Begone, Orthot: A Near-Future Exploration of Bodily Autonomy

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ABSTRACT

This design fiction explores the concept of cyborgs and the evolution of body modifications through the lens of the Febris Suite™, a fictional implant technology that aims to enhance human capabilities and relieve burdens on the body. Through this exploration, we engage with the historical context of cyborgs, the growth of the biohacking movement, and the commercialization of embedded technologies. We discuss the potential applications of this fictional technology, including emergency medical interventions, reproductive control, and access to gender-affirming care–alongside potential drawbacks and concerns, such as planned obsolescence, proprietary control, and potential social divisions based on who can afford the enhancement. We conclude by posing critical questions about the balance between bodily autonomy and the proprietary nature of implanted technologies, raising ethical considerations for the future integration of artificial systems with the body.

CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile computing theory, concepts and paradigms**; **Ubiquitous and mobile computing**; • **Applied computing** → Consumer health; • **Social and professional topics** → Medical technologies.

KEYWORDS

Bodily Autonomy, Wearable Tech, Cyborg, Ubiquitous Computing, Planned Obsolescence, Right to Repair

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1 INTRODUCTION

Wearable technology encompasses electronics that have been integrated into clothing, accessories, and the body [41]. The 1970s saw the rise of the ability for a consumer to purchase wearable technology, with the Hamilton Watch Company's release of the Pulsar calculator watch [32]. In the years since, wearable technologies have been categorized phenomenologically into a myriad of application categories, such as "Healthcare & Wellness", "Sports & Fitness", "Gaming, Interface & Novelty", "Lifestyle & Fashion", and "Security & Prevention" [1]. Contemporarily, wearable technology affords consumers with means of collecting near-instantaneous information about themselves and the world around them via sensors, processors, and connectivity capabilities [9]. Biohacking is an exploratory practice that combines the realms of biology, do-it-yourself (DIY) approaches, body modification, and technology, with the aim of optimizing or enhancing a person's physical or mental performance [42]. Biohackers–those who participate in the biohacking practice, use permanently embedded devices, which can be classified as under the broad umbrella of wearable devices, though they can also be classified as cyborgs. A variety of these permanently embedded devices are already possible in the biohacking space [29]: electronic tattoos [19, 40], RFID chips [10, 22], and magnetic implants [12]. Contemporary medical ethics has not allowed for recreational use of commercial permanent technological enhancement, which is why some have turned to biohacking. However, research on the acceptance of permanently embedded technology has shown that the more individuals perceive the usefulness and ease of use of these technologies, the more likely they are to adopt them [12].

It stands to reason that a desire to have permanent access to enhancement technology will not be a fringe movement indefinitely, and questions of how our society will be able to address the moral challenges inherent in the continued evolution of technology alongside the human body may rise. This design fiction aims to stimulate inquiries regarding the equilibrium we must establish when augmenting our physical selves: When humanity embraces the integration of artificial enhancement systems within our selves, what level of autonomy will individuals retain over their own bodies? It does so by exploring a hypothetical implant technology suite called Febris that exists in the near future after permanently embedded technology is on the precipice of being integrated within the entire body. It begins by contextualizing the imagined world in which this technology exists, as prompted by an employee of a marketing firm who asks a colleague to write a marketing analysis brief to determine whether the firm should take on the implant company as a client. The main body of the text through Section 2 constitutes the report itself. We then discuss the potential consequences of the existence of such technologies in the Authors' Notes.

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Subject: Background Check Request for Potential Client

Dear Andrew,

I hope that this email finds you well. I would like to request your assistance in building a high-level report that would investigate the background of a client we may potentially be taking on. They are a medical implant company called Febris, and one of their representatives has reached out to our company to develop their PR. Before we proceed any further, I would like for you to gather some information to allow us to make a fully informed decision, while taking any risks into full consideration.

Please focus this investigation on the following areas:

- **Cyborg Technology Background:** We are new to representing companies that sell implanted technologies. Please gather information about the key milestones in this field and any notable achievements.
- **Industry Standing:** Research Febris's position within this industry and evaluate their competitive landscape. Please analyze their market positioning. This information will help us assess their potential for growth and success, and I believe it is crucial to determine the potential satisfaction levels of the end users.
- **Business Model Considerations:** Obtain any insight you can into the financial stability of Febris by assessing their business model and any other relevant financial information that is available. This allows us to evaluate their ability to meet their financial obligations long-term and ensure a stable working relationship between us.

Include any supporting documentation, references, or sources that you consulted during the background check. If you encounter any red flags or significant concerns during your investigation, please bring them to my attention immediately so that we can evaluate the situation more closely.

Katheryn Hudson
Director of Client Services at TechIgnite
Pronouns: She/Her/Hers

Figure 1: This email from the head of client services at the TechIgnite PR firm requests an investigation on Febris, the embedded implant company. The investigation will include a background research on cyborg technologies, Febris' reputation and industry standing, and the analysis of the product lifecycle of the implant.

