



# Digitally-Induced Altered States of Consciousness and Playful HCI: Future Research Agenda of a Novel Perspective

Anatolii Belousov  
anatolii.belousov@tuni.fi  
Tampere University  
Finland

Terho Ojell-Järventausta  
terho.ojell-jarventausta@tuni.fi  
Tampere University  
Finland

Mila Bujic\*  
mila.bujic@tuni.fi  
Tampere University  
Finland

Joseph Macey\*  
joseph.macey@tuni.fi  
University of Turku  
Finland

Juho Hamari  
juho.hamari@tuni.fi  
Tampere University  
Finland

## ABSTRACT

Due to the increasing availability and efficiency of digital technologies humanity has reached a point where digitally altering consciousness might become ubiquitous, echoing in all areas of the functioning of society. In addition to the already familiar functions in terms of conveying information, enabling experiences, and extending our realities, there is an emerging field of digitally-induced altered states of consciousness (DIAL). Precursors of the societal impact of DIAL technologies include various examples from bin-aural beats to video games that provide invaluable insights into forthcoming DIAL technologies.

Although individual changes in consciousness through digital means have been studied for decades, they have been limited to the reach of technology. We suggest the field DIAL denotes the class of all digital technologies exploited for inducing altered states of consciousness (ASC). It supports a focused and holistic approach to anticipating futures and astute actions. We highlight the need for a detailed and full-fledged examination by demonstrating existing and hypothetical examples of their impact on Political, Economic, Social, Technological, Environmental and Legal (PESTEL) contexts. Based on these reflections we outline a potential research agenda to elicit discussions within the interdisciplinary community.

## CCS CONCEPTS

• **Human-centered computing** → HCI theory, concepts and models; HCI design and evaluation methods; Interaction paradigms; Interaction devices; • **Social and professional topics**; • **Applied computing** → Media arts; Forecasting;

## KEYWORDS

Digital Drugs; Psychophysiology; Bioadaptation; Binaural Beats; XR; Psychedelic VR; Technoethics; Technoculture; Futures Research; Transhumanism

\*Both authors contributed equally to this research.



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## 1 INTRODUCTION

Novel digital technologies permeate and alter almost every area of our contemporary lives, in both expected and often unanticipated ways. Other than reshaping social practices and concepts of play, they also brought forth various opportunities and pitfalls, for example via persuasive technologies such as gamification, used to directly influence and motivate human behaviours [45], or to enrich mental well-being and expand creativity and perspectives mediated by play [33]. This landscape, however, is becoming increasingly complex and uncharted as more advanced technologies are permeating the consumer market, ushering in a new era of digitally-mediated experiences. For example, implementing biofeedback or even designing bioadaptive game systems is on the rise [13, 29]. Similarly, increasing numbers are turning to these novel advancements to enhance or augment natural physical and mental capabilities through biohacking. The movement is closely associated with the ideas of cybernetic organisms, transhumanism, and the quantified self which seek to utilise technology to augment, and even create entirely new, sensory experiences and capabilities [85]; practitioners are essentially seeking to reimagine and rebuild the human condition. Given the rate of technological development, it is not difficult to conceive a future in which digital products exist that bypass contemporary media formats in order to induce psychophysiological effects for users, specifically Altered States of Consciousness (ASC). Thus, we propose to use the preliminary term and DIAL (Digitally-Induced ALtered states of consciousness) to describe these emerging technologies and associated phenomena.

However, ASC is an elusive concept; there is no consensus on its boundaries and the adopted definition varies depending on the context or purpose of application. For example, a prominent perspective considers "altered" those states of consciousness when an individual "clearly feels a qualitative shift in his pattern of mental functioning" [79]. However, this definition can lead to conflicting interpretations since it is both too broad as an individual's impression of experiencing ASC does not necessarily indicate its occurrence,

and too narrow as not all recognised ASCs are recognised by individuals. This is particularly problematic as we can observe three distinct instances relevant to DIAL: whether the technology truly induces an ASC, controls the persistence or form of the ASC, or imitates the ASC experience through a representation. As such, the definition above fails to recognise instances when a technology deceives the senses and the individual is unable to distinguish between the experiences stemming from within themselves and those projected by the technology. Thus, instead of using the phenomenal state of consciousness as a basis for the definition, the following is adopted: ASC as a "state of the mechanisms of representation in the brain resulting in a global misrepresentational organisation of the overall contents of consciousness at some moment in relation to the surrounding ("world") context (in which they occur)" [70]. In other words, ASC occurs when an individual is in a state where their cognition misrepresents their inner states or the environment, regardless of whether they consider their consciousness to be altered. Most prototypical ASCs fit this definition, e.g. hallucinations and out-of-body experiences.

