufacture of emotional arousal is used to help robot soldiers obliterate their enemies.

Figure 3. In-game score screen screenshot of *Project H.E.A.R.T.* © 2017 courtesy of authors

At the end of the game the user is presented with a high score (figure 3) that quantifies their emotional performance within the paradigm of the game; how their affect either protected their own team from trauma, or facilitated further violence against their enemies. Because of the infinite amount of enemies that spawn in the game, the high score represents how long the player can delay the inevitability of their team losing. This 'high score" itself is ambiguous in its own meaning. The player is given no information whether these numbers are to be taken as victory or defeat. This high score panel is intended to highlight the inhumanity of technological quantification when one compares the trauma of one soldier to the death of many enemy soldiers. These numbers present a space for critical reflection on the purpose of the game, such as: how is the player as an emotional body complicit in technologies of inhumane violence via militainment? How does the technological infrastructure itself coax physiological and affective responses from the viewer, however insincere or misinterpreted by the algorithm? What does 'winning' this game ultimately mean? The artists leave these value judgements up to the player. Rather than point to the promise of affective computing as a zone of authentic empathetic interaction in games, *Project H.E.A.R.T.* highlights ambiguous and problematic aspects of its own materiality.

Acknowledgements

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