Smartwatches, AI, And The Three Faces Of Technological Determinism: A Marxist Critique Of Digital Capitalism

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Abstract*.*

This study explores the role of artificial intelligence (AI) in smartwatches through the critical lens of Karl Marx's theory of technological determinism. In contrast to functionalist and adoption-centered analyses, the research problematizes the ideological and socio-economic structures underpinning wearable technologies. The objective is to reinterpret smartwatches not as neutral innovations but as artifacts embedded in digital capitalism—functioning simultaneously as autonomous agents, social constraints, and political instruments. Employing a qualitative, conceptual methodology grounded in Marxist historiography and critical media studies, the research synthesizes canonical texts with contemporary scholarship on AI, surveillance, and labor. The results reveal that AI-powered smartwatches reinforce capitalist imperatives of productivity, data commodification, and self-discipline, ultimately contributing to behavioral governance and user alienation. This study offers a dialectical framework that exposes the myth of technological neutrality and reframes wearable AI as a site of ideological reproduction. It contributes to communication and technology studies by advancing a historically grounded critique of how digital devices shape, and are shaped by, class dynamics, capitalist rationality, and power structures.

Keywords: *Technological Determinism; Artificial Intelligence; Digital Capitalism and Marxist Media Theory.*

I.   INTRODUCTION

In recent years, the rapid development and diffusion of artificial intelligence (AI) technologies have sparked renewed debates about their implications for society, culture, labor, and power. Among the many AI-integrated devices populating everyday life, smartwatches have emerged as a powerful symbol of technological convergence—blending computation, communication, health monitoring, and personal assistance into a compact wearable form. These devices are not merely passive tools; rather, they actively reshape how users engage with their bodies, environments, and social networks. This phenomenon demands critical interrogation through a theoretical framework that accounts for both material infrastructures and ideological functions of technology.A growing body of research has examined the proliferation of AI-powered wearables and their socio-technical impacts, particularly regarding surveillance, data commodification, and behavioral prediction (H. U. Uzir et al., 2023) Smartwatches today are embedded with AI algorithms capable of collecting biometric data, interpreting emotional states, and offering predictive recommendations in real time. Such advancements have elevated the smartwatch from a simple timekeeping accessory to a bio-digital interface—one that increasingly mediates the user's relationship with health, labor, and identity. Despite the widespread integration of artificial intelligence (AI) into everyday technologies, particularly smartwatches, critical engagement with the political economy underpinning these transformations remains markedly underdeveloped. Much of the existing discourse remains confined to functionalist, behavioral, or design-oriented analyses, failing to interrogate the deeper structural forces driving and shaping technological innovation.

In response, this research deliberately positions itself at the intersection of technology studies, critical theory, and the political economy of digital capitalism, advancing a robust critique through the lens of Karl Marx's historical materialism and technological determinism. Marx did not regard technological change as an autonomous or linear process; rather, he theorized it as a product of and a vehicle for the evolution of productive forces, class relations, and capital accumulation (Marx, 1867). Within this framework, smartwatches are far more than utilitarian tools—they are ideologically charged technological artifacts that both reflect and reproduce the imperatives of capitalist rationality.By embedding AI-enabled wearables within this materialist conception of history, the research contends that their emergence,

proliferation, and popularization cannot be divorced from the socio-economic configurations and ideological structures that condition their existence. Smartwatches are not simply adopted because of their utility; they are embedded within a system that valorizes efficiency, productivity, and behavioral governance—values tightly bound to the logic of capital. As such, their design, development, and diffusion are implicated in broader processes of labor abstraction, data commodification, and subject formation. At the heart of this investigation lies a core conceptual challenge: the enduring dominance of technological determinism in contemporary discourse—that is, the assumption that technological change acts as a singular, linear force that drives social transformation in a neutral and unidirectional manner.

This perspective not only obscures the complex dialectical relationship between society and technology, but also mystifies the political interests and power relations embedded in the development and deployment of AI-driven devices. By confronting this deterministic fallacy, this paper seeks to reclaim a critical understanding of technology as both shaped by and shaping historical-material conditions, and thereby contribute to a more nuanced and politically engaged conversation about the role of AI in everyday life.While early techno-optimists hailed digital technologies as emancipatory forces, critical scholars now argue that these systems often reproduce existing inequalities and generate new forms of dependency and control (Zuboff, 2019) This is especially true for wearable technologies, where user agency is increasingly subordinated to algorithmic logics and corporate interests. Smartwatches, as AI-driven devices, represent a compelling case of what Dahlin (2023) calls technological autonomy—the idea that technology, once created, follows its own logic, independent of human control. This perception often fuels public fascination and policy inertia, allowing powerful technologies to evolve without adequate ethical or political oversight. The framing of AI as a self-driving force obscures the material conditions of its production and the socio-political choices embedded in its design. Thus, there is a critical need to deconstruct the "neutrality" of smartwatches and locate them within the historical dialectic of technology and capital.Marx's notion of technological determinism is more nuanced than simple causality; it emphasizes the dialectical relationship between productive forces and social relations. In capitalist societies, technological innovation often serves capital's need for efficiency, control, and surplus extraction.