Taking into account the twin drivers of technological development and societal appropriation, an environment is created in which the development of digital products and services which directly induce psychophysiological effects, or ASC, in users is believable. Although the realisation of these technologies is unlikely to be imminent, it is a plausible and largely unexplored future. However, numerous speculative and creative imaginations of such scenarios establish a prominent cultural presence and fictional writings offer a commentary on the way in which such a phenomenon may be realised in future societies (e.g., [60]). Furthermore, currently existing proto-DIAL technologies, such as binaural beats (e.g., [66]) and video games (e.g., [22]), and the discourses around them already offer insights into an intriguing future of DIAL. Some of these technologies have already been grouped under the reductionist and misleading term *digital drugs* [6] which in itself colors the discourse and public reactions as a result of ideological or moral perspective, rather than scientific understanding [27]. On the other hand, its use demonstrates a reactive rather than informed and proactive approach to novel developments.

Given the scope and magnitude of the possible ramifications of DIAL, it is necessary to explore, understand, and anticipate the potential future scenarios. By having a range of such scenarios available it would become more likely that the implications of advancements would be assessed appropriately. Finally, a comprehensive multidisciplinary investigation of DIAL would enable both scientific and societal actors to adopt proactive positions with the goal of fostering an optimal relationship with these technologies. This work, therefore, aims to gain a more comprehensive understanding of the effects of digital technologies in mind-altering practices across various societal contexts. It is an exploratory and speculative work-in-progress, making no claims to be an extensive examination of all relevant issues. Instead, it is intended to both generate awareness of potentially revolutionary technological developments and to lay the foundations for a new area of research with significant implications for the future of playful experiences. As such, it is based on a bi-directional research question *What are relevant factors that might affect and steer developments of DIAL technologies and what*

*impact and consequences these developments of DIAL technologies might have on various societal factors?*

## 2 CURRENT STUDY

The PESTEL framework (Political, Economic, Socio-cultural, Technological, Environmental, and Legal contexts) [67, 86] is used to explore the broad field of DIAL as well as their antecedents, imaginations, and futures. Although PESTEL has primarily been used to analyse the macro-environmental factors affecting an organisation or industry, it is suitable due to its level of abstraction and consequent comprehensiveness. Accordingly, DIAL has been scrutinised by considering various signals of the futures [38] such as antecedents (proto-DIAL technologies; e.g., binaural beats), various predictions, speculative designs, and imaginations of the present and future (e.g., *Black Mirror*), and finally tangential developments (e.g., videogame loot boxes) that might inform the landscape. The study is foundational in opening a preliminary research agenda for disciplinary-agnostic discussions of futures at the intersection of playfulness, HCI, and DIAL.

Considering the technologies as the defining starting point, the discussion begins by examining how current technological developments and global trends might affect DIAL and, in turn, how potential implementations of DIAL technologies could affect the wider techno-landscape. Following are reflections on the Socio-cultural context and how the use of DIAL could interact with communities and societies more broadly, and how significant they might become in various cultural spheres. In the Political and Legal aspects, we discuss the potential interactions between DIAL and various political stances, and the regulation of DIAL. As an extension, the Economical aspect unpacks how DIAL could mesh with macro and micro economic factors alike. Finally, the Environmental aspect addresses implications of DIAL for the natural environment and sustainability, while also including built environments and systems.

## 3 EXPLORATION OF DIAL THROUGH THE LENS OF PESTEL

### 3.1 Technological context

Recent developments in consumer-grade advanced technologies and psychophysiology-related devices have already signaled the potential of DIAL. While extended reality (XR) applications currently dominate research at the intersection of human-computer interaction and ASC (see [40]), the increasing variety of consumer-friendly biofeedback and devices such as low-cost wireless EEG [82], create possibilities for more advanced and impactful DIAL solutions. These examples demonstrate that DIAL is currently closely connected with multi-use hardware and software, albeit there are examples of dedicated technology, e.g. transcranial magnetic stimulation ([19]) and lucid dream devices DreamLight, DreamLink, and NovaDreamer [3]. However, inducing dream-related ASC is shifting towards multi-use hardware [50] [43] [44].