2 RE: BACKGROUND CHECK REQUEST FOR CLIENT - REQUESTED REPORT IS ATTACHED.

2.1 Background of Cyborg Technology

2.1.1 Cyborg Technologies from 2000-2023. Cyborgs have been defined by Liam Naughton and Herbert Daly as "a functional synthesis of the biological and the technological, a living creature that has both biological and technological components" [31]. In 2010, Roger Clarke put forth a framework for defining technological interventions that are used to enhance the human body and experience to better understand cyborgs [4]. Clarke posits that this technology can be divided into: *prosthetic* and *orthotic* interventions, and then further subdivided based on the level of integration within the body. Orthotics, which Clarke has defined as "an artefact that supplements or extends a human's capabilities" [4] are relatively common, with a simple example seen in infrared goggles, allowing people to see in the dark [25, 27]. Prosthetics allow for an inherent functionality of the body previously missing or otherwise defective to be restored, such as an artificial limb in place of one lost. One can define an "Orthot" as a human enhanced by means of an orthosis [4]. Figure 2 below shows the integration levels categorized by Clarke, which are determined by considering the level of integration to the body, mapped to whether that integration is external to the body, placed upon the body, or placed within the body [4].

Biohacking is a DIY practice of science which merges body modification with technology for cybernetic exploration, and accessing cyborg capabilities [42]. The 2010s saw an emergence of biohacking activities through unconventional, unregulated, and uncontrolled procedures, grounded within emerging technologies that were often self-administered [13, 39]. The community that developed around biohacking was in its nascent stages between 2008 and 2012, but began to mature and become concerned with autonomy in 2013 and onward [28]. The discussions within these biohacking communities that had previously been theoretical had undergone a shift as the necessary tools to implement these technologies within the body became available. The knowledge that was being shared within these communities became embedded and applied [28]. However, as the movement gathered steam, the commercial viability of providing permanent embedded technologies became clear [13].

A subset of biohackers called Grinders emerged with the "aim to enhance themselves by assimilating emerging material technologies

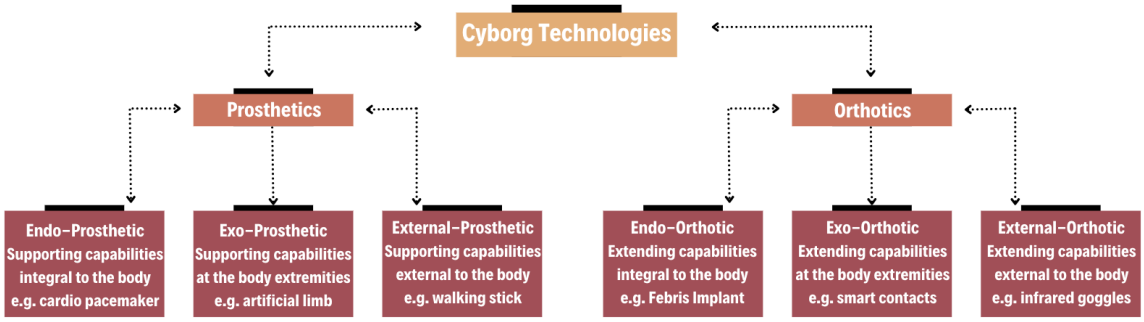


Figure 2: Inspired by Naughton and Daly's [31] understanding of Clarke's [4] framework, which breaks down the differences in enhancement types between orthotics and prosthetics. Orthotics extends a human's capabilities, while prosthetics restore the standard capabilities of the human body.

including, but not limited to, electronics with their bodies through experiments and surgeries" [6]. They are a contrast to biohackers that aim to enhance themselves through genetic engineering or lifestyle changes [43]. This Grinder subculture, borne from the biohacking movement, seemingly have adopted Naughton and Daly's definition of cyborgs, with particular focus on the way in which body modifications can add technological capability or expand the range of human senses [38]. There was lack of medical support for early attempts at biohacking, as these experiments often took place outside of hospitals, instead happening in homes or community laboratories [13, 28, 33]. Therefore, there was a distinct movement within the Grinder subculture that emphasized a do-it-yourself (DIY) attitude that was necessary for progress to be made [14, 42].

Within the scope of this report we can consider Orthots as the next iteration of Grinders, with their enhancements provided by an industry, rather than a fringe movement. We find this distinction to be important as we focus on the discussion on the impact of a central authority operating as a business that also has control over the body.

The first instance of a person being legally recognized as a cyborg occurred in 2004, when artist Neil Harbisson implanted an antenna into his skull, effectively linking the colors that the sensor from the antenna recorded, with an array of sounds [34]. By 2014, there were over 50 labs worldwide dedicated solely to biohacking–largely a grassroots movement relying on crowdfunding [17]. These DIY implants meant that modifications remained wholly in the hands of those installing them, with any changes easily made at will. Figure 3 provides a truncated timeline of a few major milestones within the cyborg space.