As Antunes (2017) notes, machines under capitalism do not merely assist labor—they reorganize it, alienate it, and render it increasingly abstract. Smartwatches, by tracking bodily rhythms, regulating behaviors, and nudging users toward "productive" habits, mirror this dynamic in the digital age. Moreover, AI-infused smartwatches illustrate the commodification of the self—where personal data becomes a resource for capital accumulation. Companies monetize users' biometric and behavioral information under the guise of personalization and wellness. This process aligns with what Zuboff (2019) defines as surveillance capitalism, in which predictive data extracted from individuals is used not just to anticipate behavior, but to shape it. Marx's critique of alienation becomes increasingly relevant here, as the individual's body is fragmented into data points that feed opaque, profit-driven systems.In the context of digital capitalism, smartwatches also reflect a broader technological ideology that normalizes constant connectivity, self-optimization, and the internalization of surveillance. These devices promote a form of self-discipline akin to Foucault's notion of biopower, yet the structure of control is now embedded in everyday objects worn on the body. While marketed as tools for empowerment and efficiency, smartwatches subtly condition users to align with productivity norms and corporate values—mirroring Marx's analysis of ideology as the "ruling ideas of the ruling class." Despite their contemporary packaging, smartwatches inherit the logic of industrial machines. They enforce a rhythm of life measured not by natural or communal cycles but by algorithmic outputs and efficiency metrics. This echoes the temporal disciplining of workers in the industrial era, as described by Marx, where the machine dictated the pace of labor.

Today, the AI-powered smartwatch continues this legacy, regulating sleep, exercise, attention, and even emotion in pursuit of optimized living.Importantly, technological determinism does not merely describe how technologies impact society—it also shapes how society thinks about technology. The notion that AI and smartwatches are inevitable, apolitical, or purely beneficial depoliticizes technological development and forecloses alternative futures. As Müller (2020) warns, ethical critiques often lag behind technological advances, allowing corporate actors to frame the narrative. A critical, historically grounded approach is

essential to resist this fatalism and to reclaim technology as a site of political struggle and democratic possibility. Recent scholarship on wearable technologies has expanded significantly, particularly in response to the integration of AI systems in consumer electronics. Studies have highlighted the increasing role of smartwatches in personal health tracking, productivity optimization, and social communication (Krey et al., 2019) These devices are no longer seen as simple extensions of smartphones but are considered independent, AI-augmented interfaces with complex social and behavioral implications. However, such studies often treat these technologies through a consumer-behavioral or engineering lens.

A growing body of literature has explored the acceptance and adoption of smartwatches, emphasizing user attitudes, perceived usefulness, and social visibility. Uzir et al. (2023) examined smartwatch usage in Ghana and found that perceived usefulness and AI-enabled personalization significantly influence satisfaction and purchase intention. While such studies shed light on user behavior, they often sideline critical socio-economic implications such as surveillance, alienation, and labor discipline. Zuboff's (2019) landmark work on surveillance capitalism positions AI technologies—including smartwatches—as central tools for behavioral data extraction. In her view, digital capitalism has evolved into a system where data is harvested not merely for prediction, but for behavioral modification. Smartwatches, with their constant biometric monitoring and feedback mechanisms, serve this logic perfectly. However, Zuboff's analysis is primarily rooted in neoliberal critique and lacks a historical-materialist grounding in labor and production relations. In the realm of digital health, Müller (2020) raised ethical concerns about AI-driven systems, especially regarding emotion-recognition software, digital assistants, and human-mimicking AI in healthcare tools. While emphasizing normative issues and the need for democratic oversight, the discussion tends to frame AI's ethical risks in abstraction from economic and class structures. Dahlin (2023) explores the resurgence of technological autonomy discourse, especially in relation to AI. She argues that digital technologies are often perceived as self-evolving entities, creating a myth of inevitability that discourages critical intervention. This reinforces the classic form of technological determinism, where the social construction of technology is obscured.

