



Piracy and the Impaired Cyborg: Assistive Technologies, Accessibility, and Access

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This paper examines software piracy in the Global South from an accessibility lens, using the bio-technical metaphor of the 'cyborg.' Drawing on qualitative interviews with people with visual impairment (VI) from India and Peru, the paper interrogates the intimate relationships that users have with assistive technologies (ATs). It outlines the effectiveness of ATs in allowing users to actively control and shape their own lives and identities, and describes the various modalities that regulate the human body, technology, and human body-technology linkages. The paper argues that software piracy, when looked through the lens of the 'cyborg,' is an act of self-making that is motivated by a desire to gain autonomy and independence, i.e., it can be understood as a way to overcome the barriers that undermine access to the technological self. Further, software piracy allows a shift in the distribution of power from those who control and regulate the assistive technologies to the cyborgs themselves.

CCS Concepts: • **Human-centered computing** → **Empirical studies in collaborative and social computing**; **Empirical studies in accessibility**; *Empirical studies in HCI*.

Additional Key Words and Phrases: disability; piracy; cyborgs; posthuman; access; accessibility; assistive technologies

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1 INTRODUCTION

Access to digital technology presents significant challenges to people with disabilities around the world. Existing market-produced, mainstream technology for specific needs often do not present sizable numbers to warrant mass production. Consequently, the development and deployment of assistive technologies have traditionally depended on a mix of governmental, private, and non-profit efforts, and driven by legislative requirement or social justice, rather than pure financial objective. However, assistive technologies remain expensive, and their piracy is rampant around the world, especially in the Global South.

This paper examines software piracy in the Global South from an accessibility lens, using the biotechnical metaphor of the 'cyborg' — a hybrid techno-organic body [16, 32] that blurs the boundaries between machine and organic body. To the user of assistive technologies, the limits of where the body ends and the technological appendage begins are never fixed; the act of being an assistive technology user requires a constant ability to adapt and reimagine the technologies one is surrounded by. Using a case study of assistive technology use by people with visual impairment in India and Peru, this paper focuses on how individual agency extends beyond the biological to include the socio-technical systems that constitute it.

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This paper argues that software piracy is an act of self-making when looked at from the lens of the cyborg. It stresses the ability of technologies, such as assistive technologies (or ATs), to reconfigure and rethink notions of the body and technology in the context of people with disabilities. The metaphor of the cyborg allows us to interrogate the intimate relationships between humans and technology, and the role that economic, structural, and institutional factors might play in impeding this relationship [13]. This includes studying what technologies are available, who has access to them, and how markets, social norms, laws, and the design of technologies regulate the possible linkages between humans and technologies.

The focus of this paper is the “materiality” of cyborgs [69]: access to technologies is restricted because of socio-economic, political, institutional, and technical factors, especially with respect to people in low- and middle-income countries. This is especially true for people with disabilities, where a wide range of forces - economic, political, and professional - have led to dependency [53]. ATs have been touted as an important means to improve the quality of life by reducing the physical, social, and technical barriers they face. However, access to ATs remains severely constrained by high costs and inefficient distribution mechanisms. Further, the architecture of the technologies directly regulate and restrict users - for example, most ATs are closed, rather than open-source.

Disability scholars have been critical of conflating people with disabilities and their use of assistive technologies with cyborgs, arguing that popular narratives of the cyborg continue to frame the disabled body as broken; one which can be ‘fixed’ and made ‘normal’ with the help of technologies [51, 81]. Building on disability scholar Reeve’s [69] notion of the “impaired cyborg”, the paper discusses how people with disabilities actively use technologies to renegotiate their identities in society. This metaphor helps describe the relationships that people with disabilities have with technologies without perpetuating ableist assumptions of ‘broken’ bodies needing to be fixed. The figuration of the “impaired cyborg” explores how people with disabilities actively use technologies to redesign their identities in new ways. In the process, it unsettles what it means to be ‘normal’ in terms of everyday practices, cultural norms, and ethics. The paper thus looks beyond technologies normalizing/extending the body. Instead, it instead focuses on the various modalities that regulate the human-technology linkages of impaired cyborgs.

HCI and CSCW research has looked to understand the relationships humans have with technologies and conceptualize ethical design that is cognizant of how power and control flow through society. This paper builds on the notion that a posthuman future as a cyborg could be emancipatory, but the ability to be a cyborg is severely restricted by existing and deeply-entrenched social, economic, and political structures. Through focusing on people with visual-impairments (VI) living in low- and middle-income countries such as India and Peru, the paper will argue that access to well-designed and appropriate ATs plays an important role in creating relatively autonomous ‘cyborg’ bodies. With access to ATs restricted, the act of pirating -- a common phenomenon in much of the Global South -- when looked from the lens of a cyborg, constitutes an act of self-making. Piracy is motivated by the need and desire to overcome the barriers that impede an individual’s ability to transcend socially constructed boundaries of ‘disability’ and be able to renegotiate their identity in society.

2 BACKGROUND: CYBORGS, DISABILITY, AND ACCESS

2.1 Assistive Technologies and Access

The rise of the modern industrial society, emphasizing a conventionally productive body and a rigid set of social roles and relations, has marginalized people with disabilities. Across the world, the majority of them fall outside the class of formal wage-earning citizens. In the Global South, a large proportion of people with disabilities work exclusively in the informal economy - unregulated

work that is often invisible to the state. With their prevalence higher amongst low-income and vulnerable communities, people with disabilities, on the whole, have lower educational levels, lesser economic participation, higher rates of poverty, poorer health, and increased dependence on the welfare state and kinship networks [55].

While it might be overly-simplistic to encode technology use and access between the non-disabled and disabled as a linear digital divide of ‘haves’ and ‘have-nots’ [34], there is still compelling evidence that people with disabilities significantly lag behind the rest of the population in ICT use [84]. Studies show that people with visual impairment are less likely to use computers and access the Internet than those with sight [21]. Importantly, it has been argued that while demographic and socio-economic variables factors are partially responsible for the lack of access to ICTs, technical barriers of accessibility are a major cause of people with visual impairment lagging with respect to computer and Internet use, especially in developing countries [60].

Assistive technologies have been recognized as an essential need for people with disabilities – for example, the UN Convention on the Rights of Persons with Disabilities (UNCRPD) outlines that assistive technologies are important for the full and equal enjoyment of human rights. Appropriate ATs, under the right structural and institutional conditions, have been empirically shown to reduce dependence and increase autonomy for those with disabilities [73]. For example, accessibility research has documented how access to AT use by people with visual impairment (VI) leads to higher aspirations [57], increased status [58], and more independence [62, 63]. They thus play an important role in increasing access and participation, along with shaping social, professional and political interactions.

Accessibility research, studying the design and use of ATs, has stressed the notion of “social accessibility” [76] which looks beyond the functional aspects of ATs and instead focuses on how ATs fit into everyday social lives. These studies stress that designers need to be aware of the social dimensions of both independence [39] and trust [9] in the context of AT use. On these lines, Faucett, et al. [24] discuss how the design of ATs needs be cognizant of the complex and nuanced ways in which disabilities are socially constructed in society, especially the politics of visibility/invisibility. Accessible making is thus shaped by the practices of everyday life and how people with disabilities negotiate their status through the value of their work [18].

Every disability has a distinct set of barriers borne out of a person’s unique experiences with the world, and this also shapes their use of ATs. This paper focuses specifically on people with visual impairment (VI) in India and Peru and their interactions with ATs: how they gain access to ATs and how ATs shape their identities. In recent times, information and communication technologies (ICTs) are shaping individual aspirations, social relationships, and workplace environments; ATs that provide access to these ICTs are thus central in enabling social and economic participation [23]. With the majority of mainstream digital technologies still not accessible to people with visual impairment, ATs are an important means of accessing social and economic spaces currently mediated by ICTs.

Access to ATs is, however, limited, especially in low- and middle-income countries where only an estimated 5 - 15% of the people needing ATs have access to them [55]. Factors affecting access include the lack of knowledge on ATs, the relatively high costs of obtaining an AT [59, 61], as well as its limited supply - with both quantity and distribution affecting the ability of individuals to obtain and use ATs [22]. Consequently, in most of the Global South, piracy is an important means by which these populations access ATs [48].

2.2 Piracy and Access in the Global South

For a large percentage of the population living in the Global South, piracy is an important means of experiencing otherwise inaccessible cultural and economic goods [65]. HCI/CSCW research

has previously studied pirate communities [12] and piracy, including how illegal sharing practices constitute vibrant socio-technical ecosystems [80], drive technology adoption, and promote digital literacy [43]. However, the dominant narrative of policy-makers, corporations, and development agencies, continue to portray piracy as a crime -- an unethical and undesirable behavior that needs to be dealt with through incentives and deterrents. This has been reflected in most behavioral research on end-user piracy [40].