In Lauren Britton's fieldwork within the Grinder subculture, they mention that Grinders do not consider their implants separate entities to themselves, and view the failure of an implanted device as a type of death [2]. This emotional attachment could be due to the nature of the struggle to develop and implement this technology in the first place, or it could be inevitable as one modifies the body in such a visceral way—even when the technology becomes commercially available and sanctioned by medical professionals. The failure of enhancement devices can be devastating, as would the lack of support for a device that one comes to rely on.

Case in point: In the early 2010s Second Sight was a company that began manufacturing bionic eye implants called Argus implants, and Second Sight went bankrupt in 2020 [35]. Their users had relied on the technology to combat vision loss. After Second Sight's closure, replacement parts were no longer being manufactured, and employees that handled support of the device were fired [35]. One recipient of the Argus bionic kept a defunct implant in her eye socket since the cost of removal was too expensive [35]. Another user needed to contact the European community of Argus users to see if anyone had the spare parts to help them refurbish their implants [35]. Still another recipient who required an MRI to rule out a potential diagnosis of brain cancer could not do so [35] – due to the way in which magnetic fields from an MRI affect the device. Doctors had been instructed to contact Second Sight for safety assurances, but as Second Sight would not respond to repeated contact attempts, a CT scan was performed on the patient instead [35]. Whether the patient that needed the MRI had brain cancer remains undetermined. Medical professionals that had encouraged the adoption of this technology for their patients had not considered that it may become obsolete [35].

2.1.2 Cyborg Technologies from 2024-Present. Another potential driving factor in the acceptance of implanted technologies beyond commercial viability may have come about due to the effect of the "burden nullification" movement of the 2030s. This movement saw the rise of technology like smart contact lenses replacing smartphones, as the interface used augmented reality to replace the function of a phone screen, which was much more convenient than a handheld device. Soon, technology that reduced any sort of burden upon the user was in high demand, after a series of global economic crises left millions unemployed, and those still employed bowing under the pressure of maintaining a struggling economy.

In 2043, as the military began using neural enhancement technologies that allowed brains to connect to machines in order to exert control and two-way data transfer, a project that had been in development since the late 2010's [7] the United States created government funding sources for companies that produce systems that relied upon the usage of technologies that extended human capabilities.

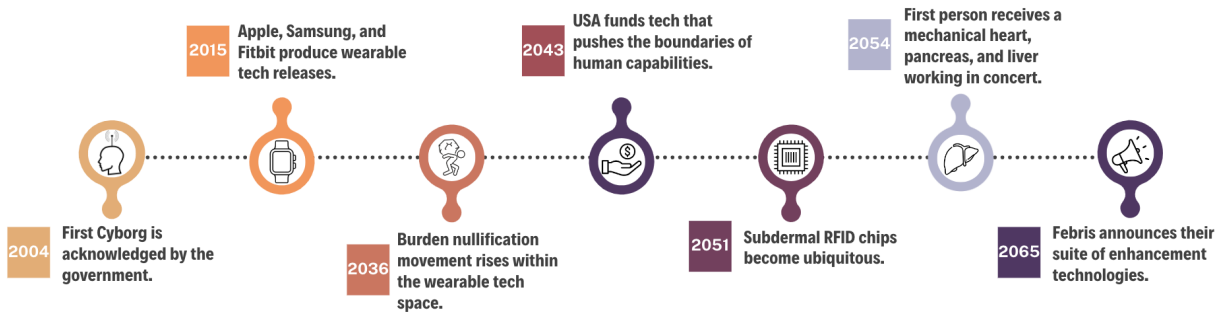


Figure 3: A snapshot of major developments that contributed to the current state of cyborg and enhancement technologies.

The movement towards relieving the user of simple burdens seemed to be the main push that brought about the current embedded technology landscape that we see today, marked by the ubiquitous adoption of subdermal RFID-based chips in 2051. These embedded chips allow for users to reduce any strain placed upon them, allowing hands-free control, easy tracking of all biometrics, reduced need for external computing devices, and dispelling the need for physical access controls worldwide, as unauthorized users are physically unable to enter restricted areas without previously encoded biometric data.

2054 saw the first successful case where a person was able to have an entirely mechanical heart, pancreas, and liver transplanted into their body, showing the viability of the body to accept multiple mechanical organ interventions.

As of 2065, there has been a renewed interest in going beyond skin-deep to see how this "burden nullification" movement can be applied to other processes within the body. The forerunner in this technological space is a medical implant company named Febris, who has revolutionized the industry with the announcement of a new technology this year. They provide a system of implants that work in a supportive capacity to nullify the burden placed upon many organs in the human body–with the caveat that the recipient of the Febris implant pays a monthly subscription for its continued function. This suite of interventions consists of a series of attachments to organs throughout the body, excluding the brain. Many of these attachments found their origins in Endo-Prosthetic implants, such as the pacemaker or the artificial liver. There is also a control panel placed subdermally, only allowing Febris-qualified technicians and the user to make adjustments. The control panel signals for the acceleration and deceleration of the efficiency of function of any organ with the assistance of the attachment, and allows the user to have full reign over their hormones, within non-lethal limits. To apply Clarke's framework, these would be considered an Endo-Orthotic intervention, as they extend capabilities of parts of the human body that are key to its continued function.