Within the field of media and communication, wearable devices are increasingly analyzed through interface studies and media materiality. Scholars have observed how smartwatches condition user behavior through haptic feedback, visual alerts, and embedded gamification (Cunningham et al., 2020) Yet, these micro-level analyses often miss the macro-level implications of who designs these interfaces, for whom, and to what economic end. Research on digital labor has critically examined how platforms extract value from user interaction. Terranova (2020) and others argue that even non-waged activities—such as using apps or interacting with devices—generate surplus value. Smartwatches, by continuously collecting user data, extend the boundaries of labor into biometric and affective domains. However, little research links these insights directly to AI wearables. There has been growing concern in critical algorithm studies about the opacity of AI decision-making and its social consequences. Eubanks (2019) and others warn that algorithmic systems risk reinforcing structural inequality through bias and lack of transparency. While these critiques are urgent, they often emphasize outcomes rather than the conditions of technological production. In studies of digital embodiment, scholars have examined how wearable tech reconfigures the human body as a site of data extraction, control, and optimization (Lupton, 2021a) Smartwatches, in particular, produce new bodily regimes by quantifying health, sleep, and activity. While these studies often draw from Foucault, they tend to treat power as dispersed and ubiquitous, sidelining capitalist class dynamics. Sociological studies have also examined how consumer technology is normalized in everyday life. Studies by Rauschnabel et al. (2020) and others show how smartwatches become embedded in users' routines, identities, and status performance.

While helpful in understanding cultural acceptance, these approaches rarely interrogate how capitalism manufactures needs and shapes desire for such technologies. Technological determinism itself has been re-evaluated in recent years. Bimber (2021) critiques simplistic versions of the concept and calls for a more pluralistic understanding. Scholars have debated whether technologies shape societies or vice versa, often landing in post-structuralist or constructivist camps. However, few contemporary works revisit Marx's original dialectical view, where productive forces and social relations evolve together. AI research in global contexts is expanding, highlighting how technology adoption is shaped by culture, infrastructure, and

political economy (H. U. Uzir et al., 2023) However, many of these studies remain regionally descriptive and don't fully engage with the deeper historical-materialist underpinnings of global tech diffusion. This research also build upon theoritical foundation as below:
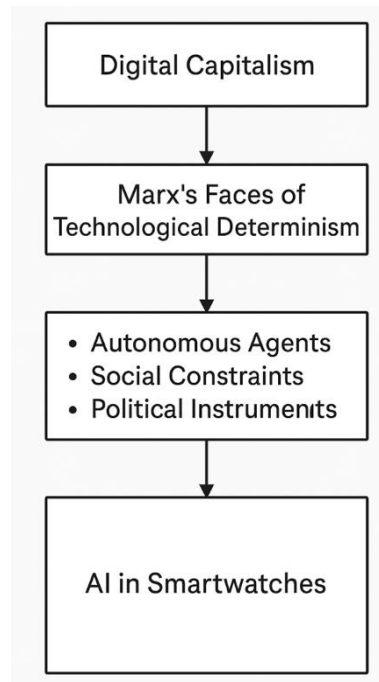
Fig 1. Theoritical Framework of AI in Smartwatch (Source: researchers)

The theoretical framework illustrated in the diagram is grounded in a Marxist interpretation of technological determinism and is designed to critically analyze the role of AI in smartwatch development within the broader structure of digital capitalism. At the top of the framework lies digital capitalism, a socio-economic system characterized by the extraction of data, the commodification of digital labor, and the expansion of surveillance infrastructures (Zuboff, 2019). Within this context, technology is not neutral or autonomous; it is shaped by capitalist imperatives, often reinforcing existing power structures and class relations (Terranova, 2020). The second layer draws from Karl Marx's three faces of technological determinism, which this study employs as an interpretive lens: (1) technology as an autonomous force, (2) technology as a social constraint rooted in capitalist production, and (3) technology as a political instrument for social reconfiguration. These dimensions reveal how AI-powered smartwatches can appear simultaneously as inevitable innovations, as disciplinary tools of labor and health management, and as ideological instruments that sustain capitalist rationality (Dahlin, 2023). The intermediary layer in the framework—"Autonomous Agents," "Social Constraints," and "Political Instruments"—captures these three determinist dimensions, emphasizing the dialectical nature of technology and society. Finally, the base of the framework focuses on AI in smartwatches as a concrete technological artifact through which these forces manifest. Smartwatches are thus examined not merely as devices, but as material sites of capitalist logic, embodying and extending the operational goals of digital capitalism through surveillance, behavioral conditioning, and the commodification of biometric (Müller, 2020; H. H. Uzir et al., 2023).

This integrated framework provides a politically engaged and historically grounded perspective to analyze how wearable technologies contribute to the reproduction of capitalist structures, while simultaneously offering a platform for critical resistance and theoretical intervention.Despite the widespread integration of artificial intelligence (AI) into everyday technologies, particularly smartwatches, critical engagement with the political economy underpinning these transformations remains markedly underdeveloped. Much of the existing discourse remains confined to functionalist, behavioral, or design-oriented analyses, failing to interrogate the deeper structural forces driving and shaping technological innovation. In response, this research deliberately positions itself at the intersection of technology studies, critical theory, and the political economy of digital capitalism, advancing a robust critique through the lens

of Karl Marx's historical materialism and technological determinism. Marx did not regard technological change as an autonomous or linear process; rather, he theorized it as a product of and a vehicle for the evolution of productive forces, class relations, and capital accumulation (Marx, 1867). Within this framework, smartwatches are far more than utilitarian tools—they are ideologically charged technological artifacts that both reflect and reproduce the imperatives of capitalist rationality.

