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Exquisite Corpus

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As humans, we regard our bodies through their visual surface components. The interior, when considered at all, is typically only due to medical concern for one's-self — rarely envisioning that of others. While radiological tools have dramatically improved our capacity for noninvasive representation, their use is often confined to the domains of personal health. This work seeks to instead uncover the possibilities they represent to show the full scope of our bodily form. In their obfuscation of the accustomed visual boundary, they remove associations of race and many aspects of gender. To further the dissolution of perceived identity, it excavates our inner sameness through algorithmically merging bodily interiors into 3D human chimeras — hybrid beings existing beyond the possibilities of genetic merger. Through the collection of simple participant biometrics, blended avatars constructed from real human data are selected based on similarity to give viewers a bodily representation that extends beyond the surface manifold commonly regarded as the self in both physical and virtual worlds.

Keywords: Radiology, Chimera, Self-perception, Avatars, Medicine, Organism, Machine Learning.

Description

Introduction

Exquisite Corpus is a work that helps visualize an understanding of the similarities of the human organism through relations to our interior organic structures shown outside of the medical context of pathologies. From an interactive perspective, it responds to participants in the interaction zone by analyzing basic aspects of their bodily proportions and showing them a speculative volumetric computed tomography (CT) scan of their head and torso.[1] These images themselves are made through an algorithmic merger of public data to both highlight the similarities between humans while further disassociating the anonymized data from any existing individual. Three physical hybrid organs of the heart, brain, and larynx are presented as well to better highlight their individual structures.

Theory

Exquisite Corpus is an excavation of the organic interiors of human existence, blended into new chimeric individuals. Head and torso CT scans are aggregated to form new hybrid sections and these sections are then combined into bodies existing in the absence of markers for typical human differentiations. First in that, as volumetric interiors, they do not have the visual bias of the skin and second in that the interiors are themselves both blended and recombined. They are agender, as they are without race. Society struggles in foretelling the future of the human organism through contextualization of its historic, visual representation. Even within the scientific field, medical diagrams and studies of the inner body are fraught with racial, sexual, and colonialist biases that still need to be addressed. By first removing the exterior visual factors and then by blending the inner, it is hoped that the new considerations of potential futures may become exposed.

Additionally, these constructed beings produce a counterpoint to those imagined as the inhabitants of virtual worlds. Those account only for the manifold geometry (are represented only by their "skin"), as characters with no need of organs have no utility in using the computational resources to generate them. Digital avatars, no matter how whimsical, follow the visual ideations of our perceived world. This then produces beings predicated on the visual surface tells of what makes a bodily identity, even if allowing one to widely explore alternatives (including the non/semi-human) to their own. In contrast, *Exquisite Corpus* portrays virtual representations which,

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1. CT scanning is a technique for high resolution internal images using a moving, rotating X-ray tube to capture the subject from multiple angles before combining them computationally into a 3D representation.

while definitively human in form, are in no way defined by exterior understanding.

These individuals exist absent the mechanisms and limitations occurring within the genetic blending of ancestry. As there are no traits which become dominant or recessive, all physical characteristics are merged. This representation, both interior and blended, then provides a means not only of surfacing the physical self from behind the prior mentioned sources of interpersonal bias, but also a speculative entry to a future vision no longer bound to our mendelian genetic inheritances.

Presentation

Viewers are introduced to the work through a video screen showing volumetric CT imagery of chimeric heads[2] and bodies. Upon detection of a participant standing within the interaction area, basic biometrics ratios are analyzed and compared to a database of these hybrid forms containing 1,764 potential head and torso combinations. The screen then updates to show their match, thus giving the viewer a speculative personal CT scan, but one that both does not require the personal safety concerns of radiation, and shows their similarity to other persons through the blended forms of four others that are not themselves. Additionally, three physical models of selected organs are displayed on a light table.

Background

Medical Depictions of the Interior

Through much of recorded history, artists have been illustrating the interior of the human body, for both medical and dramatic purposes. The earliest known instructional illustrations appear in 4th century BCE Alexandria, continued the 18th century in the works of Berhard Siegfried Albinius such as *Tabulae Sceleti et Musculorum Corporis Humani*. The invention of color printing techniques in the 19th century later allowed a blossoming industry of medical illustration to come forth, driven in large part by the illustrations of Max Brödel, director of the Department of Art as Applied to Medicine at Johns Hopkins university (see Branigan 1995). The first depictions to not touch our senses directly was ushered in in the late 19th century by Wilhelm Conrad Röntgen who provided the first look at the bone structure of the living hand through that of his wife Anna Roentgen in an image entitled *Hand with Rings*. Only in this interaction of the unfelt and unseen X-ray with photoreactive paper were we first able to reveal the hidden body without physical interference. As what became also