Neural implants are an example of particularly interesting technology in the context of DIAL. Currently largely inaccessible, their use has mostly been limited to health (e.g., motor rehabilitation [36]) but there is notable interest in their development and bringing them to the consumer market (e.g., *Neuralink*). They can provide high spatiotemporal biosignal recordings ([17]) and deep brain

stimulation ([65]), functionalities that could revolutionise DIAL. Due to this and similar technologies slowly becoming a part of everyday life, they are likely to see increased interest from HCI, initially through speculative applications which then shape further developments. Although the early efforts (e.g., [32]) will likely primarily include *imitations* of DIAL akin to prototyping rather than fully-fledged true DIAL applications, they are a desirable and even necessary step in holistically preparing for the future.

As both inspirational and cautionary scenarios, similar to the aims of speculative design efforts [12], it would be prudent to systematically and critically examine existing representations of DIAL in popular fictional media. In the context of video games, a popular example is the *Black Mirror* episode "Playtest" (S3E2; 2016) where neural implants are used for distorting the perception of reality. Although the episode has been also read through the lens of socio-economic commentary [52], another perspective could focus on the technology and its capabilities and potential in various domains. This line of questioning and scenario-building is of significance particularly when considering our collective inability to reliably predict the future. Thus, whereas technologies discussed here are likely to be closely tied to future DIAL applications, perhaps even more pertinent is considering the extraordinary possibilities.

Anticipating the future, it is plausible that DIAL will be primarily dictated by technological developments of multi-use hardware and software. Domains such as health and well-being might be the first ones to significantly drive and shape the development of DIAL technologies [41], as indicated by the current interest in utilising new technologies on one hand and the renewed interest in psychoactive substances on the other. However, leisure applications could possibly be one of the dominant drivers as well, as historically seen through the video games industry and suggested by a strong exploratory experimental interest in playful experiences in the context of new technologies (e.g., [13]).

### 3.2 Socio-cultural context

We anticipate that the impact of DIAL technologies will primarily be notable in the socio-cultural context. As witnessed in the example of the history of interactive media adoption and use, communities and identities built around them play a significant role in how a phenomenon is both conceptualised and adopted (e.g., *Facebook's* announcement of Meta and metaverse), as well as how it replicates existing sociocultural inequalities and controversies (e.g. GamerGate [58]).

First, on an individual level, proto-DIAL technologies have seen a range of uses, whether deliberate or unintended. Video games and XR technologies have provided platforms for novel and often unexpected phenomena, from distorted perception of the environment (e.g., game transfer phenomena [22]) to altering how we perceive ourselves (e.g., Proteus effect [68] and self-counseling paradigm [76]) and others (e.g., VR embodiment and bias [5]). They have been used for well-being purposes, such as meditation (e.g., [64, 73]) and phobia relief through out-of-body experiences [9], but also for recreational examples as lucid dreaming stimulation [3, 23], awe-inducing or feeling connected with other [15, 31], or aiming for psychedelic-like experiences [40]. Experiences mediated through these technologies, despite the potential benefits, have not been

spared from the maladies of the environments they were created in (see Social Shaping of Technology theory [53]). Indeed, they continue to replicate similar inequalities, biases, and structures existing around us, perpetuating discrimination, prejudice, and distorted perspectives of, e.g., racial [11] and gender stereotypes [4], and heteronormativity [72]. This is further reflected in behavior towards other users, whether during the experience or outside it, and is being exacerbated by the proto-DIAL features, for example, VR embodiment can facilitate sexual harassment [77]. Thus, we can see strong signals of how the deeper and more meaningful impact of DIAL can offer prosocial potentials on one hand but also the perpetuation and even encouragement of attitudes and behaviours detrimental to both individuals and society at large.