By embedding AI-enabled wearables within this materialist conception of history, the research contends that their emergence, proliferation, and popularization cannot be divorced from the socio-economic configurations and ideological structures that condition their existence. Smartwatches are not simply adopted because of their utility; they are embedded within a system that valorizes efficiency, productivity, and behavioral governance—values tightly bound to the logic of capital. As such, their design, development, and diffusion are implicated in broader processes of labor abstraction, data commodification, and subject formation.At the heart of this investigation lies a core conceptual challenge: the enduring dominance of technological determinism in contemporary discourse—that is, the assumption that technological change acts as a singular, linear force that drives social transformation in a neutral and unidirectional manner. This perspective not only obscures the complex dialectical relationship between society and technology, but also mystifies the political interests and power relations embedded in the development and deployment of AI-driven devices. By confronting this deterministic fallacy, this paper seeks to reclaim a critical understanding of technology as both shaped by and shaping historical-material conditions, and thereby contribute to a more nuanced and political.The central research problem that motivates this study is the persistent reliance on technologically deterministic frameworks in explaining the role of artificial intelligence (AI) in consumer technologies—particularly smartwatches. Much of the current scholarship either overemphasizes the functionality and adoption behavior of smartwatches or presents AI as a neutral, apolitical force driving innovation.

These approaches tend to overlook the structural power relations and ideological assumptions that shape the development, deployment, and normalization of AI-enhanced wearables. This research interrogates the myth of neutrality embedded in technological progress narratives by applying a Marxist critique that views smartwatches not as value-free tools but as material articulations of capitalist rationality, deeply intertwined with labor commodification, surveillance, and ideological control. By shifting the analytical focus from technology's functions to its socio-political formations, the study seeks to reveal the hidden mechanisms of power and inequality embedded in the evolution of AI wearables.In addressing this problem, the primary objective of this study is to reconceptualize AI-driven smartwatches as ideologically charged artifacts by employing Karl Marx's three faces of technological determinism. The study aims to (1) analyze how AI-smartwatches are discursively and materially framed as autonomous agents of change; (2) investigate the socio-economic constraints that influence their production, design, and consumer adoption; and (3) critique how these devices serve as political instruments reinforcing capitalist ideologies of efficiency, self-regulation, and productivity. This layered analytical framework enables a dialectical reading of technology and society, bridging gaps between critical theory, digital capitalism, and communication studies.

Furthermore, the study contributes to contemporary discussions on AI ethics and governance by situating them within the material conditions of technological production, rather than abstract moral codes alone.The novelty of this research lies in its integration of historical materialism with critical media studies to unpack wearable AI. While existing research often focuses on user acceptance or technical innovation, this study offers a historically grounded and politically engaged framework that highlights how AI in smartwatches reflects and reproduces capitalist logics of control, discipline, and data commodification (Couldry & Mejias, 2019). By framing smartwatches as sites where class, labor, and ideology intersect, the study not only fills a theoretical gap but also opens new pathways for critiquing the socio-political stakes of AI in everyday life. This framework contributes to the emerging scholarship on "data colonialism", where the human experience itself becomes raw material for capital accumulation. In doing so, the research aims to reframe debates about AI and smart technologies away from abstract innovation toward the material politics of their development and usage.

II.   METHODS

This study adopts a qualitative, conceptual, and theoretically grounded approach to examine how AI-powered smartwatches function as technological artifacts within the structure of digital capitalism. Rather than relying on empirical data collection, the research utilizes critical textual analysis and conceptual synthesis, rooted in Marxist historiography and critical theory. This methodology is aligned with the objectives of the study, which seeks to expose how seemingly neutral technologies are shaped by historical material conditions, ideological structures, and capitalist production imperatives (Marx, 1867; Zuboff, 2019). The research follows an interpretive-descriptive design that bridges theoretical traditions in critical media studies, technology philosophy, and political economy. It engages in a historical-materialist reading of both classical texts—particularly Marx's Capital—and recent theoretical interpretations of AI, surveillance capitalism, and wearable technology. This approach supports a dialectical understanding of technological development, one that recognizes technology as both a product of socio-economic forces and an active agent in reshaping those forces (Dahlin, 2023; Terranova, 2020). The primary analytical framework employed in this study is based on Marx's theory of technological determinism, specifically his "three faces" of determinism: (1) the belief in technological autonomy, (2) the understanding of technology as shaped by social constraints, and (3) the interpretation of technology as a political and ideological instrument. These categories serve as analytical entry points to interpret the socio-political role of smartwatches in capitalist systems.