There is now a growing 'culture of piracy' [17] across the world, which has been precipitated by the Internet. In the Global North and developed parts of the Global South, increasing broadband speeds along with the rise of P2P and file-sharing services have allowed people to share, reproduce and transform copyrighted intellectual property with ease and in great volumes. This has led legal scholars [5, 44] and economists [4] to debate the efficacy of archaic copyright laws in the age of networked communities and arguing for the creative potential of piracy in driving innovation and increasing welfare. However, they remain deeply critical [44] or silent on the nature of piracy in low-income parts of the Global South, which continues to be looked at as parasitic as it, through abusing intellectual property rights, blatantly disregards capitalist ideals of ownership.

In contrast, post-colonial scholars have argued against the hegemony of intellectual property [45, 65, 82, 85]. In this narrative, piracy culture in the Global South plays a key role in revolutionizing access of previously marginalized populations to the flows of economic and cultural modernity. Thus piracy is strongly embedded in informal social and economic practices and caters specifically to the needs and desires of low-resource communities.

This paper builds upon this notion of piracy as a means of access, focusing on the piracy of ATs by the visually impaired in low- and middle-income countries such as India and Peru, though the arguments can be extended to other contexts. It argues that the piracy of ATs is motivated by a desire of marginalized people with impairments to access and control a technology that is important for their survival in modern industrial society. It uses the lens of the 'cyborg' to discuss the intimate relationships that individuals have with technologies, and how piracy can be understood as a way to overcome the barriers that undermine access to the technological self.

2.3 The Cyborg Lens

Tools can be considered as an extension of oneself rather than as individual objects -- when tools work efficiently, there are no discontinuities between the self and the tool [35]. The world experienced by a human is a function of these tool-augmented interactions, and individuals share their cognitive and physical workloads with these tools. The tools, in turn, do not exist in isolation, but only in relation to the humans who define and use it.

An instrumental definition of technology is a network of tools that are a means to an end; however, modern technologies such as information and communication technologies (ICTs) also radically transform our orientation with the environment. There is a continuous interplay between ICTs and humans, a process of co-evolution, and an implied interdependence that results in socio-technical systems where humans and technologies find themselves irrevocably intertwined in social, political and economic matrices. Thus, while human-tool and human-machine relationships have been around for most of human history, ICTs have increased both the quality and quantity of this coupling [32]. This has led to the paradigm of 'post-humans' or 'cyborgs' which represents a distinct departure from natural biological evolution.

Cyborgs cover a wide spectrum of human-technology couplings, from the restorative and normalizing to the reconfiguring and enhancing [32]. The term 'cyborgs', an abbreviation of "cybernetic organisms", was originally used to describe self-regulating human-machine systems that could adapt to harsh physical environments in the context of space exploration [16]. The notion of cyborgs, as a hybrid creature that blurs the boundaries between organic and machine,

subsequently found a place in science fiction and was seized by scholars such as Haraway and others as a metaphor that also blurred traditional notions of identity. As boundary-figures between the organic and inorganic, they represent a wide spectrum of human-machine couplings. Moving away from the notion of fixed identities, the cyborg discourse instead embraces these boundary-figures, who are now refigured as being the norm rather than the exception [51]. It consequently questions the notion of what it means to be ‘normal’ or ‘human’ – arguing that our social identities are continuously constructed through the linkages that the human body forms with technology.

A cyborg body’s interaction with its environment - both physical and social - is shaped by the biological body, the inorganic technology, as well as the nature of linkages between the two. For instance, when an individual with vision impairment uses a prosthesis of screen reading technology, the hybrid body interacts with the environment in a radically different way than just the individual components - the nature of coupling between the body and AT determines the cyborg body’s agency and ability to be an active autonomous participant in society.

2.3.1 Cyborgs, Accessibility, and Computing. Work on collaborative technologies and socio-technical systems have looked at postmodern subjectivities and challenged the ontological nebulous boundaries between body and machine [52, 56]. This includes posthuman conceptualizations [68, 79] that stress on entanglements between human and non-human entities. These studies show how posthumanism informs social justice work [72] by decentering the human and explicitly accounting for non-human actors.

Design research has further begun studying human-computer integration as a distinct sub-field, as opposed to human-computer interaction, largely in the context of wearable technologies [10, 38, 41]. On these lines, a range of “Do-It-Yourself” projects study how people with disabilities can be empowered through designing their own custom assistive technologies [37, 50, 78]. Studies have captured how people with VI seek to have greater control over the ATs they use, finding ways to re-purpose and personalize them [11, 66]. However, there remain barriers in their ability to successfully do so [7].

While these studies do capture the marginalization of people with disabilities, they are predominantly situated in the Global North. There remains a lack of studies capturing the lives of people with disabilities in the Global South and the institutional and infrastructural constraints that mediate their relationships with technology.

2.3.2 Cyborgs and Disability. ATs – when appropriate and available – play a key role in the lives of people with disabilities and significantly reshape how one navigates physical and social environments. With advances in technologies, the boundaries between body and technology have increasingly become blurred [28]; the tightly-knit relationships with technologies also significantly shaping the socially constructed identities [2, 71] of people with disabilities. Studies exploring the use of technologies by people with disabilities have outlined how it becomes an important means to resist stereotypes and labels. For example, Cynthia Benett et al. [6] discuss the role prosthetics play in the development of identity beyond just functional benefits and how ATs become sites of self-expression and experimentation.

The metaphor of the cyborg focuses on the potential freedom afforded by new techno-biological configurations, especially how they re-figure an individual’s personal identity and subjectivities. However, disability scholars have critiqued applications of the cyborg metaphor to people with disability studies. Siebers [77] argues that the metaphor romanticizes the cyborg experience, for example, suggesting that technologies coupled with the human body always lead to positive outcomes. This techno-utopian narrative, through arguing that the ‘disabled body’ can be enhanced with ‘technologies’ to heighten existing abilities, reinforces the medical model of disability: a ‘disabled’ body is broken by default, but can be fixed and made more useful by the use of external

technologies. The focus on enhancing the abilities of a biological body is a theme that pervades most popular uses of cyborg theory. We see similar narratives in the case of the ‘supercrip’ [36], which stereotype inspirational tales of individuals using technologies to ‘normalize’ their bodies and achieve success by doing tasks that non-disabled individuals consider ‘normal’. The cyborg metaphor, as used in these narratives, ignores the actual lived experiences of people with disabilities and their imperfect relationship with technologies. Often body-technology linkages are assumed to be frictionless when in reality they are fraught with struggles and discomforts. Balsamo [3] further argues that the hybrid body with respect to people with disabilities is not more free from discipline and control. Instead, it further gets entrenched in socio-technological systems of surveillance that shape the access to and use of ATs, such as non-profits, insurance companies, and the markets. Lastly, and relevant to our paper, the emancipatory potential of a cyborg metaphor is meaningless when the vast majority of people with disabilities still struggle to access useful and relevant technologies [69].

This paper approaches the notion of cyborgs using disability scholar Donna Reeve’s [69] conceptualization of ‘impaired cyborg’ – a cyborg identity that does not aim to fix an individual, but instead represents new ways of being, in the process destabilising the binaries of disabled/non-disabled and normal/abnormal. Beyond a purely functional purpose of reducing impairments (from a normative standpoint), technologies also become integral to new embodied experiences and ways of being. The metaphor can thus be liberating by focusing on how people actively redesign their bodies through the use of technologies and carve out alternate identities in society. However, being an empowered cyborg is contingent on overcoming a multitude of existing economic, social, political, and technical constraints. Over-represented among the poor and marginalized, the ‘impaired cyborg’ is less about the biological body and extension of abilities, and more about the socio-economic and political realities of access and control with respect to technologies.

3 DATA

The paper is a re-look at past data from a qualitative study of people with visual impairment from India and Peru. The study was conducted from 2012-2013 with 72 male and 29 female respondents from India, and 26 male and 24 female respondents from Peru. All interviews were in-depth qualitative interviews accompanied by a short demographic survey. Interviews were conducted in the local languages, depending on the preferred language of the interviewee. Interviews took between 15-120 minutes; all interviewees were adults, typically in college, at the workplace, or unemployed. The original purpose of this study was to investigate the nature of assistive technology use by the visually impaired in development contexts. Subsequently, the interviews included a broad discussion of issues from childhood experiences to present-day use of technology, though our general focus was on AT and workplace experiences, social aspirations, and architectural access.