Communities, however, can have significant impacts on their exploration as well as use. In the context of DIAL, it is relevant to address cyberdelic, biohacking, and transhumanism communities. They are often characterised by openness to experiences related to relevant technologies and knowledge exchange, sometimes also holding events to demonstrate new experiences that might elicit DIAL (e.g., [32]). These communities often emerge either as a response to a new technology, a values-driven group using technology as a tool, or a combination of the two. Moreover, they also appear as a form of resistance to current sociocultural and political circumstances; cyberdelic is an example of a counterculture movement in response to legislative restriction to psychedelic substances. Some, such as biohacking, predominantly remain as underground movements due to the legislative and ethical issues around do-it-yourself biotechnological modifications. Whilst there is some overlap between biohacking and transhumanism, the latter remains a broader philosophical movement built around transcending the human condition through the merging of technology and biology. Thus, it values optimal physical but also emotional, moral and even spiritual augmentation and development [57]. As an extension, technology itself can be conceptualised as constituting an implicit religion, that is, it is a site that has given rise to new belief systems, encouraging reflection on the nature of self, and can be fetishised to such an extent that it gives rise to quasi-religious discourse, including some associated with posthumanism [14].

In the context of creative industries, psychedelics have historically been important in supporting divergent thinking and inspiration [39] indeed, proto-DIAL have already been explored as creativity enhancers [69]. Experiences such as synaesthesia can both reimagine art [8] or for creating new forms [34]. New technologies tangential to DIAL have already paved the way for novel creative forms and interactions utilising gaze and BCI (e.g., [26, 84]), as well as to blur the lines between the self and the art (e.g., [71]), signaling the potential horizons in the futures of DIAL and creativity.

On the other hand, creative works can be used as rich sources of potential future scenarios of DIAL as well as for gauging public attitudes and discourses. A rich fiction corpus depicts various trajectories societies can take in light of new technologies, some of which are currently becoming a reality. Such narratives have persuasive power as they can formulate meaning and causality; a clearly presented causal chain is viewed as more compelling and more believable than information presented independently of such a supporting framework. Thus, it would be beneficial to engage with them in a two-fold manner, both drawing from them as fruitful



sources for foresight and discussion on one hand and creating them (e.g., through speculation) to further probe various aspects and implications of DIAL [7, 59].

### 3.3 Political and Legal contexts

When discussing the possible political challenges affecting the development of DIAL, it is useful to draw parallels with psychedelic drugs. In addition to potentially similar effects, DIAL technologies have similar applications; even recently we could observe the emerging moral panic around the issue [27]. Concerns about the spread of Digital Drugs in schools emerged in the United States in the 2010s. Unlike Saudi Arabia, no government restrictions were introduced because there was not enough evidence that binaural beats could cause drug-like effects. However, in 2010, the Oklahoma Bureau of Narcotics and Dangerous Drugs warned concerned parents that the use of Digital Drugs could spur curiosity and lead to attempts to try illegal substances [20]. Notably, however, some Chinese schools have used Psychedelic VR for the opposite purpose, demonstrating the effects of psychedelic drugs to deter students from using chemical psychedelics [78]. Which particular aspect or potential of this technology is presented for public judgment is crucial; for example, framing binaural beats as "digital drugs" determined the political discussion around these technologies in some Arab countries and led to strict measures to curb their spread and use [27]. While there do not seem to exist restrictive measures globally, there do appear to be more debates in public and legislative bodies than scientific investigations. The prominence and tone of the discussions, however, differ greatly according to the socio-cultural environment, signaling the need to account for religious, values and ethics systems.

Even if the technology is presented in an exclusively positive light, it is essential to consider and adapt the discourse according to the surrounding ideological currents. Perceived elitism, a sociocultural misfit, or an incompatible value system can greatly affect how DIAL is treated by the governments [83]. Moral panics can also sway public opinion and this narrative can be abused by those in power, as seen in debates around videogames' influence on aggression and mass shootings [28]. Furthermore, legislation, regulation, and oversight all depend on these factors. This is particularly problematic for emergent technologies such as DIAL where there may be little or no reference point to established institutions, products, or practices [48]. Other than regulations framed as safety measures, a strategy familiar from the context of psychedelic substances is harm reduction. It has become one of the central paradigms for approaching potentially problematic and addictive behaviors in the past decades [56], including for interactive media [51, 75]. It is bottom-up, advocating for users and decriminalisation of substances or practices often provides the necessary space for public discussions and implementing harm reduction [75].