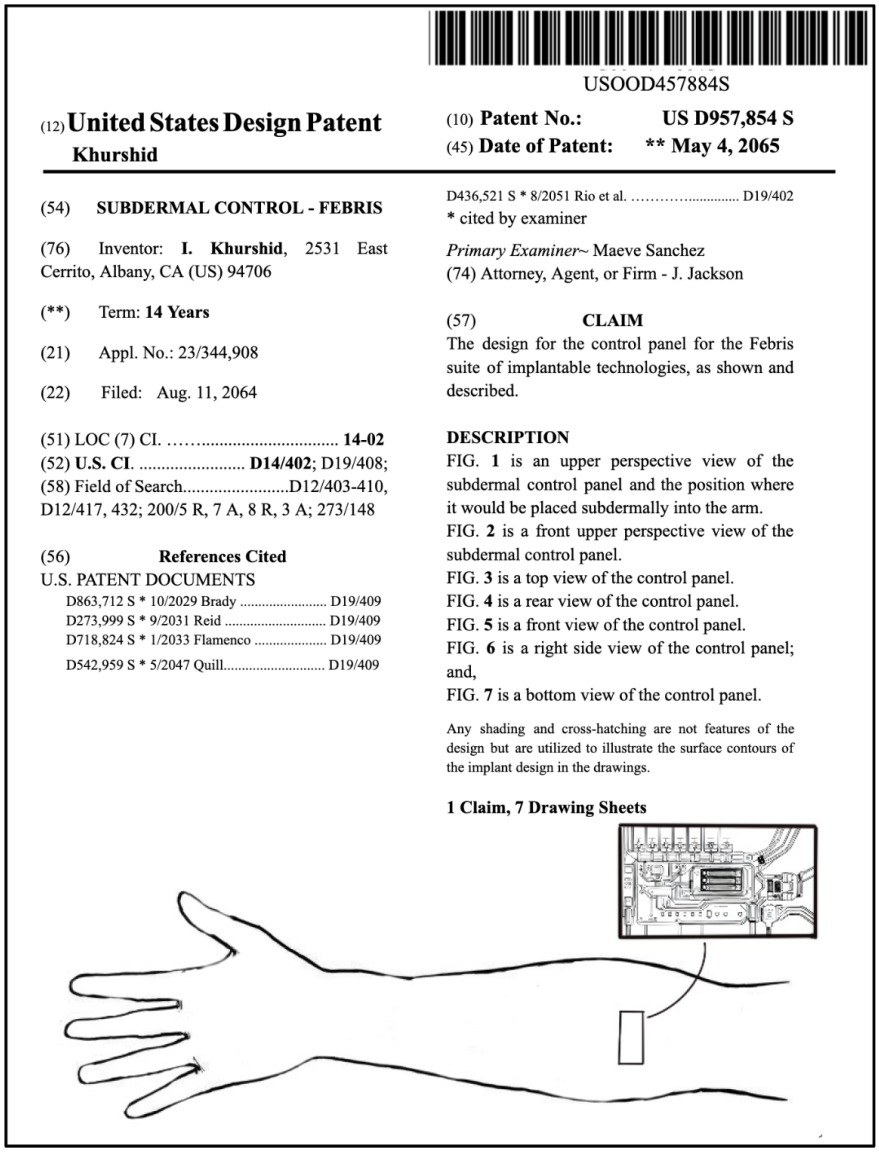
2.2 Industry Standing

Febris implants have versatile applications, and the diverse use cases and potential for pervasive usage means that these implants may be influential within the tech industry. We have divided these use cases into civilian and military applications.

2.2.1 Civilian Applications. With the significant progress that human augmentation has made in the past 50 years, it should come as no surprise that the U.S. Food and Drug Administration has cleared the Febris Suite™ of Endo-Orthotics. This technology alleviates the burden placed upon the human body to operate at optimal levels without assistance. An image from the patent filing for the subdermal for the Febris Suite™ control panel is shown in Figure 4.