The initial goal of the research was to understand the challenges with respect to access to technology on the ground, but over time discussions about the relationships interviewees had with ATs led us to revisit the work. Consistent themes of technology, identity, and access were found, and the interviews were re-coded from a cyborg perspective. The coding started with narratives of AT and the ways they were seen as augmenting an individual’s physical and emotional being, as well as helping create their own identities. With many respondents admitting that they pirated ATs, coded interviews were analyzed to identify the role of ATs in their lives and the motivations behind piracy. Subsequently, the lens of cyborg was applied to analyze their relationship with ATs and their decision to pirate. In the following sections, the paper discusses the relationships people with visual impairment have with ATs, along with analyzing how the metaphor of cyborg helps us understand the act of pirating ATs.

4 VISUAL IMPAIRMENT, ICTS, AND ASSISTIVE TECHNOLOGIES

“The crucial aspect here for any VI person, accessibility is the key for knowledge.” – I88

Over the last few decades, knowledge of computers, mobile phones, and other information and communication technologies (ICTs), such as the Internet, have had a profound impact on an individual’s quality of life. Besides making information and knowledge more accessible, they have significantly reshaped how we navigate the social and economic world around us. Respondents stressed that as a “blind person you actually require these kinds of [technology services] much more than any normal person”. Multiple interviewees mentioned how they preferred to use Internet-based services such as mobile banking, paying bills online, and the online recharge of prepaid mobile currency, rather than visiting a physical location. Similarly, online shopping was preferred over purchases at brick-and-mortar shops. Thus, knowledge of and access to ICTs was an important need for people with VI looking to simplify the logistics of everyday life:

“Yes. If we have computer knowledge, we can completely change our life style. We have the facility to do transactions through computers; we should make use of it in our day-to-day life. Then our life will become easy. So we should update ourselves to the modern technology. I feel it is essential for each and every individual.” - I14

The Internet has also been instrumental in facilitating communication and building relationships, and the social inclusion of our respondents was often contingent on being part of virtual networks that mirrored and extended offline relationships. Many of the respondents discussed how they were now able to sustain communities virtually and even form new communities around the shared identity of VI.

Professional success in the labour market also required individuals to access, learn and use ICTs, such as computers. Almost all the jobs that our respondents aspired to required knowledge of computers. These included working in accountancy and the information technology (IT) industry. Competitive exams for government and public sector jobs, such as banks, required prerequisite knowledge of computers. Further, many software companies were known by the VI community to be open to hiring people with VI. These shaped the ambitions, and consequently the trajectory of education of our respondents – many travelled to other cities just so they could learn how to use computers.

Access to ICTs such as computers and phones was thus integral to the social and economic lives of our participants. All our respondents emphasized their importance, and could not “imagine life without access” to these technologies. However, this was contingent on having access to the relevant assistive technologies (AT) that played a vital role in allowing them to actually use the ICTs. Importantly, respondents were able to now use ICTs without the logistics that accompanied relying on others to help them operate the technologies. The below quote emphasizes the importance of ATs in bridging the VI community with existing ICT ecosystems and consequently allowing them to access virtual services.

“If AT was not developed, we would never have come near computer. If this software is not there, we can never think of accessing computers and getting on internet. Internet is a storehouse of knowledge and as a teacher, this is most essential... AT software is the bridge between the VI community and the computers” – I62

Assistive technologies are thus important for people with VI attempting to use technological services in their everyday lives, or in other words, “bridge” the VI community with ICTs. Through providing access to ICTs, ATs such as screenreaders also increase access to existing sources of knowledge and information. For example, with limited physical books with tactile text and images, they allow people with VI to read virtual books downloaded from the Internet.

ATs have further significantly expanded the range and breadth of social and economic experiences of our respondents. This has allowed increased participation in the labour markets, along with a significant expansion of their social networks. In the below quote, we see how using ATs such as screenreaders have helped people with VI build new social networks, both domestic and international:

“When I lost my vision, the so called friends in my college distanced themselves from me... After I started to use the screen readers, I am able to connect to other VIs all over the globe. Now my network of friends has gone beyond the previous situation wherein I had vision but I had limited friends from my state. Now I know people across India because of networks exclusively available for us; able to forge friendships with many VI; share a lot of knowledge. So this has given me a fresh outlook and now I am interacting with a larger world.” - I054

Thus, through bridging people with VI with existing ICTs, ATs afford users inclusion and access to society along with significant improvements in the quality of life. In effect, existing assistive technologies are allowing people with VI to ‘enter’ society and be allocated ‘normal’ roles.

“After I started using assistive technologies, I have become independent, my productivity has increased and now I am of more use to the company. My confidence level has also increased.” - I034

However, as a distinctly instrumentalist approach, this sort of normalization continues to perpetuate the myth of the ‘disabled’ as the ‘other’ striving to meet the norm [54]. In the subsequent sections, the paper interrogates the relationships that users have with their ATs through the lens of the cyborg. We outline that besides the functional aspects of ATs, they are also effective in allowing people with VI agency to actively control and shape their own lives and identities. Further, the paper outlines the barriers that continue to impair the cyborgs – constituting the biological body coupled with the ATS – in pursuing their self-determined objectives.

5 IDENTITY, TECHNOLOGY AND THE CYBORG BODY

Analyzing the use of assistive technologies (ATs) through the lens of the cyborg allows us to look beyond the normal/abnormal dichotomy. Instead, we see how people with VI are creating their own identities subject to their relationships with technologies. Identities are often in flux and continuously shaped by capabilities and aspirations. Assistive technologies significantly expand the boundaries of the capability space [26], which consist of not only individual capacities but also local and structural factors. Local factors include community norms and the physical infrastructures that shape everyday life, while structural factors include the various broader mechanisms that affect individual freedoms such as markets, laws, and political institutions.

Further, as we saw in the previous section, ATs also shape aspirations. Aspirations are necessarily future-oriented and influenced by a multitude of factors, including local contexts and social interactions. Through enabling access to ICTs, ATs broaden both capabilities and aspirations and influence an individual’s socially constructed identity. The below quote shows how ATs, through allowing access to new knowledge, enable alternate technology-mediated identities:

“When JAWS came, that helped me very much. The whole things got transformed. With the computer knowledge and AT lot of doors got opened before me. With this knowledge alone, I got my job. I couldn’t even think of using computers if there was no JAWS. So the screen readers have changed my whole objective from being that of a literary person to a technology person.” - I056

As technologies become integral to the practices of everyday life, they become extensions of the body and self. From an instrumental or functionalist perspective, they can be looked at as appendages to the organic body, which extend their actions and interactions, providing access and facilitating participation in society. However, looking at this coupling from a cyborg perspective brings focus to individual agency in reconstructing the sense of self through the enactments of everyday life. The human bodies form performative configurations with the ATs and create new socio-technical practices. However, as we see in the below quote, incompatibilities of either the human body with the ATs or the ATs with existing infrastructures can significantly impair the cyborg:

“So screen reading assistive technology is like my right hand out there for any kind of aspirations when it comes to corporate world, the first thing that I will look forward to and my managers will also look forward to me being okay with the tools. What even they want (is that) they would want me to work effectively like the other people and I shouldn’t be making any kind of errors, experiencing any kind of incompatibility with the tool which will affect the other people’s production. So in a nutshell I can say it is very, very important.” - I098

The transformational influence of ATs in the lives of people with VI is clearly visible in the way they change the routines of everyday life. These new routines are integral to their participation in existing socio-technical and socio-economic ecosystems, while also performatively constructing their self and identity. For our participants, the use of AT, was “more than just (about) comfort”, rather “it was a need”. As a cyborg, the coupling of technology and body enable a multiplicity of possible identities and an extension of functions; however, this is contingent on accessing and using ATs. Appropriate, well-designed, and accessible ATs made the cyborg individual more independent in everyday life. Echoing critical disability scholars, we see the multifaceted nature of dependency [69] – independence in society is possible only through being dependent on technologies. We see this relationship of people with VI and screen readers in the following quotes:

“It diminishes your dependence... but you are still dependent.” - P18

“Screen reader is like my friend – it is like oxygen for me; if it is not there, I can’t do anything” - I074

ATs are integral to the freedoms enjoyed and the nature of crafted identities. While these ATs are designed primarily for people with disabilities, they continue to encode existing political, social, and cultural perspectives to disability. Further, the economics of supply and demand along with intellectual property regimes dictate the nature of markets that exist for ATs. There remain tensions between the values shaping the design and distribution of ATs and the relationships people have with ATs, which hinder the cyborg individual. The next section describes the various modalities that shape how human-technology linkages of the cyborg individual are regulated.