2. Head CT representations additionally were processed with bone removal, to better highlight the soft tissue structures that would otherwise be occluded by the skull.

known as “nuclear medicine” developed, so too did additional tools such as magnetic resonance imaging (MRI) and the use of inaudible high frequency sound reflections known as ultrasound. With the expansion of computing technology, these techniques were further expanded to produce three dimensional representations of their subjects through CT scanning. These tools have provided artists new means for visual expression both within and outside of the medical field including experiences such as *Virtual Anatomy and Pathology at Deep Space,* “a project designed to utilize the data generated by [radiological] devices to deliver faster — and, above all, better — visualizations” providing a “combination of virtual reality technology and medical science” (Ars Electronica Futurelab 2022).

Virtual Depictions of the Avatar

The avatars of virtual worlds have allowed games players to explore a range of alternative existences to include the gendered, trans-species, multi-species chimeriscisms, and trans-humanist existences. They are, however, mostly limited to only the visual components and more specifically to the surface manifold. The virtual body lacks needs such as air, food and water (and the expulsory needs of the body cleaning itself). That these notions of the interior do not exist in the virtual space only accentuates that the avatar is as-yet wholly reliant on the physical body, and that no matter how wild the representations of virtual space, the players remain tethered to their similar inner topologies. That is to say, much like their real-life selves, the visual expressions of the avatar, no matter how distinct, all share the common inner forms of the users.

As artificial intelligence (AI) advances, we find another form of being that is recognized in the absence of its physicality. AIs in many mid to late 20th century science fictions were presented as disembodied voices such as that of HAL 9000 in the film *2001: A Space Odyssey* (1968). What we see now is often their disembodied artistic creations such as those from drawing prompts in Stable Diffusion (Rombach et al. 2021) or Dall-E (Ramesh et al. 2022). While these tools and affiliated chatbots are often at the forefront of media coverage of AI, it should be noted that it has as well been present through non-player-controlled characters in video games. As the capabilities of the machine learning (ML) driven models increases, potentially leading to an inability to distinguish whether one online is in conversation with a human, it becomes only the physical form of the user that differentiates. This initiates a new variation of the old concern in telepresence — trust. Extending this offline and into the physical realm: as robotics and AI improve, the exterior becomes even less relevant to the commonalities of humanity.

Machine Learning in Radiology

The field of radiology is currently deep in research about how to use algorithmic techniques to improve access to and quality of diagnosis through training to improve the visual output quality (thus allowing low-dose CT imaging to minimize radiation risk), automatic tissue differentiation, and identification of pathologies that might be missed by manual review, while further allowing a greater number of patient reviews. There is a large body of critique in the literature about the possibilities as well as concerns of bias within these uses.[3]

Methods

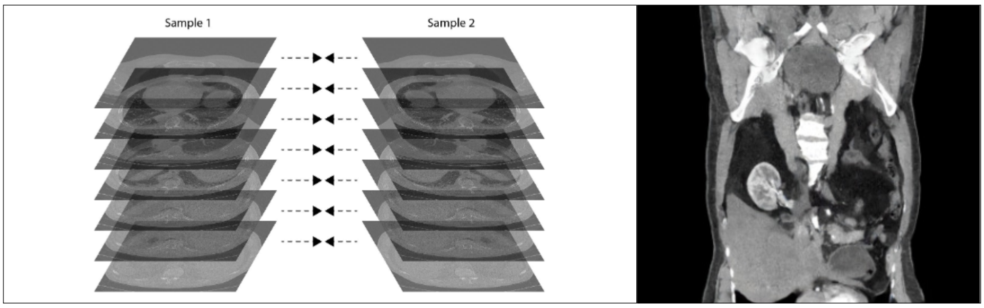

Figure 1: Representation of interpolation technique. The volume is converted to a series of slices. The slice at each height from each of two samples is interpolated to create the hybrid slice. Right: One slice of a merged torso.

To accomplish its goal of investigating the internal spheres of the human being in a manner intended to detach it from both medical consideration and the visible outer strata, *Exquisite Corpus* takes regional CT body scans from anonymized public datasets[4] and uses machine learning to blend the forms into chimeric individuals. This is produced using a novel re-appropriate of slow motion interpolation technique and a custom, simplified, non-voxel rendering technique to show the volumetric results. The resulting imagery, while featuring an array of unnatural artifacts, blends to a quite recognizable human form with clear organ differentiation. Additional tools were then used to produce physical 3D printed models.