Using this control panel allows users to enact greater bodily autonomy over themselves than they may have been able to previously undertake. However, delivery of drugs and active substances as a therapeutic approach, with delivery directly to specific organs at specific times and doses, is something that medical professionals were willing to engage with as early as 2023 [21]. Applications range from basic quality of life improvements, to life-changing outcomes such as:

- **Sports:** Athletes would be able to increase the efficiency with which their lungs operate and process oxygen for short bursts at a time. Active use of this functionality would likely have to be limited during competitions, but it would likely be an effective tool in the case of training. Many performance enhancing procedures are not banned by major competitions, so the Febris implant could be used as a training tool.
- **Pregnancy:** For a high risk pregnant individual, they can control the functioning of their endometrium to ensure that adequate nutrients are transmitted in early weeks of pregnancy, as circulation to the human placenta is not completely established until a point between the tenth and twelfth weeks of pregnancy [16]. Individuals that wish to control their reproductive success can control their ovulation, even pausing their menstrual cycle entirely if they wish.
- **Medical Emergencies:** There are applications that could be useful in case of emergencies. An Orthot with severe allergies could provide themselves with epinephrine in case of an allergy attack by adjusting their hormonal interface.
- **Gender-Affirming Care:** Access to gender-affirming care for non-binary and transgender youth between 13 and 20 has been shown to lower the odds of moderate to severe depression by 60%, and suicide by 73% [37]. Access to hormone therapy at any age would be freely available through the use of Febris Suite™, and available to be controlled and disbursed by the suite's end user.



USOOD457884S

(12) **United States Design Patent**
Khurshid

(10) **Patent No.: US D957,854 S**
(45) **Date of Patent: ** May 4, 2065**

(54) **SUBDERMAL CONTROL - FEBRIS**

(76) Inventor: **I. Khurshid**, 2531 East Cerrito, Albany, CA (US) 94706

(**) Term: **14 Years**

(21) Appl. No.: 23/344,908

(22) Filed: Aug. 11, 2064

(51) LOC (7) Cl. ……..... **14-02**
(52) **U.S. Cl.** **D14/402**; D19/408;
(58) Field of Search.....D12/403-410, D12/417, 432; 200/5 R, 7 A, 8 R, 3 A; 273/148

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Primary Examiner~ Maeve Sanchez
(74) Attorney, Agent, or Firm - J. Jackson

(57) **CLAIM**
The design for the control panel for the Febris suite of implantable technologies, as shown and described.

DESCRIPTION
FIG. **1** is an upper perspective view of the subdermal control panel and the position where it would be placed subdermally into the arm.
FIG. **2** is a front upper perspective view of the subdermal control panel.
FIG. **3** is a top view of the control panel.
FIG. **4** is a rear view of the control panel.
FIG. **5** is a front view of the control panel.
FIG. **6** is a right side view of the control panel; and,
FIG. **7** is a bottom view of the control panel.

Any shading and cross-hatching are not features of the design but are utilized to illustrate the surface contours of the implant design in the drawings.

1 Claim, 7 Drawing Sheets

Figure 4: The first page of the patent that was filed for the control panel that Febris would implant into the arm of the user subdermally. This panel would allow the user to control the efficiency and function of their organs through hormonal distribution.

- **Preventative Health-Care:** Enhancements could also be used to automatically provide vaccine and antibiotic courses. This could prove to be controversial, and may drive anti-vaxxers away from this suite of technology and impacting the economic output. More consideration of the counter-orthotic movements should be undertaken.
- **Organ Health:** Considering the level of control that one would gain over their own bodies, it also seems that some illnesses that directly affect organs could be nullified. If one has pre-established control and monitoring of their organs, they would be able to monitor the efficiency of the function of these organs at all times, and therefore could raise alarms if something were to go awry. This early detection system and continued biometric record would allow for definitive proof of an issue to be shown to a medical practitioner, sidestepping the issue of that practitioner dismissing their concerns or attributing it to some secondary source.

If Febris decides to build and maintain clinicians' trust, that will facilitate user engagement and acceptance when it comes to tools like the ones Febris offers. Abstracting from this, it may mean that the life expectancy of an Orthot may be higher than that of an unenhanced individual due to the implementation of an early-detection system.

2.2.2 Military Applications. In 2019, the U.S. Department of Defense Biotechnologies for Health and Human Performance Council released a report detailing cyborg technology feasibility. One of these technologies is what they call an "optogenetic bodysuit", which would involve subcutaneous sensors for muscle sensing, computation, and stimulation [7]. The bodysuit would allow an outside operator to take control of the combatant's body, essentially piloting them like a video game character. Though this is not an identical function to Febris implants, and is wholly counterintuitive to the goal of bodily autonomy, the outcome of enhancement is the same. This report then goes on to provide recommendations for the Department of Defense to implement in coming years, including the suggestion that "efforts should be undertaken to reverse negative cultural narratives of enhancement technologies" [7]–calling for a reduction of the stigma surrounding the technology, and increasing the rate of adoption.

There also is the consideration of how this technology would apply in other contexts where a third party is introduced. The set of enhancements discussed are not unlike the chemical enhancements received by Bucky Barnes or Captain America—notable fictional superheroes or "super-soldiers" with enhanced stamina and power [3]. Consider an unenhanced person who joins the military, agrees to receive the suite of implants, but has the implants and functionality paid for by the military. The military has paid for the implants to allow their recruit to be the optimal combatant, so who gets the final say on how it is used? Would it be removed post-discharge? Would there be a separate version of the Febris Suite™ developed for tactical usage? There is no inherent problem in using enhancement technology to benefit the military, in theory it should be considered a feasible tool as any other, but it also brings up the topic of how one would be able to defend against an enhanced individual.