6 MODALITIES OF REGULATION AND THE CYBORG BODY

To understand how socio-economic and socio-technical factors shape the experiences of people with VI, the paper analyzes the forces that prevent or discourage seamless human-technology coupling, or in other words, ‘disable’ the cyborg. With respect to the human body-AT linkages, these forces restrict access to ATs. These could either be explicit control, for example, when someone is restricted from installing a software by authorities or implicitly through existing socio-technical regimes. Lessig [44] discusses four modalities that regulate individuals or activities - the market, social norms, laws, and architecture. Chandra and Jones [13] extend this to cyborg bodies and argue that they operate at three distinct levels – the biological body, the technology, and the

linkages between body and technology. All modalities constraining at each level are relevant to understanding the forces that shape the possibility space of the cyborg body.

6.1 ATs and Markets

Existing market systems constrain the availability and distribution of ATs. Markets also determine the economic viability of people with disabilities to invest in ATs, especially in terms of how they shape employment opportunities. With the majority of people with disabilities living in low-income settings, economic costs are an important barrier resulting in the lack of accessibility. Most ATs for people with VI are expensive, in part because of the small markets and high research costs [59]. While open-source alternatives exist (such as NVDA) and solve the problem of cost, their availability and offered support is shaped by a variety of factors, including market size, technical proficiency, and network externalities.

Further, with much of the development done in the West, there remain few cheap localized software that can be customized to the unique needs of different users in the Global South. As we see in the below quote, a major concern for people with VI was the lack of internationalization in screen readers with respect to speech:

“In JAWS , many accents are available like French/American/British/Chinese. These accents are not available in NVDA, they can introduce some more accents for the benefit for V.I. persons.” - I010

ATs, in general, have limited markets, as they are usually built for a certain type of disability. Government legislation and non-profit initiatives play an important role in increasing the size of the AT markets and decreasing costs through subsidies. For example, with respect to screen readers, we find that proprietary software is expensive and can only be obtained through discounts. However, discounted proprietary software only extends the dependency of the visually impaired on expensive variants of technologies. In the long run, actualizing and maintaining the cyborg body is left dependent on organizational decisions and navigating bureaucratic hurdles, especially with respect to new installations and upgrades. In the below quote, we see how the expensive costs of proprietary software lead to greater administrative red-tape:

“Even now purchasing the proprietary software like JAWS is not easy in a govt organization; we have to get many approvals from the higher authorities; some of them will approve it; some of them will disprove[sic] it; for a minor community whether a huge amount is to be spent to buy the proprietary software.” - I57

Finally, labour market demands and existing technology trends dictate if it is economically viable for certain human-technology coupling to exist. ATs are designed to be compatible with certain ICTs, and their effectiveness is contingent on the present and future popularity of these ICTs. People with VI need to invest time and resources to learn how to use an AT, and must decide on the potential of an AT based on existing observations. As a respondent pointed out, ATs and accessibility initiatives are meaningless if they don't cater to existing and future market needs:

“Now I am working in a software company and trying to understand the best and sophisticated technology which is being highly used; and I will be able to know which are the tools that need to be encouraged; or which are the tools that need to be provided; there is no point in going ahead with doing accessibility to some technology which is not being highly used in the market.” -I046

6.2 ATs and Social Norms

Social norms influence the negotiation of social interactions and determine how people perceive those with visual impairment and ATs. There has historically been social stigma attached to both,

and these contribute to misperceptions about the true abilities [75] of people with VI using ATs. Respondents perceived that they were treated as “lower citizens” at every level of society, and even with access to ATs, they were often regarded to be unemployable. Respondents also talked about how the common perception of people with VI was that they were low-income, uneducated, and not independent, which shaped how people responded to them in everyday life. We see in the following quote that changing the mindsets of people with respect to VI was regarded to be an important step in allowing greater participation in society, and this had to come all the way from the government:

“The top most priority for the government is to acknowledge that these people are very much eligible to work. In the various circles of our government, not only in our political circles but also in our bureaucracy a lot of people still feel that they are little under-rated citizens. That is the mindset that the government first has to change. - I037

Our respondents experienced stigma when it came to their use of ATs. For example, some were sometimes “not treated well” when using a cane in public. Others spoke of family members and friends trying to help them whenever they see them using ATs, thus interfering with them being independent. The existence of ATs thus does not guarantee that people with VI can use them to their full potential and create new identities for themselves. Existing social norms shaping their ability to actually use them. In the following quote, we see how people with VI face ignorance with respect to their potential capabilities:

“But I feel even now the situation is the same; whenever people see me carrying a laptop or working on the computers, they ask what is that I am doing with a computer when I can’t see. They are surprised that I can work on the computers as they can; they are simply baffled when I say I can check my mails and I can surf the net; still general public are not aware that technology has enabled a VI to keep up with the present day scenarios.” - I060

These social norms were often enacted in organizational practices, leading to respondents facing issues at their workplaces or when searching for employment. Most non-disabled people had little or no awareness about the abilities of people with VI and their respective ATs. Prior work has documented the additional invisible work needed by people with VI to create accessible workplaces [8]. This significantly shaped the workplace experiences of the respondents, including finding their ability to perform organizational tasks questioned:

“... it’s very difficult to get a job in an MNC company for a visually disabled person. Do you know why? There is no proper awareness in the people. Normal people who are using computers for the past 10-12 years who work in big companies do not know what is narrator; they do not know what is magnifier. These are small tools which have been given by Microsoft. If they know of these tools, they won’t ask how a visually handicapped person can work.” - I003

With organizations and government agencies often controlling the procurement, distribution, and installation of ATs (such as screen readers), misperceptions about disabilities and the relevant ATs play a significant role in how accessible these ATs are, and thus the nature of cyborg bodies. Existing social norms and organizational practices further influence broader government legislation and industry decisions, and consequently provide avenues for the exertion of power - from social institutions, organizations, and the state. For example, in the following quote we see how corporations chose to not procure open-source software because of existing organizational security practices that preferred commercial proprietary software:

“In JAWS we can script. NVDA is an open source. In my workplace open source is not allowed to be placed due to security reasons. They want licensed and legal version which is available only in JAWS” - I001

While debates between commercial proprietary software and open-source alternatives are a consequence of industry perceptions and practices related to open source, we see in the next section that they also relate to how the architecture of the technologies regulates the human-technology connections.

6.3 Architecture of ATs

The architecture of the technologies directly influences the freedoms enjoyed by the extended selves. For example, Chopra and Dexter [14] argue that closed software reduces autonomy in a cyborg world by allowing the growth of government and corporate power through systems of control that regulate and restrict. Open-source technologies emphasize a slightly more democratic ideal, allowing anyone with the expertise to acquire and alter existing code, allowing the software to evolve and adapt to local circumstances. Free, open-source alternatives played a crucial role in helping some respondents access technologies. Nevertheless, open-source is not without issue with its users generally being more tech-savvy. While online forums and other informal support mechanisms helped people with VI learn and troubleshoot software, the lack of ongoing formal support for open source software was sometimes a hindrance. In contrast, there were far more reference documentations when it came to commercial ATs such as the JAWS screen reader. Respondents also often found the open-source software to be less “efficient”, i.e. not completely integrating with their work practices. A related key issue was how technologies often get tied to certain ecosystems, for example, respondents found that open-source software hindered them by not being compatible with existing workplace technologies:

“The drawback with NVDA is, it is still not compatible with Microsoft XL. I have NVDA installed on my laptop. I am trying to do my day to day activities with this software, what I am doing in office. At my office, I do not use any formulas, only one simple spreadsheet, and the features I use are filtering, sorting, cell validation. When I tried to do these operations on my laptop with NVDA, it is not possible. I am not able to do filtering, etc. therefore NVDA has to be made compatible for simple operations like these.” - I23

However, non-profit establishments and educational institutions often lack financial resources and cannot afford expensive commercial software. Their lack of technical expertise also meant that they were less likely to use open-source software. In this scenario, they often installed demo versions of commercial software which were limited in functionality:

“For example, about computers, at school they installed the demo version of the program (JAWS) that finishes every 40 minutes. It’s also worth noting that in that time there was no license and we had to restart the computer every 40 minutes. So imagine, you’re preparing the text and the machine tells you that you have to restart it, otherwise your JAWS turns off.” - P04