It is then imaginable that the near-future expansion and likely global reach of DIAL will instigate familiar discourses [6]. Condemnation of technology and practices around them, particularly due to the challenging nature of potential mind alteration, the possible punitive legislation of their uses, and finally the tension between criminalisation and harm reduction. However, even with the example of binaural beats as a prelude to DIAL, there is an evident

lack of holistic scientific attention and investigation that could inform legislative and harm reduction practices and serve as a harm reduction strategy in itself.

### 3.4 Economic context

There are wide-ranging possibilities when speculating on the economic impact of DIAL technologies. Considering the current economics around proto-DIAL such as binaural beats [6] and VR, the current market appears to be primarily based on free access to content via streaming services and distribution platforms. However, as noted in the Technology aspect, more advanced examples of DIAL have been developed for the healthcare and wellness industries, are restricted by the governing bodies, and are significantly more expensive. Moreover, such advances are often likely never to reach the consumer market or domains such as leisure due to lacking profitability in the healthcare system, often caused by varying patenting practices between pharmaceutical and software-based products [49][10]. Therefore, significant technological and application advances in the field of DIAL that are economically accessible to wider society and do not deepen the digital divide require significant endorsement from the public sector or regulating for socially beneficial use.

Moreover, it has been suggested that a motivational factor for use is experiencing similar effects as those of recreational drugs [6]. This is unsurprising when taking into account that psychoactive substances are still predominantly illegal while practices such as microdosing, when small amounts of substances are ingested in order to boost creativity, productivity, and mental health without inducing fully psychoactive experiences [47], are increasingly widespread. Such motivations and diverse means of satisfying the users' needs signal a market demand for mental boosts either for leisure or work and study. However, as noted in the Legal context, despite the resurgence of psychedelics research and their relative destigmatisation in the public, not all societies are welcoming to potential DIAL. This further translates into the economic factor as restrictions often pave the way for illicit use and black-market trade (e.g., [35]). Thus, legal, regulatory, and economic perspectives will need to rely on understanding the effects of different DIAL technologies and applications and carefully consider the risk-benefit ratio.

### 3.5 Environment context

Finally, digitalisation of different aspects of life has raised concerns about the increasing need for data storage and the subsequent detriments to our natural environment due to high resource demands [55, 62]. About 80% of the data flow on the internet is in the form of visuals [74] and the early stages of DIAL applications, particularly related to XR, are likely to contribute to this number. Similarly, there is an increasing concern, on one hand, about the availability of computing hardware materials which might hinder the development and spread of DIAL technologies and, on the other, about the increased e-waste as digital devices become more ubiquitous [63]. Depending on how complex and data-driven DIAL technologies become, they might significantly add to the overall load put on the environment by digital technologies. However, some of these threats to our environment could be curbed with renewable energy

[61] and energy-efficient algorithms [1] and should be considered when developing or accepting any such device or application.

Akin to many other technologies, along with posing an additional environmental threat DIAL also holds the potential to contribute to our efforts toward sustainability. For instance, pharmaceutical psychedelics can lead to the disruption of ego that helps users to relate to others and the world and the feeling of being one with nature [42] or simply aid in education and attitudinal and behavioral changes similarly as with XR technologies today [15]. Perhaps DIAL technologies could provide safer and easier access to such experiences and be used to nudge [25] more sustainable lifestyles or aid in mental well-being by curbing climate anxiety, which is likely to be increasingly widespread [18].

Moreover, our built environments can both guide the use of DIAL technologies as well as be shaped by their form and use practices. Similarly as digitalisation has incited a reimagining of our everyday environments over the past decades, DIAL technologies could leave a deep mark on how we structure our spaces and systems. Signals of these potentials can be seen both in the recent paradigm shifts toward playfulness primarily in Western societies, as prompted by the rise of interactive media and video games in particular, generating playful reorganisation of spaces and activities that are traditionally seen as strictly serious (e.g., [2]), often in order to make them more pleasurable and engaging (e.g., [16]). Thus, it is not unimaginable that the potential penetration of DIAL technologies and applications in various domains will be enmeshed with how we organise our environments and their meanings for our lives (for an example of speculative cities in the broader context of transhumanism, see [80]).