As tides change within the attitudes towards enhancements, we should be on our collective guard about the source of the shift towards positive sentiment. Even if the development of the optogenetic bodysuit has not yet come to fruition, something simpler like permanent ocular enhancement that allows for sight beyond the normal visible spectrum, [7] another of the DoD's case studies within the report, seems feasible. There is clear intent to make Orthots a reality, at least in the military, within this century.

2.3 Considerations of the Product Lifecycle

There are drawbacks to these technologies when it comes to implementation, which Febris does not clearly disclose to their users. As Febris has achieved FDA clearance, we have not delved deeply into the medical issues that may arise over the course of this report. Instead, in order to review the potential consequences of such a groundbreaking shift under the skin, we analyze some broader logistical impacts of the implementation of a Febris Suite™ into a user's body. One problem arises when one considers the longevity of these technologies. Though the Consumer Product Safety Commission theoretically has the power to ensure standards of durability upon products, planned obsolescence is still legal in this country due to decades of lobbyists pulling together resources blocking legislation addressing the issue. It is imperative to analyze the potential ways in which planned obsolescence may affect this technology – a concerning prospect as it is embedded within the body.

To be clear, as previously stated, the component pieces that allow the Febris Suite™ to operate lay upon a rich history of successful individual Endo-Prosthetic implants, such as the pacemaker or the artificial liver. As the endocrine system releases hormones in the pituitary and pineal glands, which in turn are broken down in the liver and kidneys, having one of these components fail and negatively affect the organ could lead to dangerous hormonal imbalances. The liability inherent within having the component pieces purposely fail and actively endanger the health of the user is likely too high for the company to bear. The Febris Suite™ is still a new technology, and it is designed and distributed by a for-profit organization. The main source of revenue for Febris is the monthly or annual subscription service that allows for the user modulation of hormones, and acceleration or deceleration of the efficiency of organ function. As with any for-profit company, Febris ostensibly aims to have year-over-year growth of their profit margins. Therefore, what is the incentive for designing for longevity, or even ease of repair?

International labor standards have unfortunately not progressed with the rate of general progress in society, and it remains far easier to facilitate the production of new items than to repair old ones. This adds nuance to the traditional product development lifecycle. Unlike a device like a smartphone, the disposal of this technology would likely be invasive or costly—meaning that many people may not choose to upgrade, and sales could stagnate.

Logistically, where does that leave the growth of Febris?

As the company evolves, the Febris Suite™ technology is bound to become more efficient and streamlined. There has not yet been word on the plan in place for upgrading this technology for a given user with the first generation of the suite installed. However, biometrics are still collected for the entire lifetime of the active component. This means that there will be a wealth of knowledge that Febris will be able to collect about the Orthot, unless the Orthot takes action to de-integrate the Febris system from their body. As subsequent iterations of the suite are generated, support resources for the original iteration may dwindle, as is the norm for most product life-cycles. The subscription service model presented by Febris has long-term ramifications as well. The user will likely be paying the company for continued function, even when the component pieces are no longer supported for repair. Accessories and add-ons that will be developed in the future may not be backwards compatible– the company likely to prioritize replacement over repair of the suite component, as described in the terms of service policy:

> *"Components that are considered defective within the lifetime of the warranty shall be replaced or repaired at our discretion, likely to be replaced. The inherent advantage of the replacement method is that the system will be at full capacity within a shorter time period in case of sustained component failure, or a complicated issue. The end user will receive replacement components of the same make and model, within a reasonable timeframe. The component that needs a replacement must show no signs of tampering or repair from a third party in any way, as this will void the warranty. Repairs will only be undertaken if the repair can be undertaken in one scheduled repair session. In case of an urgent need*

for same-day repair, repairs can be undertaken on the same day, at a significant upcharge."

The Febris Suite™ is only adjustable by Febris technicians and the Orthot, ostensibly a measure put in place to reduce the likelihood of a third party actor unduly tampering with the body functions of the Orthot. With the projected reduction of resources allocated to repair for the Febris Suite™ end user, these orthots have to resort to third party services that will inevitably spring up to offer repairs, but that renders the Orthots ineligible for any assistance that could be offered by Febris in the future.

2.4 Client: Febris - [] Accept / [X] Deny

After taking the above into consideration, we shall not be taking Febris on as a client. We believe that the risks posed are too great.

3 AUTHOR'S NOTES: QUESTIONS OF AUTONOMY, LIABILITY, AND EQUITY

"The investigation of the real and the possible are fundamentally different activities of inquiry." (Franke, Björn) [11]

Traditional forms of design stem from our current norms, and therefore reinforce the status quo [18]. Speculation and design fiction allow us to demonstrate the potential ramifications of technologies that may arise in the future, and recontextualize the contemporary norms. Through scenarios that provoke critical reflection, we are able to engage with the future that may come to fruition if we do not critically examine the role that new forms of technology will play in our society.