Finally, the ability of ATs to seamlessly integrate themselves with everyday life is shaped by the architecture of the technologies. The integration happens at two levels: 1) technologies integrating with the body, and 2) the hybrid techno-biological body performatively integrating with everyday practices. There could be “seams in the cyborg” [27], i.e. disjunctions where the technology does not fit with an existing body. Disability scholars have documented how this has often led to pain or physical discomfort to individual bodies [64]. At the level of socio-technical practices, this leads to

the disruption of existing routines. For example, in the following quote, we see how work practices are sometimes disrupted by workers having to switch on and off their ATs:

“when a co-worker approaches and (I ask) “I want to revise this, help me with that”, (co-workers say) “I better turn off your JAWS”, because JAWS doesn’t let others use the mouse. Commonly, people work with the mouse, so if they are going to use it, they have to turn off JAWS.” - P01

6.4 Laws and ATs

Laws are an important force shaping the distribution and use of ATs in most countries in the world, as they establish what technologies and accessibility services various institutions are required to provide. For example, the United Nations Convention on the Rights of People with Disabilities (UNCRPD) is an important international treaty supported by many countries, including in the Global South, which aims at tackling the socio-economic and socio-cultural factors that marginalize people with disabilities, and includes provisions for the distribution of assistive technologies [60]. However, its implementation has been contingent on governments forming and executing local laws and policies that help people with disabilities. For example, respondents in India discussed how, as a community, they often felt left out and were unable to reap the benefits from the ongoing economic growth in the country:

“This is a developing phase of the country. As the economy is growing, as we are progressing towards a developing country, consideration should be given to that section of the society which is also contributing and also in the mainstream. When we advocate diversity, equality, birth right, fundamental right, in our constitution, the same should be extended to all sections of the society. But we have been neglected. Most of the policies are just drawn; but if the same is drawn with concern, with understanding, it will go a long way in helping the VI community. I am ok with smaller policies, fewer policies; but let them be implemented properly.” - I024

Thus, creating a law or policy was not enough; it had to be implemented by the government. An issue with many countries in the Global South, and especially in Peru and India, was inaction from local actors who remained entrenched in social norms and stigma against disability. Respondents were keen on the government playing a more active role in enforcing existing laws - for example, enforcing quotas in the workplace that are required by law to ensure there is sufficient representation of people with disabilities in professional settings.

Respondents also stressed the government’s role in enacting creating policies and enacting laws to help train people with VI and increase access to ATs. In response to expensive ATs, the respondents stressed that the government had an important role to play in subsidizing costs or encouraging open-source software:

“...the government must provide facilities to VI like the cane, wheel chair and it must also encourage the NGOs to provide training for VI, so that more number of VI can be trained. The screen reading software used by VI is expensive and every VI may not be able to afford it. I think the government should take initiative and make the software available to VI free of cost.” - I033

“... govt should bring about a policy to encourage bringing out open source software; for example JAWS . . . Only IBM or Microsoft is able to buy JAWS. But common people, it is out of reach. Who can invest Rs.60000 or more for this software? And every year, this cost is increasing. So govt should encourage bringing out open source softwares” - I47

Laws largely treat the body and technology as separate entities [42] — boundaries and classifications are integral to the functioning of legal systems. However, with cyborgs blurring existing dichotomies, technology laws can become an avenue of control. We see this in the case of intellectual property (IP), where laws shaping technology use tie the cyborg body to the existing capitalistic system. Laws applied to a ‘cyborg’ need to contend with issues of how technology is integral to one’s cyborg identity, for example, who controls the intellectual property?

A hybrid cyborg body has the potential to be liberating; however, beyond the ‘disabled body’ being controlled, technologies and the technology-body linkages bring with them further avenues of control. The cyborg body is in-effect controlled by: 1) high costs of proprietary software regulated by markets, 2) bureaucratic decisions at the government and organizational level, and 3) laws and social norms. For a cyborg body to truly be autonomous and independent, it needs direct control over the technologies that constitute it. This directly maps to the demands of those with visual impairments, and with disabilities, in general, for not just “improvements in existing services but control over them” [53]. Autonomy is thus contingent on cyborg bodies reducing the loci of external control.

7 ASSISTIVE TECHNOLOGIES, PIRACY, AND CYBORGS

Despite the high license costs of screen readers such as JAWS, studies have shown their high use amongst people with visual impairment. A large percentage of respondents in these studies also acknowledged using pirated copies of JAWS [48]. Our interviews confirmed that many respondents were indeed using pirated copies of expensive proprietary software. The decision to pirate was influenced by prevailing norms about piracy along with the institutional, legal, and economic structures that shaped existing policies of piracy deterrence as well as the perceived risks and costs. A respondent mentioned that sometimes they had to “reformat the computer every three months” when using pirate software and would have preferred to use the original software but did not have the resources to do so.

Pirated software was the gateway for our participants into the world of technology. Most of the respondents were introduced to ATs in specific, and ICTs in general through using a cracked (copy-protection removed) versions of screen reader software. Invariably, the respondents blamed the costs of ATs as their primary reason to pirate:

“I have the pirated version of the JAWS on my computer. The AT software I use is very expensive and is not affordable at all. Also the mindset of an Indian is, if it is available for free, use only that.” - I19

“I have the pirated version of JAWS on my laptop. I know it is not correct. But when I see so many of my friends are using the same, I think I can also have it on my system. But it is a costly thing to buy for me. I can’t afford it.” - I31

The knowledge that the act was “not correct”, as some respondents mentioned, did not prevent the act of piracy, with social influence within this community playing an important role. The widespread piracy in the VI community created a descriptive norm that made this action acceptable enough to emulate, and this in-group norm is visible in the open support of piracy by disabled people and disability rights groups [60]. Using pirated ATs was integral to people with VI reshaping their socially constructed identities and living a professional and social life of relative autonomy.

Piracy was also crucial in helping our respondents in getting around existing norms that lead them to a state of dependency. Respondents, upon finding themselves becoming increasingly dependent on their close social networks obtained cracked versions of software (such as screen-readers) from others in the VI community. Being able to form human-technology linkages, albeit with ‘illegal’ technologies, was integral to them becoming relatively independent. Subsequently, as

impaired cyborgs, they had the agency to reshape their capacities and aspirations, and subsequently reconstruct their identity in society.

Further, piracy allowed them to get around bureaucratic inertia and workplace culture that stymied access to ATs. As most workplaces did not provide ATs, it was often left to the employees to procure it and use it without letting the employers know that they needed it and had obtained it:

“... I asked for a computer in my next job and got me do my tasks. They gave me a system and asked me to work in the same. I loaded the cracked version of screen readers and started working there. None knew about this; otherwise they would not have allowed me to do work. In JAWS we have a version called 10.1139 where it says no activation needed for installation. So we have used this version. It was already cracked by someone else. I got a copy of it and used it.” - I1010

Obtaining the cracked software from personal connections was often easier than navigating organizational hierarchies to purchase it officially. The structural violence of bureaucracies in the form of ‘red tape’ has historically affected marginalized populations disproportionately. In the context of people with VI, they have to get approvals through many layers of hierarchy and navigate excessive bureaucratic procedures. Procuring software in organizations is often not trivial and involves negotiating bureaucratic inertia, institutional inflexibility, and entrenched organizational practices. In the below quote, we see the arbitrariness of decisions related to the installation of ATs that led the respondent to install and use a pirated software:

“For example, here I have JAWS ... the informatics guy came here and deleted all my screen readers because they said that as we don’t have licenses, they didn’t want me to have it, so they deleted it. So I said “how am I going to work”, “that’s not my problem” he said. ...here in informatics, they don’t want JAWS because the Ministry hasn’t bought it and if it hasn’t, they don’t want it to be here. So I ask “why don’t you buy it?”, (they say) “oh, because it’s not considered in the budget” (...) They don’t make things easy, really.” - P03

Software piracy is thus a means to control the technological means that can extend the self. It facilitates the making of the cyborg body, enabling people with VI to overcome the structural, institutional, and economic barriers that limit their access to technology. Through constituting a piracy-enabled cyborg body, they are now allowed relative flexibility in the socio-technical structures that bind them – freedom in technology choice and use accompanied by independence in their daily social and professional lives. The marginality of people with visual impairments definitely plays an important role in their decision to pirate. Importantly, software piracy allows a shift in the distribution of power from those who control and regulate the ATs to the cyborgs themselves. This provides them with the agency and autonomy to choose their technical appendages, and thus shape their own cyborg identity. While limited by the architecture of the assistive technology, through circumventing the legal barriers of intellectual property (IP), they are able to overcome prevalent laws and norms that impede access along with market factors such as costs and inefficient distribution.