#### 4 DIAL - A NEW RESEARCH FIELD

With the caveat of the novelty of the research field, and a conscious decision not to draw hard lines of what technologies or experiences are directly DIAL related, the reflections throughout the PESTEL framework depict a future brimming with potential for benefits as well as ramifications in all spheres of our lives. Considering the controversial sociopolitical status of psychedelic substances and other mind-altering means, recent societal lessons from (mis)use of new technologies, and the fast-paced development and commercialisation of devices that converge human biology and consciousness with digital technologies, DIAL and the term "digital drugs" emerge as a distinct fulcrum of interdisciplinary research agendas that should extend beyond the currently recognised scope.

We propose a comprehensive research agenda for a dual examination of DIAL encompassing sociological and technological dimensions. Our preliminary exploration has identified key technologies within this realm, denoted as proto-DIAL, possessing the potential to induce altered states of consciousness. By delving into user behaviour and motivations behind adopting these technologies, a deeper understanding of the socio-cultural drivers of the advancement and utilisation of DIAL can be achieved. Complementing this, we recommend tracking emerging technologies, such as advancing VR and neural implants, with prospective ASC-inducing capabilities. Speculations about possible technologies for ASC-inducing purposes serve as a foundation for envisioning potential societal ramifications of DIAL, informed by insights into user motivations.

This dual approach can construct a panorama of future scenarios about DIAL's societal implications. This work-in-progress paper constitutes the cornerstone of this endeavour, poised to facilitate the identification of existing knowledge gaps. In the future, this paper will be supplemented with data from interviews with experts and workshops tailored to each domain will form the basis for enhancing our comprehension of the societal factors influencing the implications and development of DIAL technologies.

Games and playfulness are of particular interest to DIAL due to a range of circumstances: they have close ties to proto-DIAL and the forefront of digital cutting-edge and speculative design, strong communities, and are extraordinarily versatile and pervasive in the everyday (from leisure to health and education). Thus, we propose the first future research agenda in playful HCI as a unique lens to appropriately examine, position, anticipate, and design DIAL. We suggest an interdisciplinary three-fold approach, as demonstrated through the PESTEL reflections, to holistically and critically investigate DIAL: a) systematically mapping the current proto-DIAL landscape, b) identifying emerging antecedents and tangential phenomena, and c) employing speculative design and futures research approaches.

*Mapping the landscape.* Examples of what we term proto-DIAL do not reflect its entirety either in terms of technologies or experiences they afford. As such, systematic reviews and classifications would aid in building appropriate terminology that guides future research. Moreover, meta-reviews of the effects of different forms of DIAL and their contrast with both psychedelic substances and digital experiences not previously considered as DIAL could aid in clearer conceptualisations.

*Antecedents and emergent DIAL.* Although, as shown, some designs directly aim at ASC-related experiences, DIAL should draw from a wider set of grounds for informing the field. As noted primarily in terms of videogame effects such as game transfer phenomenon [22] and Proteus effect [68], we have seen unexpected phenomena emerge from current interactive media that warrant further scrutiny through the lens of DIAL; particularly relevant is their potential future pairing with psychophysiological user data, creating, for example, impactful bioadaptive scenarios [13, 46]. These might not only be potentially directly harmful to users but also bring up privacy and other ethical issues (e.g., [24, 30, 54]). Similarly, (un)ethical design, regulation examples, and unintended translation of societal divides and of close phenomena would inform and guide our discussions and shaping of prosocial DIAL.

*Speculation and futures.* DIAL could particularly benefit from the rich speculative and participatory tradition in HCI, enabling not only playful explorations and creativity but also critical inquiry. Similarly, the existing rich corpus of fictional scenarios should be utilised in conjunction with speculative efforts. Moreover, futures research as an exploration and anticipation of potential future scenarios and their impact rather than prediction has predominantly been overlooked. Although close to speculation, its approach is relatively more grounded, based on signals from the past and present jointly with extensive stakeholders' involvement [21, 37].

Finally, as DIAL technologies and experiences can be expected to permeate the fabric of daily life, it is paramount that the future agenda does not include only actors from academia. Rather, it requires a joint approach and timely conversations involving an array

of industry, academic, and public stakeholders, from health and regulation to game designers and relevant communities. Dissemination should thus involve white papers, popular science communication, and other means of engaging and inclusive and prolific public discourse. This is particularly relevant when considering potential ethical issues around DIAL that require input from all niches of society, such as reinforcing the digital divide [81] and strengthening structural inequalities.

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