As Dahlin (2023) argues, the myth of technological autonomy is pervasive in digital cultures, often concealing the real social forces behind technological development. This study expands upon that critique by connecting it to labor, class relations, and commodification processes inherent in wearable technologies. To construct the theoretical foundation of this study, the first category of data draws from canonical Marxist texts, particularly Das Kapital (Marx, 1867) and The German Ideology. These foundational works provide the conceptual framework for understanding technology not as a neutral instrument of progress, but as a material expression of capitalist social relations. In Das Kapital, Marx presents the dialectical interplay between the forces of production and social relations, which this study applies to the development and deployment of AI in smartwatches. These texts offer a powerful critique of how machinery, labor, and commodity production function under capital, which directly informs this paper's analysis of how wearable technology mediates both economic value and ideological reproduction. Marx's emphasis on alienation, surplus value, and labor abstraction guides the interpretation of smartwatches as digital instruments that extend capitalist control into bodily rhythms and everyday life. Thes econd set of data consists of contemporary academic literature, specifically works published from 2019 onwards, which offer empirical and theoretical insights into AI technologies, surveillance capitalism, and wearable devices. For instance, Uzir et al. (2023) explore user acceptance of AI-driven smartwatches in Ghana, identifying factors such as perceived usefulness, AI personalization, and digital trust as key to adoption—factors that this study reinterprets through a Marxist lens as mechanisms of ideological compliance and behavioral control. Müller (2020) contributes to the ethical discourse surrounding AI and robotics, highlighting the tension between automation and human agency.

Similarly, Dahlin (2023) critiques the narrative of technological autonomy that surrounds AI discourse, arguing that such myths obscure the political choices and economic structures underlying technological change. These scholarly works provide the current context needed to position smartwatches within the evolving AI landscape and to critique the dominant ideologies that frame them as benign innovations.The third category of data includes industry reports and market research that contextualize the proliferation of smartwatches and related AI technologies within global digital capitalism. These sources include consumer behavior studies, product adoption metrics, and forecasts on AI integration in wearables. For example, Rauschnabel et al. (2020) examine the symbolic and utilitarian values of smartwatches, demonstrating how fashion, visibility, and technological sophistication drive consumer perception. Zuboff (2019) frames such market dynamics within the broader structure of surveillance capitalism, where behavioral data is extracted, commodified, and used to shape future behavior. This research benefits from these insights by not merely referencing adoption trends but by interpreting them as reflections of capitalist

commodification, where even bodily data becomes a source of profit. Taken together, these data sources enable a robust synthesis that connects classical theory to empirical observation, allowing for a historically informed and politically engaged analysis of AI in smartwatches..

Additionally, this research employs a conceptual case study approach focused on smartwatches as an illustrative and symbolic technological artifact. The case study is not empirical in the traditional sense; instead, it is used as a heuristic device to explore how capitalist logic materializes through digital devices. Smartwatches are examined for their AI-driven functionalities—such as biometric monitoring, emotion recognition, and predictive feedback—and how these are embedded within broader systems of surveillance, data commodification, and labor discipline (Lupton, 2021a) The case study operationalizes the theoretical framework by mapping the three faces of technological determinism onto the development and deployment of smartwatch technologies, particularly in their dual role as consumer gadgets and ideological tools.The validity of this methodology lies in its consistency with Marxist critical traditions and its ability to generate meaningful, politically engaged insights into how technology functions within capitalist systems. Unlike empiricist methodologies that seek causal generalization, this approach is reflexive, interpretive, and historically grounded—designed to expose the ideological assumptions that underlie dominant narratives about technology and innovation. However, the methodology is not without limitations. The absence of user-level empirical data limits insights into individual experience. Moreover, this conceptual focus may overlook granular technical distinctions between smartwatch models or brands. Nevertheless, the critical strength of this approach lies in its ability to interrogate the underlying social forces that shape the development and use of AI technologies in everyday life.

III.   RESULTS AND DISCUSSION
Historical Context of AI Development

The first conference on artificial intelligence (AI) was held in 1956 at Dartmouth College in the United States, marking the formal establishment of AI as a distinct field of inquiry. Early developments, such as automated reasoning and chess-playing programs, began to emerge in the 1960s. However, the field remained mostly theoretical until the 1990s, when the exponential growth of Internet infrastructure and computational resources enabled the collection of massive datasets, paving the way for real-world AI applications (Ahmed et al., 2021; Zhang, 2023) The most widespread applications of AI today include the processing and analysis of large volumes of unstructured data—particularly in images, videos, and text—supported by advancements in deep learning and neural networks (Alzubaidi et al., 2021) These tools have reshaped not only technical capabilities but also social, political, and economic structures.In recent years, AI has found a home across a range of industries including healthcare, finance, security, transportation, and smart city planning. Its commercial potential has driven significant private and public investment (Chatterjee et al., 2020). To increase AI's reliability, models are now equipped with techniques such as noise-aware and outlier-aware attention mechanisms, which help manage annotation uncertainty and data imbalance. Despite these technical gains, scholars note that many deep learning models remain "black boxes", with incomplete understanding of their internal logic and decision-making processes (Castelvecchi, 2021). Consequently, AI developers face major challenges in building platform-agnostic, distribution-invariant systems that generalize across environments—a problem that underscores both the power and fragility of current AI (Zhang, 2023). Initially grounded in symbolic logic and rule-based systems, AI was envisioned as a domain where machines could emulate human reasoning.