8 DISCUSSION: PIRACY AS AN ACT OF SELF-MAKING

Disabilities, as categories, are deeply entrenched in the “economic, political, social, technological and ideological forces” [53] that shape policy. The hybrid figure of the cyborg subverts and reconstitutes these categories [51], and in the process blurs the boundaries between disabled and abled, normal and abnormal, body and machine. Reeve’s conceptualization of the ‘impaired cyborg’ explores the realities of life as a person with disability using technologies. Life as a cyborg – or a body hybridized by technology – is not always a positive experience. For example, the use of technologies can lead

to disruptions in routines when the technologies fail to integrate with existing socio-technical practices. Importantly, independence experienced by a cyborg body in society is contingent on the organic body's dependence on assistive technologies.

Consequently, the modalities that regulate technologies now also regulate the everyday experiences of people with disabilities — an extra layer of surveillance alongside preexisting ones. Nonetheless, people with disabilities interacting with technologies *are* cyborgs when they can craft new identities: this is however contingent on the organic body being able to access the technologies that can extend it, along with the freedom to form linkages between body, technology, and the environment. This paper focuses on the forces that hinder access to technologies to argue that pirating can be viewed as an act of self-making in a cyborg world. In the context of people with VI, it is motivated by a desire to overcome the barriers that impede existing and potential linkages.

The majority of people with disabilities are in the Global South, and their marginalization is largely a result of poverty and weak state institutions — it is thus intertwined with globalization and legacies of colonization. For example, Meekosha and Soldatic [49] argue that the redistribution of power and wealth to the Global South would be far more effective in improving the lived experiences of people with disabilities in these parts of the world. Intellectual property (IP) is one such source of power whose hegemony continues to maintain historical power imbalances.

Current global institutions defined by the Global North have created economic, legal, and socio-technical structures that lead the technologies required for the cyborg bodies to be unequally distributed and controlled by privileged interests. Through laws and consensus-building norms — largely a consequence of colonialism — the interests of dominant classes are preserved in society [30]. Global capitalist entities, with their power and influence, have tried to shape laws and construct narratives that position piracy as a criminal and unethical activity. These laws are contoured by the boundaries of nation-states, with most intellectual property protected by countries in the Global North. The increasing hegemony of intellectual property has led governments across the world to declare war on pirates. Dent [20] argues that the “derogation of piracy” is the primary means by which “the neo-liberal experience” is shaped in the Global South. Through creating a moral dichotomy of the pirate versus the virtuous ethical customer, corporations seek to extend their control to existing technology-mediated spaces. Further, copy-protection technologies are a means for companies to not only shift the “locus of control from law to technology,” but also a means to subtly reinterpret law [29].

While piracy can be a means by which communities express their resistance to these ideals, i.e., a counter-hegemonic act, an alternate assertion argues that it is primarily non-hegemonic. Brazilian anthropologist, Gustavo Lins Ribeiro [70], uses non-hegemonic globalization to describe informal actors who wish to benefit from global capitalism and have little motivation in destroying or subverting it. Sundaram [82] describes how piracy helps integrates actors with the global economy, and is purely a habitual means of getting around the inadequacies of existing markets rather than a conscious opposition to intellectual property rights.

Understanding piracy is important to computing research looking to expand technology access to populations at the margins around the world. Around the world, marginalized individuals and communities, when faced with constraints to access, find informal workarounds, often bordering on the illegal [46]. With technologies crucial to a decent living, access to them have already started to be classified as “universal rights” — for example, the right to Internet access [83] or access to affordable assistive technologies. However, as technologies become integral to not just navigating everyday life but also one's constructed identity, the question of whether it is ‘okay’ to pirate technologies is fundamentally an ethical one which asks if the ability to become a cyborg is an individual right. In such a context, we can reconceptualize human rights as ‘cyborg’ rights. This is particularly true for marginalized communities such as those with disabilities who can aspire to

a life of relative autonomy only through their linkages with technologies. In an unequal world, where the ability to access and use technologies is determined by socio-economic status, piracy empowers individuals and communities to shift the balance of power.

Posthuman and legal scholars have already begun to think of the changing nature of rights in a cyborg world. For example, in the ‘Cyborg Bill of Rights’, Gray [31] proposes amendments that consider the political rights of cyborg individuals in a postmodern democratic society. With a wide spectrum of individuals now technologically altered, Gray suggests broader liberties and freedom and protection against corporations/governments. Similar proposals by cyborg theorists argue for the right to self-modify along with retaining ownership over one’s constitutive technologies [47]. Clarke [15] outlines the various kinds of rights that cyborg bodies might demand, including the right to access crucial technologies. This includes rethinking privacy rights as the lines between technology and body begin to blur [19]. A crucial aspect is the reinterpretation of property rights in a cyborg world. As legal scholar Ramachandran [67] argues: “property rights and freedom of contract have always threatened to stifle us via our bodies, such as by constructing us as “disabled” rather than “abled,” or by determining whether we will need to perform physical labor to survive.” We thus need an alternate conceptualization of rights that can protect the ability to craft new identities and ensure that powerful entities do not impose control over the identities of others.

The link between marginality and piracy suggests that design and policy approaches looking to address social and economic inequalities will need to look more closely at the ways existing global structural barriers and property rights impact access to technologies. Even with access to technologies, people with disabilities (such as people with visual impairment) will face a range of other barriers in having complete control over the technologies they use. Thus, the cyborg identity – while potentially liberating – is heavily dependent on the socio-material and economic realities of who has access and control over the technology, along with the broader structures that facilitate or constrain the appropriation of technologies. For example, would encouraging the creation of free accessible open-source alternatives allow lesser avenues for the exertion of industry control over the technology component of the cyborg body? Non-hegemonic practices such as piracy are a reaction to existing systems that impede access to the cyborg self. Studying piracy enables us to parse the needs and motivations of marginalized communities along with critically assessing how power shapes the construction of identities in capitalist societies.

8.1 Cyborgs and Design

This paper focuses primarily on the cyborg, keeping into account racial, feminist, and ableist critiques of how this metaphor can trivialize the lived experiences of people with disabilities. Easy access to affordable, well-designed technologies, along with evolving social norms and enacted laws/policies have the potential to help impaired cyborgs to challenge the status quo by creating new ways of being, or identities that can disrupt traditional binaries of disabled/non-disabled and normal/abnormal. However, coupling a body with technology is not a panacea, rather it brings new avenues for regulation. Designing for the margins need us to be aware of the forces that regulate techno-biological linkages.

While data in this paper focuses on people with disabilities, the outlined arguments relate to marginality and access and can be extended to other groups living at the margins of society. We are moving towards an age where technologies are becoming integral to who we are, our value systems, and the freedoms we strive for.

Design in a posthuman cyborg world would need to rethink existing paradigms of human-centred design and the nature of collaborative systems; instead of focusing on just ‘human’ needs, we will need to think of the needs of a cyborg body. Cyborgs, as coherent techno-biological entities [33], are embedded in the socio-technical infrastructures of everyday life that shape politics, value

systems, and ethics. Extending existing STS posthuman work, this paper argues of the need to think beyond the binaries of human/non-human, instead thinking of a world of hybrid entities where agency and power are distributed between the various components that constitute these bodies [25]. Design thinking in such a world would be what Neubeauer [52] argues an act of “technohuman reconfiguration in practice”, wherein “technology, humanity, and integrated technohumanity” are effects of the practice. This marks a distinct shift from traditional anthropocentric models of design, instead we decenter the human, allowing design thinking to extend beyond conventional (often Western-centric) human values, ethics, perceptions, and scales.

Marginalization has increasingly been conceived in terms of freedom, with development constituting the act of removing the unfreedoms that deter individuals from exercising their agency [74]. As we approach a cyborg world where individuals strive to create hybrid bodies and identities, we will also need to assess the nature of freedoms that are desired in such a society. For example, Alcaraz [1] argues for morphological freedom, i.e. the “freedom to bio-technologically modify one’s bodily form” as a dimension shaping ethics in a cyborg world. On similar lines, MacKinnon [47] proposes the right to “organic naturalization” which prevents third-party ownership of vital cyborg body systems.