Figure 2: An early test head CT merger that was blended using images sliced on the transverse plane shows tearing when combined and re-sliced on the coronal plane. This was minimized in later experiments by better conforming the positions of the subject data. Artifacts relating to dental work proved especially challenging for this technique.

Blending two CT scans into one coherent human volume required a novel approach, as the majority of related algorithms were for image quality improvement or surface manifold blending. There is no developed algorithm to produce volumetric blending of physical forms as were required by this artwork. A novel approach was developed in which each pair of sliced layers were interpreted through a machine learning algorithm designed to interpolate intermediate frames. This was accomplished through use of the FILM (Frame Interpolation for Large Motion) (Reda et al. 2022) developed for interpolation of slow-motion video, without additional training with radiological data (Fig. 1, 2).

3. Such critiques can be found in McBee et al. (2018) and Pesapane et al. (2018).
4. These datasets include a head CT set (Crawford & Mader 2022) and a torso CT lymph nodes torso set (Roth et al. 2014) accessed from The Cancer Imaging Archive (Clark et al. 2013).

Rendering

In order to produce the visual component on available hardware, a custom rendering pipeline was developed using the vvvv visual programming package (vvvv 2022). Rather than the more customary approaches, such as voxel-space rendering or surface manifold segmentation, this technique used only a stack of textured image planes to represent the volume. This method required little additional computational overhead beyond loading the images and making color adjustments to better highlight organ differentiation. While this technique limits the range of rotation as a camera angle tangential to the image plane results in its disappearance, this was irrelevant to the intended representation (Fig. 3).

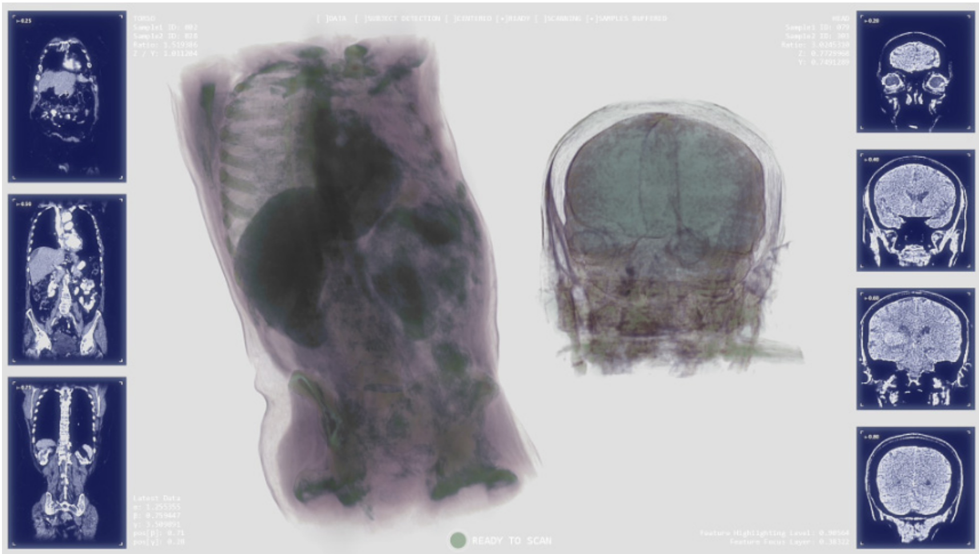

Figure 3: A frame of false color representation of the torso and head as separate models. The color palette shifts during exhibition to highlight different organs and tissue structures. Left and right images show equally spaced individual slices of the hybrid regions.

Interaction

Pose estimation (see Cao et al. 2021) was incorporated to collect basic biometrics from interacting participants to select chimeras most closely matching their own proportions. Rather than the typical use-case of this technique for determining the pose of an individual, only the point representations of the shoulders, hips, eyes, nose, and ears was needed here. To minimize the inherent noise of the selected algorithm, these points' positions were averaged of several samples. Their distances were then converted into ratios and these ratios compared to a table of those calculated for the database of pre-blended chimeric sections.

Segmentation and 3D Printing

In addition to the interactive elements, three organs were produced through selected blending and segmented into models for physical 3D printing or flexible resin. The blending process was the same as for the interactive elements, but the volumes were cropped to only the relevant portions before interpolation. These were then brought into the Slicer medical imagery software for segmentation from surrounding tissue and conversion to a mesh model. These models were then imported into Blender (Community, B.O. 2018) for cleaning preparation for the printing software. Models were printed using PreForm (FormLabs 2022) software and printed in flexible resin (Fig. 4).

Figure 4: Resin printed merged organs. Left: Two hearts. One sample female, one sample male. Center: Three voice boxes (larynx, no sample data). Right: Two brains. One sample female, age 79; One sample male, age 19.

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