However, early expectations often clashed with technological limitations, leading to periods of stagnation famously referred to as "AI winters" (Russell & Norvig, 2020). The recent revival of AI interest has been driven not by the re-emergence of symbolic reasoning, but by the success of data-driven, machine learning (ML) methods, particularly deep learning. This paradigm shift—from symbolic to statistical AI—was enabled by the confluence of big data, increased computational power, and algorithmic innovation (LeCun et al., 2019). The sustained investment by governments and corporations globally has re-positioned AI as a general-purpose technology, with far-reaching implications across sectors such as healthcare, logistics, finance, and national security (Brynjolfsson & McElheran, 2019). Contemporary AI systems are

built on neural networks that mimic certain aspects of the human brain, allowing machines to recognize images, process language, and make decisions based on probabilistic reasoning. Unlike early AI, which was brittle and context-specific, today's deep learning models are characterized by their scalability, adaptability, and capacity to self-optimize through massive training datasets. However, with this capability comes significant opacity. Deep learning models are often criticized as "black boxes" because of their inscrutable internal processes, making them difficult to interpret and audit (Doshi-Velez & Kim, 2017). Furthermore, researchers have raised ethical concerns about AI's bias, accountability, and potential for social harm—particularly in predictive policing, credit scoring, and health diagnostics—where opaque decisions can reinforce systemic inequalities (Morley et al., 2021).

These concerns have catalyzed a new subfield known as explainable AI (XAI), which seeks to make algorithms more transparent and trustworthy. Though the technical literature on AI is extensive, there remains a lack of comprehensive historical understanding accessible to the broader public and even many researchers. The trajectory of AI is often misunderstood as linear progress, obscuring decades of setbacks and methodological dead ends. Much of its evolution has been shaped not just by technological innovation but by shifting epistemologies, funding priorities, and geopolitical conditions (Hern, 2020). While the symbolic logic tradition dominated early AI research—where mathematical proofs and abstracted models were central—modern AI has moved toward probabilistic learning and massive data-driven training, sometimes at the cost of interpretability (Samek et al., 2021). Understanding this historical and epistemological evolution is essential for evaluating AI's societal impacts and future directions. The rapid advancement in bionic systems and embedded AI technologies has catalyzed the proliferation of smart, interconnected devices ranging from small-scale wearable products like smartwatches and smart glasses to large-scale embedded systems such as smart home appliances and autonomous healthcare monitors. These intelligent devices are increasingly capable of self-learning, adaptive reasoning, and autonomous decision-making, mimicking human sensory and cognitive functions to monitor the environment, track behavioral patterns, and facilitate self-evaluation in real time (Alshurafa et al., 2020; Zhang, 2023). The integration of biofeedback and biometric recognition enables these tools to engage in continuous life-logging and health assessment, supporting applications in preventive medicine, elder care, and personal well-being. Their design relies on the fusion of multimodal data streams—from physiological inputs to environmental signals—making them capable of interpreting complex scenarios and generating personalized responses across multiple domains (Alavi et al., 2021).

This evolution has led to the emergence of Cognitive AI systems, which are not merely task-execution platforms but are designed to simulate higher-order cognitive processes such as perception, inference, understanding, and mindfulness. Cognitive AI architectures are constructed through AI decomposition techniques that break down complex cognitive activities into manageable components, supported by collaborative software-hardware platforms and standards across multiple industries (Zhang, 2023). These systems rely on cross-domain swarm intelligence—a networked integration of human and machine knowledge—designed to enhance decision-making, pattern recognition, and human-machine collaboration. In such frameworks, AI agents share data, refine models collectively, and engage in continuous knowledge production and dissemination, helping facilitate intelligent behavior in uncertain environments (Lu et al., 2020). However, these advancements bring critical challenges. The computational speed, scale, and autonomy of these devices far exceed the cognitive processing capacity of the human brain, leading to systems that are often opaque, unpredictable, and difficult to govern (Castelvecchi, 2021). In addition, the operation of these AI-enhanced bionic systems challenges classical assumptions about causality, logic, and interpretability, especially when their algorithmic decisions deviate from expected human reasoning or cultural norms. Scholars have raised concerns regarding the epistemic trustworthiness of such systems, especially in life-critical fields like healthcare or security, where machine misinterpretation can have serious ethical implications (Samek et al., 2021; Tjoa & Guan, 2021). As these devices blur the lines between subjective human observation and objective digital reasoning, ensuring semantic coherence, accountability, and safety compliance becomes a central concern for researchers and developers alike.
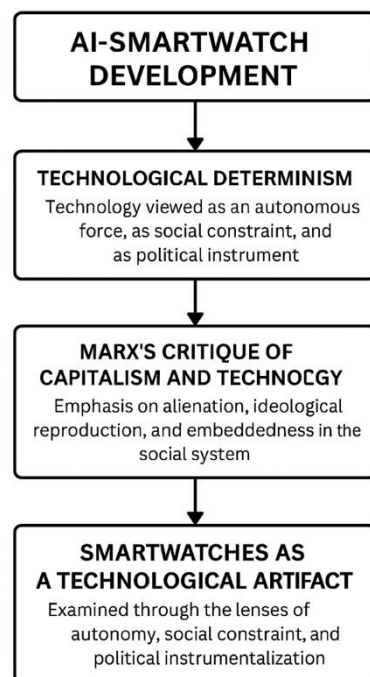
Analysis of Technological Determinism