As a society, we will have to broadly consider the philosophical, sociological, and legal implications of these new kinds of freedoms being seen as basic human rights. As designers, we are directly implicated as we play an essential role in shaping both the nature of technologies and access to them. In a cyborg world, we will need to question issues of marginalization, lack of equity, and power distribution at various levels: 1) the organic body – do cyborgs have control over their organic body and do they have access to biological essentials (for example, healthcare and nutrition), 2) the technical – is there an equitable distribution of technological artefacts and do cyborgs have choice or freedom in the technologies that they are coupled to, and 3) the relationship between the organic body and technical – are the technologies appropriately designed to be compatible with the organic self and do cyborgs have control over the technologies that help constitute them?

This paper has shown how the deep intimate relationships humans have with technologies can reshape lives and identities. Both humans and technologies are enmeshed in existing social, political, and economic matrices, influenced by powerful forces of hegemony and capitalism. However, in the face of marginalization by oppressive systems (for example, able-ism), communities and individuals strive to find solutions (for example, piracy) that move them closer to a cyborg body that permits them freedom, autonomy, and choice. A posthuman cyborg lens allows us to interrogate these actions and imagine futures that are more inclusive and equitable.

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REFERENCES

- [1] Aleksandra Lukaszewicz Alcaraz. 2019. *Cyborg Persons or Selves*.
- [2] Elisabet Apeldoorn. 2012. Falling in love with a wheelchair: enabling/disabling technologies. *Sport in society* 15, 3 (2012), 399–408.
- [3] Anne Marie Balsamo et al. 1996. *Technologies of the gendered body: Reading cyborg women*. Duke University Press.
- [4] Paul Belleflamme and Martin Peitz. 2014. *Digital piracy*. Springer.
- [5] Yochai Benkler. 2006. *The wealth of networks: How social production transforms markets and freedom*. Yale University Press.
- [6] Cynthia L Bennett, Keting Cen, Katherine M Steele, and Daniela K Rosner. 2016. An intimate laboratory? Prostheses as a tool for experimenting with identity and normalcy. In *Proceedings of the 2016 CHI Conference on Human Factors in*

- Computing Systems*. 1745–1756.
- [7] Cynthia L Bennett, Abigale Stangl, Alexa F Siu, and Joshua A Miele. 2019. Making Nonvisually: Lessons from the Field. In *The 21st International ACM SIGACCESS Conference on Computers and Accessibility*. 279–285.
 - [8] Stacy M Branham and Shaun K Kane. 2015. The invisible work of accessibility: how blind employees manage accessibility in mixed-ability workplaces. In *Proceedings of the 17th International ACM SIGACCESS Conference on Computers & Accessibility*. 163–171.
 - [9] Robin N Brewer and Vaishnav Kameswaran. 2019. Understanding trust, transportation, and accessibility through ridesharing. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. 1–11.
 - [10] Lauren M Britton and Bryan Semaan. 2017. Manifesting the cyborg through techno-body modification: From human-computer interaction to integration. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. 2499–2510.
 - [11] Erin Buehler, Stacy Branham, Abdullah Ali, Jeremy J Chang, Megan Kelly Hofmann, Amy Hurst, and Shaun K Kane. 2015. Sharing is caring: Assistive technology designs on thingiverse. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 525–534.
 - [12] Priyank Chandra. 2016. Order in the warez scene: explaining an underground virtual community with the CPR framework. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. 372–383.
 - [13] Priyank Chandra and Jasmine Jones. 2015. Assistive technologies and autonomy in a cyborg world. In *Proceedings of the Seventh International Conference on Information and Communication Technologies and Development*. ACM, 31.
 - [14] Samir Chopra and S Dexter. 2007. Free software and the political philosophy of the cyborg world. *ACM SIGCAS Computers and Society* 37, 2 (2007), 41–52.
 - [15] Roger Clarke. 2010. Cyborg rights. In *2010 IEEE International Symposium on Technology and Society*. IEEE, 9–22.
 - [16] Manfred E Clynes and Nathan S Kline. 1995. Cyborgs and space. *The cyborg handbook* (1995), 29–34.
 - [17] Ian Condry. 2004. Cultures of music piracy: An ethnographic comparison of the US and Japan. *International journal of cultural studies* 7, 3 (2004), 343–363.
 - [18] Maitraye Das, Katya Borgos-Rodriguez, and Anne Marie Piper. 2020. Weaving by touch: A case analysis of accessible making. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 1–15.
 - [19] Robert M Davison. 2012. The privacy rights of cyborgs. *Journal of Information Technology* 27, 4 (2012), 324–325.
 - [20] Alexander S Dent. 2012. Piracy, circulatory legitimacy, and neoliberal subjectivity in Brazil. *Cultural Anthropology* 27, 1 (2012), 28–49.
 - [21] Kerry Dobransky and Eszter Hargittai. 2006. The disability divide in internet access and use. *Information, Communication & Society* 9, 3 (2006), 313–334.
 - [22] Arne H Eide and Tone Øderud. 2009. Assistive technology in low-income countries. In *Disability & international development*. Springer, 149–160.
 - [23] Katie Ellis and Mike Kent. 2011. *Disability and new media*. Routledge.
 - [24] Heather A Faucett, Kate E Ringland, Amanda LL Cullen, and Gillian R Hayes. 2017. (In) visibility in disability and assistive technology. *ACM Transactions on Accessible Computing (TACCESS)* 10, 4 (2017), 1–17.
 - [25] Laura Forlano. 2016. Decentering the human in the design of collaborative cities. *Design Issues* 32, 3 (2016), 42–54.
 - [26] Alexandre Apsan Frediani. 2010. Sen’s Capability Approach as a framework to the practice of development. *Development in practice* 20, 2 (2010), 173–187.
 - [27] Peter ES Freund. 2004. Civilised bodies redux: seams in the cyborg. *Social Theory & Health* 2, 3 (2004), 273–289.
 - [28] Barbara E Gibson, Franco A Carnevale, and Gillian King. 2012. “This is my way”: reimagining disability, in/dependence and interconnectedness of persons and assistive technologies. *Disability and Rehabilitation* 34, 22 (2012), 1894–1899.
 - [29] Tarleton Gillespie. 2009. Wired Shut, Copyright and the Shape of Digital Culture. *Journal of Information, Communication and Ethics in Society* (2009).
 - [30] Antonio Gramsci. 2011. *Prison Notebooks Volume 2*. Vol. 2. Columbia University Press.
 - [31] Chris Hables Gray. 2000. *Cyborg citizen: Politics in the posthuman age*. Routledge.
 - [32] Chris Hables Gray, Heidi J Figueroa-Sarriera, and Steven Mentor. 1995. The Cyborg Handbook. (1995).
 - [33] Jonathan W Gray. 2016. “Why Couldn’t You Let Me Die?”: Cyborg, Social Death, and Narratives of Black Disability. In *Disability in Comic Books and Graphic Narratives*. Springer, 125–139.
 - [34] David J Gunkel. 2003. Second thoughts: toward a critique of the digital divide. *New media & society* 5, 4 (2003), 499–522.
 - [35] Martin Heidegger. 1996. *Being and time: A translation of Sein und Zeit*. SUNY press.
 - [36] P David Howe. 2011. Cyborg and supercrip: The Paralympics technology and the (dis) empowerment of disabled athletes. *Sociology* 45, 5 (2011), 868–882.
 - [37] Amy Hurst and Jasmine Tobias. 2011. Empowering individuals with do-it-yourself assistive technology. In *The proceedings of the 13th international ACM SIGACCESS conference on Computers and accessibility*. 11–18.
 - [38] John Jones, Catherine Gouge, and Mariah Crilley. 2017. Design principles for health wearables. *Communication Design Quarterly Review* 5, 2 (2017), 40–50.