Product innovation occurs at such a fast pace that regulatory procedures to control the usage of a new innovation may be rendered obsolete before they are even finalized [8]. This makes it imperative to generate discussions regarding where the bounds of these technologies should be ethically before technologies of this type materialize. In this paper, we use the framing device of a background check on a potential client for a marketing firm to explore some consequences of the fictional development of a medical implant that may very well be developed in some form in the near future, as health tech becomes more sophisticated [21]. The method of speculative fiction allows us to contemplate possible consequences and questions that arise in the world in which a technology like the Febris implant exists [36], and to probe questions that arise from the implications of contemporary technologies.

3.1 Contemporary Concerns - Neuralink

In 2020, Elon Musk claimed that his brain-computer interface (BCI) implant company may potentially have operative devices by 2025 [23]. In May 2023, the FDA provided approval for human trials to begin using this implant.[1] In early 2024, the first implant was successfully placed within a human. Musk has stated that the initial forms of this technology are aimed towards the treatment of neurological disorders or brain injuries. As with many technologies with assistive capabilities, the implantation of this device as it currently stands would likely have benefits in autonomy for those who may want the assistance. Successful brain and spinal cord implants already developed have been shown to be key in allowing for paralyzed individuals to regain the ability to walk [26].

However, Musk has also mentioned that he eventually wants the company to work towards enhancing human capability through telepathy [23]. This eventual step beyond normal human capabilities would place this technology under the umbrella of Endo-Orthotics. Neuralink is a for-profit company that explicitly intends to allow for the extension of what is possible for a human to accomplish. There is no precedent to rely upon when aiming for the extension of human capabilities through implants, and therein lies the issue at hand. Neuralink has stated that the implantation would be undertaken via a proprietary robot that currently performs the installation of their implanted device at a success rate of approximately 87% in under an hour, as the installation process is currently beyond the capabilities of neurosurgeons [30].

There is not yet any word regarding how much installation of such a device would cost, how issues with the implant would be addressed by a technician or a doctor, or how removal of the implant would potentially affect the implantee. Security protections should be in place around the data in transmission within this implant from the inception of the technology. Contemporarily, the data that is being transmitted would just be communication between the brain, the device, and the body itself. However, as the technology iterates, the more abstract or outlandish applications of this technology could come to fruition. Data breaches of a technology that directly interface with the human brain could be disastrous, and could represent a major breach of autonomy. If this information is to be collected anywhere by Neuralink, it should not be allowed to be sold to or accessed by a third party. Liability in the case of a brain implant could also beget complications. Take the example of a person who is using the Neuralink to assist them in walking post-paralysis. If the implant miscommunicates a signal, causing the user to fall and leading to bodily harm of the implantee, would Neuralink be held responsible?

It is not yet possible to explicitly state what the full extent of what the Neuralink implant would allow humans to accomplish is. However, we find that the news of the FDA approval of this brain-computer interface device shows that discussions regarding the reality of Endo-Orthotics should be occurring now, and that the HCI community should determine its stance on this topic before the technology becomes ubiquitous. Much like the optogenetic suit that is under consideration by the U.S. Department of Defense [7], Neuralink is a technology that is under consideration that we believe would cross the barrier into Endo-Orthotics. We present the case of the fictional Febris Suite™ as a technology that would also be implanted within the organs of its users, developed by a for-profit corporation, with similar questions that would arise regarding autonomy, liability, and equity.

3.2 Autonomy After Implantation

In her work regarding cyborgs, Donna Haraway imagines a world where there is no boundary between technology and the human body—allowing the oppressed body to be freed [15]. This sentiment has been echoed by Grinders as they state that a driving force of utilizing embedded technologies is to push past the established

[1] This news comes in spite of investigations still underway regarding accusations of animal abuse during Neuralink's animal testing [5].

limits of societal norms, and beyond gender binary constructions [2].

We would hypothesize that Grinders may be willing to be in the first wave of users for Endo-Orthotic technologies, since there is a clear inclination towards allowing technology to be embedded into the body. However, would technologies that are developed by corporations be accepted by Grinders? The norms that are put in place for embedded technologies such as Neuralink or Febris will likely be encoded by the companies themselves, and this may be a point of tension that would limit the adoption rates of the Grinder population long-term in a way that may not impede the adoption rates of the general population. Would Grinders find a way to break past these norms and hack the technologies offered by these companies, potentially to the detriment of their own heath, in order to shrug off the guardrails of these technologies?