Marx's theory of technological determinism presents technology not merely as an outcome of human ingenuity but as an instrument deeply entangled in the dialectical progression of historical materialism. The first analytical face of technological determinism — technology as autonomous force — reflects the modern narrative that AI systems, once developed, evolve independently of their creators' control. This narrative persists in today's AI debates, particularly with opaque machine learning models that "learn" behaviors and associations not explicitly programmed by developers (Raji et al., 2020). Marx's insights anticipate this condition, arguing that capitalist forces allow technologies to evolve along paths driven not by human needs but by profit motives, often creating unforeseen socio-economic consequences. The first face — technology as possessing its own teleology — resonates with the contemporary idea of technological "black boxes." AI systems like GPT models or autonomous vehicles develop decision patterns that even their engineers struggle to fully understand, embodying what Marx predicted as the alienation of labor through machinery (Burrell, 2019). This autonomy, however, is ideological in nature. It masks the reality that these technologies are designed within capitalistic structures that prioritize efficiency and control. The myth of autonomy, as Dahlin (2023) argues, contributes to public complacency, reinforcing the idea that technology simply follows its own inevitable evolution, rather than reflecting deliberate economic and political interests. The second face of technological determinism describes technology as constrained by — and constraining — social forces.

Technologies such as smartwatches are not produced in a vacuum; they are designed and marketed to fit into lifestyles built on surveillance, productivity, and consumption. Here, Marx's notion of "the social relations of production" becomes relevant: smartwatches are embedded in systems that commodify user behavior and biometric data (Couldry & Mejias, 2019). Their design — always on, always collecting — reflects not just user convenience, but a logic of data extraction and behavioral governance. This demonstrates how technology both arises from and reinforces capitalist structures. The third face of technological determinism concerns the political instrumentalization of technology. AI-enhanced smartwatches offer rich terrains for behavioral modification, nudging users to walk more, sleep better, or manage stress — all while feeding data into corporate algorithms. These mechanisms are not neutral; they shape subjects in ways aligned with capitalist productivity goals. This aligns with Zuboff's (2019) concept of surveillance capitalism, where data is not merely collected, but mobilized to engineer future behavior. Marx's analysis helps expose this hidden function: technologies operate not only as tools, but as active agents of ideological reproduction and social control. Marx's critique of alienation finds a digital echo in the use of AI devices like smartwatches. These gadgets quantify and externalize bodily functions, turning lived experiences into data commodities. Workers may become alienated not only from their labor but from their own bodies, now tracked and optimized for productivity. Studies in digital health culture reveal how such technologies often lead to self-surveillance, where individuals internalize capitalist metrics for health and wellness, effectively governing themselves (Lupton, 2021).

This reframes Marx's alienation theory into a digital context, showing how the body itself becomes a site of capital accumulation. Smartwatches are not merely digital tools; they are ideological artifacts that embody and reproduce dominant social logics. Their sleek design and emphasis on self-optimization reflect the neoliberal imperative of individual responsibility, masking systemic health and labor inequalities. Their mass appeal lies not only in their utility but in their symbolic association with modernity, control, and success. As Marx noted, commodity fetishism occurs when social relationships are obscured by the object's appearance — and smartwatches exemplify this, presenting technological advancement while concealing their role in extending capitalist surveillance (Fuchs, 2020). The proliferation of AI in smartwatches illustrates the dialectical relationship between technology and labor. On one hand, these devices enhance user productivity and health tracking. On the other, they impose a new labor regime where time, steps, calories, and sleep are constantly measured. As Terranova (2020) emphasizes, this represents "free labor," where users generate value through their data and behavior without compensation. This tension — between empowerment and exploitation — is central to understanding smartwatches through a Marxist lens, where tools of convenience become sites of commodified life. Marx's idea of embeddedness — that technology

cannot be separated from its social context — challenges current narratives around neutral innovation. Smartwatches, and AI in general, are not apolitical; their development reflects choices made within unequal power structures.