- [39] Vaishnav Kameswaran, Jatin Gupta, Joyojeet Pal, Sile O'Modhrain, Tiffany C Veinot, Robin Brewer, Aakanksha Parameshwar, and Jacki O'Neill. 2018. 'We can go anywhere' Understanding Independence through a Case Study of Ride-hailing Use by People with Visual Impairments in metropolitan India. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (2018), 1–24.
- [40] Nixon K Kariithi. 2011. Is the devil in the data? A literature review of piracy around the world. *The Journal of World Intellectual Property* 14, 2 (2011), 133–154.
- [41] Krista Kennedy. 2018. Designing for human-machine collaboration: smart hearing aids as wearable technologies. *Communication Design Quarterly Review* 5, 4 (2018), 40–51.
- [42] Bert-Jaap Koops, Mireille Hildebrandt, and David-Olivier Jaquet-Chiffelle. 2010. Bridging the accountability gap: Rights for new entities in the information society. *Minn. J.L. Sci. & Tech.* 11 (2010), 497.
- [43] Neha Kumar and Nimmi Rangaswamy. 2013. The mobile media actor-network in urban India. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 1989–1998.
- [44] Lawrence Lessig. 2009. *Code: And other laws of cyberspace*.
- [45] Lawrence Liang. 2005. Porous legalities and avenues of participation. *Sarai reader* 5, 1 (2005), 6–17.
- [46] Ramon Lobato and Julian Thomas. 2018. *The informal media economy*. John Wiley & Sons.
- [47] MacKinnon Richard. 2017. The Cyborg Bill of Rights v1.0 / Boing Boing. <https://boingboing.net/2017/02/01/the-cyborg-bill-of-rights-v1-0.html>
- [48] Ted McCarthy, Joyojeet Pal, and Edward Cutrell. 2013. The "voice" has it: screen reader adoption and switching behavior among vision impaired persons in India. *Assistive Technology* 25, 4 (2013), 222–229.
- [49] Helen Meekosha and Karen Soldatic. 2011. Human rights and the global South: The case of disability. *Third World Quarterly* 32, 8 (2011), 1383–1397.
- [50] Janis Lena Meissner, John Vines, Janice McLaughlin, Thomas Nappey, Jekaterina Maksimova, and Peter Wright. 2017. Do-it-yourself empowerment as experienced by novice makers with disabilities. In *Proceedings of the 2017 Conference on Designing Interactive Systems*. 1053–1065.
- [51] Ingunn Moser. 2000. Against normalisation: subverting norms of ability and disability. *Science as culture* 9, 2 (2000), 201–240.
- [52] Ruth Neubauer. 2019. Design Thinking: From Individual Thinking Towards a Technohuman Reconfiguration. In *Proceedings of the 17th European Conference on Computer-Supported Cooperative Work-Demos and Posters*. European Society for Socially Embedded Technologies (EUSSET).
- [53] Mike Oliver. 1989. Disability and dependency: A creation of industrial societies. *Disability and dependency* (1989), 6–22.
- [54] Michael J Oliver. 1999. Capitalism, disability, and ideology: A materialist critique of the. *A quarter-century of normalization and social role valorization: Evolution and impact* (1999), 163.
- [55] World Health Organization et al. 2011. *World report on disability 2011*. World Health Organization.
- [56] Jo Orsatti, Ella Hafermalz, and Dirk S Hovorka. 2016. Rethinking." Rethinking: Post-Human Boundaries" Pre-given or Performed? *ACM SIGMIS Database: the DATABASE for Advances in Information Systems* 47, 4 (2016), 41–44.
- [57] Joyojeet Pal, Tawfiq Ammari, Ramaswami Mahalingam, Ana Maria Huaita Alfaro, and Meera Lakshmanan. 2013. Marginality, aspiration and accessibility in ICTD. In *Proceedings of the Sixth International Conference on Information and Communication Technologies and Development: Full Papers-Volume 1*. 68–78.
- [58] Joyojeet Pal and Meera Lakshmanan. 2012. Assistive technology and the employment of people with vision impairments in India. In *Proceedings of the Fifth International Conference on Information and Communication Technologies and Development*. 307–317.
- [59] Joyojeet Pal, Manas Pradhan, Mihir Shah, and Rakesh Babu. 2011. Assistive technology for vision-impaired: an agenda for the ICTD community. In *Proceedings of the 20th international conference companion on World wide web*. ACM, 513–522.
- [60] Joyojeet Pal, Ugo Vallauri, and Victor Tsaran. 2011. Low-cost assistive technology in the developing world: a research agenda for information schools. In *Proceedings of the 2011 iConference*. ACM, 459–465.
- [61] Joyojeet Pal, Anjali Vartak, Vrutti Vyas, Saikat Chatterjee, Nektarios Paisios, and Rahul Cherian. 2010. A ratification of means: International law and assistive technology in the developing world. In *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development*. 1–11.
- [62] Joyojeet Pal, Anandhi Viswanathan, Priyank Chandra, Anisha Nazareth, Vaishnav Kameswaran, Hariharan Subramonyam, Aditya Johri, Mark S Ackerman, and Sile O'Modhrain. 2017. Agency in assistive technology adoption: Visual impairment and smartphone use in Bangalore. In *Proceedings of the 2017 CHI conference on human factors in computing systems*. 5929–5940.
- [63] Joyojeet Pal, Anandhi Viswanathan, and Ji-Hye Song. 2016. Smartphone adoption drivers and challenges in urban living: Cases from Seoul and Bangalore. In *Proceedings of the 8th Indian Conference on Human Computer Interaction*. 24–34.

- [64] Alyson Patsavas. 2012. *Suffering Cyborgs: Inhuman Pain, Human Subjects*. Ph.D. Dissertation. MA thesis, University of Illinois at Chicago.
- [65] Kavita Philip. 2005. What is a technological author? The pirate function and intellectual property. *Postcolonial Studies* 8, 2 (2005), 199–218.
- [66] Halley P Profita, Abigale Stangl, Laura Matuszewska, Sigrunn Sky, and Shaun K Kane. 2016. Nothing to hide: aesthetic customization of hearing aids and cochlear implants in an online community. In *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility*. 219–227.
- [67] Gowri Ramachandran. 2009. Against the right to bodily integrity: of cyborgs and human rights. *Denv. UL Rev.* 87 (2009), 1.
- [68] Neil Ramiller. 2016. New technology and the post-human self: Rethinking appropriation and resistance. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems* 47, 4 (2016), 23–33.
- [69] Donna Reeve. 2012. Cyborgs, cripples and iCrip: Reflections on the contribution of Haraway to disability studies. In *Disability and Social Theory*. Springer, 91–111.
- [70] Gustavo Lins Ribeiro. 2012. Globalization from Below and the non Hegemonic Word-System. *G. Mathews, G. Lins Ribeiro y C. Alba Vega, Globalization from Below: The World's Other Economy, Londres, Routledge* (2012), 221–236.
- [71] Jacquie Ripat and Roberta Woodgate. 2011. The intersection of culture, disability and assistive technology. *Disability and Rehabilitation: Assistive Technology* 6, 2 (2011), 87–96.
- [72] Emma J Rose and Rebecca Walton. 2015. Factors to actors: Implications of posthumanism for social justice work. In *Proceedings of the 33rd Annual International Conference on the Design of Communication*. 1–10.
- [73] Marcia J Scherer. 1996. Outcomes of assistive technology use on quality of life. *Disability and rehabilitation* 18, 9 (1996), 439–448.
- [74] Amartya Sen. 2001. *Development as freedom*. Oxford Paperbacks.
- [75] Kristen Shinohara and Jacob O Wobbrock. 2011. In the shadow of misperception: assistive technology use and social interactions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 705–714.
- [76] Kristen Shinohara and Jacob O Wobbrock. 2016. Self-conscious or self-confident? A diary study conceptualizing the social accessibility of assistive technology. *ACM Transactions on Accessible Computing (TACCESS)* 8, 2 (2016), 1–31.
- [77] Tobin Siebers. 2008. *Disability theory*. University of Michigan Press.
- [78] Karin Slegers, Kristel Kouwenberg, Tereza Loučova, and Ramon Daniels. 2020. Makers in Healthcare: The Role of Occupational Therapists in the Design of DIY Assistive Technology. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 1–11.
- [79] Nancy Smith, Shaowen Bardzell, and Jeffrey Bardzell. 2017. Designing for cohabitation: Naturecultures, hybrids, and decentering the human in design. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. 1714–1725.
- [80] Thomas N Smyth, Satish Kumar, Indrani Medhi, and Kentaro Toyama. 2010. Where there's a will there's a way: mobile media sharing in urban india. In *Proceedings of the SIGCHI conference on Human Factors in computing systems*. 753–762.
- [81] Andrew C Sparkes, James Brighton, and Kay Inckle. 2018. 'It's a part of me': an ethnographic exploration of becoming a disabled sporting cyborg following spinal cord injury. *Qualitative research in sport, exercise and health* 10, 2 (2018), 151–166.
- [82] Ravi Sundaram. 2009. *Pirate modernity: Delhi's media urbanism*. Routledge.
- [83] Linnet Taylor. 2016. From zero to hero: How zero-rating became a debate about human rights. *IEEE Internet Computing* 20, 4 (2016), 79–83.
- [84] Maria Rosalia Vicente and Ana Jesus Lopez. 2010. A multidimensional analysis of the disability digital divide: Some evidence for Internet use. *The Information Society* 26, 1 (2010), 48–64.
- [85] Shujen Wang. 2003. Recontextualizing copyright: Piracy, Hollywood, the state, and globalization. *Cinema Journal* (2003), 25–43.

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