How will this desire to break free of societal norms interact with the prevailing laws? Febris implants as a tool would be a simple way of retaining access to gender-affirming care. Orthots would be able to adjust their estrogen or testosterone levels as desired, with nobody able to bar access to medications, no prejudiced practitioners denying requests to receive gender-affirming care. The fictional release of this technology is placed 40 years into the future, hopefully well past the time that restrictions on access to gender-affirming care are lifted. Ponder the alternative case that they are not. With the knowledge that this technology could be used to assist with gender-affirming care, would there be backlash or bans forbidding usage in this way—would Febris have to release a version of the technology that does not allow for this adjustment?

Haraway later mentions that "One should expect control strategies to concentrate on boundary conditions and interfaces, on rates of flow across boundaries—and not on the integrity of natural objects." [15] Questions of boundaries and the ways in which they may be crossed abound when the mechanisms with which to control others become explicitly manifested within the world. When would people be allowed access to the technology installation? Would children be allowed to enhance their own bodies in any way? Is it possible to predict what the psychological ramifications would be of growing up, enhancing yourself by means of technology continuously? Theoretically, the Febris Suite™ would not allow the user to truly hurt themselves, but will we trust children to be able to control their own bodies? If children are allowed to be enhanced, would enhanced children have their enhancement settings controlled by their parents, and if so, would this stop at the age of majority? Would people who have received the implant as a result of the time that they had spent in the military ever receive access to fully control their own implants? *The potential for abuse when someone has not just "viewer" access, but "editor" access over the body of another person is chilling.*

Haraway goes on to say how "Cyborg imagery can suggest a way out of the maze of dualisms in which we have explained our bodies and our tools to ourselves." [15] We can not continue to imagine technological tools as two entirely separate entities. The answer to the question of where the technology ends and the person begins will get less simple as the coupling of the two grows tighter.

HCI researchers and designers may benefit from engaging with questions of long term psychological effects of emerging technologies that they explore in their own work, as well as the power dynamics at play when it comes to the control of those technologies.

3.3 Will Liability Be Shared?

There is also no clear answer for what constitutes voiding of warranty for an implant of this type. Would liver damage as a result of alcohol consumption, which would reduce the efficacy of the implant, be considered a warranty breach? Would further body modifications that may impede the Febris functions be banned? There will likely be proprietary mechanisms in place to prevent adjustments not sanctioned by Febris. Febris will have ownership and the final word on how their tech is modified, but at this point, there is no clear delineation between where the body ends and the tech begins. Ultimately, does the installation of this technology mean the Orthot has ceded partial ownership of their body?

Drawing further into questions regarding ownership and liability, if an Orthot chose to commit an unsanctioned violent crime while actively enhancing themselves, would they face harsher consequences for being enhanced while conducting the crime. Would they still be considered unarmed? *Would the technology that was in place for enhancement be found liable for providing them with the method used to cause harm*?

As embedded technologies come to fruition, considerations of liability for the harms that can be enacted through usage of these technologies should be centered by designers.

3.4 Equity In Access To Implants

Falling out of sync with the support cycle for the Febris Suite™ could pose significant issues to those who do not want to, or can not afford to, get upgrades. There is also the potential for maliciously restricting access to these enhancements by pricing people out. How might this affect existing class divides? Privilege and ease of access should not be a defining factor in being able to control your body and bring it to its best potential.[2] Access to technology is often influenced by socioeconomic factors, and the divide that will likely be created between enhanced and unenhanced people may lead to disparities where those from lower-income backgrounds are at a disadvantage. This may limit their opportunities for education, employment, and participation in the economy, depending on how codified the divide becomes [20]. *Is it ethical to release a technology that could so clearly be used to exacerbate social divides without putting guardrails up for fair usage before it is released to the public?* We believe that HCI community members should develop their stances on Endo-Orthotic technologies so that guidelines for fair usage can be developed and deployed. There is an inherent paradox at play when it comes to the implant technology that is used primarily for enhancement. Though it has a purported purpose of allowing the user to exert the ultimate levels of autonomy over one's body, the proprietary nature of the company's provided enhancements also mean that there is an invisible specter moving along inside.

[2]As a point of reference, we can consider the Blue Sky Studios movie Robots, released in 2005. In a world where everyone is a robot, the company responsible for releasing parts to allow repairs stopped manufacturing parts, outlawed repairs, and intended to collect the defunct robots to melt them down to provide upgrades for upper-class robots. [24]

4 CONCLUSION

The do-it-yourself attitude in the biohacking space to create cyborgs is an attitude that may have a limited shelf life. We draw ever closer to the realities of Endo-Orthotic acceptance. It would not be surprising to see the development and large-scale production of these technologies shift to the hands of companies with established presence in the wearable technology and medical implant spheres. One would imagine that given sufficient levels of adoption of these technologies, a Luddite approach—a refusal to become enhanced—may take the counterculture space that Grinders once occupied. We hope to one day reach a world where technology can allow us to assert control over our own bodies wholly by means of technological enhancement. However, these incredible technologies will not exist in a vacuum, and if not maintained, the implementations of these technologies may leave us worse off than before.

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