The appearance of personalization hides the fact that these technologies enforce normative behavioral patterns, often aligned with Western, capitalist, and heteronormative ideals. As Noble (2018) argues in her work on algorithmic bias, technologies often reproduce and exacerbate existing inequalities, reinforcing racial, gendered, and class-based disparities even as they promise neutrality.The three faces of technological determinism also provoke reconsideration of what constitutes technological progress. In contrast to techno-optimist narratives, this study aligns with a critical-progressive vision: one that recognizes innovation must serve collective good rather than capital expansion. Emerging calls for degrowth and ethical design in AI reflect this sensibility. Instead of viewing AI-enabled smartwatches solely as advancements, this analysis insists on evaluating whose interests they serve, what subjectivities they shape, and what labor they demand — both from users and behind-the-scenes supply chains (Eubanks, 2019) Marx's framework invites us to reimagine AI not as an inevitable endpoint of technological evolution, but as a field of political struggle. The smartwatch, as both a consumer product and a surveillance apparatus, embodies the contradictions of digital capitalism. It mediates between labor and leisure, empowerment and control, utility and ideology. Through this lens, we see that AI does not just automate—it restructures power. As AI continues to evolve, Marx's faces of technological determinism offer an essential toolset for critically navigating its social consequences and reclaiming technology for democratic ends.

Fig 2. Analysis of Tehnology Determinism (Source: researchers)

Smartwatches as a Technological Artifact

Technological artifacts such as smartwatches exist within a deeply entangled matrix of materiality, social utility, and symbolic value. Unlike the reductionist perspectives often associated with hard or soft technological determinism, which regard technologies either as autonomous agents of change or as passive tools shaped by social needs, the reality is considerably more nuanced. Smartwatches exemplify this complexity. These wearable digital devices offer continuous connectivity, biometric monitoring, and user-friendly interfaces, positioning themselves as both extensions of smartphones and as independent communication hubs. The deterministic view that such artifacts either control or are controlled by society is insufficient to grasp their dual role as both shaped by and shaping their socio-technological context. As Lu and Liu (2021) argue, wearable technologies introduce new forms of social relations that cannot be understood purely through linear cause-effect frameworks.The application of Marx's dialectical materialism to smartwatches facilitates a more critical engagement with how these devices mediate and restructure

everyday life. Marx understood technological development as intertwined with the economic base, yet not as a unidirectional force. Smartwatches, when viewed through this dialectical lens, appear not merely as instruments of convenience or innovation but as manifestations of capitalist logic in wearable form.

As Fuchs (2022) observes, digital technologies reproduce the material conditions of surveillance capitalism, wherein data collection becomes embedded in personal routines under the guise of utility and wellness. The smartwatch, then, functions as both a commodity and a disciplinary device—encouraging users to monitor productivity, health metrics, and digital notifications, thus reinforcing ideologies of self-optimization and datafication.Smartwatches also complicate traditional modes of interaction with technology. Unlike smartphones, which rely on tactile engagement, smartwatches emphasize glanceability—an always-on awareness that blurs the line between voluntary use and passive surveillance. This affordance invites a reconsideration of visual discipline, where users are not just active participants but also subjects constantly exposed to potential observation—either by algorithms, apps, or social norms. The question thus emerges: who watches the wearer of the smartwatch, and how does the gaze become internalized? This builds upon Ruckenstein and Dow Schüll's (2023) concept of "digital self-management," where individuals increasingly regulate their lives according to the imperatives encoded in wearable interfaces. Moreover, smartwatches are not purely utilitarian devices—they carry significant aesthetic and symbolic weight. Much like traditional wristwatches functioned as markers of class or taste, modern smartwatches participate in the reproduction of social distinction. The branding strategies of companies like Apple and Samsung foreground exclusivity and design, aligning their products with luxury lifestyles and techno-futurism. These objects thereby serve dual purposes: they are tools of communication and health surveillance, and also signifiers of cultural capital.

As Chan et al. (2020) highlight, the value of wearables often extends beyond technical utility, encompassing performative aspects of identity, prestige, and even morality in health-conscious cultures.This performativity aligns with Bourdieu's theory of distinction, but with a Marxian inflection: smartwatches become sites of alienated labor and consumption, as the user performs constant micro-labor—checking, syncing, tracking—while data capital is extracted invisibly by tech corporations. Through this, the smartwatch user participates in their own commodification, as their biometric and behavioral data become assets in a broader economy of predictive analytics (Zuboff, 2019). Far from being neutral tools, these devices materialize the contradictions of digital capitalism: they promise autonomy while deepening dependency, they offer personalization while promoting standardization, and they suggest health empowerment while reinforcing surveillance norms. The social reception of smartwatches also reveals a shift in the perceptual framework of what constitutes a "useful" technology. Their rise is not only linked to their technical capacity but also to cultural imaginaries of productivity, fitness, and digital integration. In this sense, smartwatches do not merely respond to social demand—they produce it. As Pantzar and Ruckenstein (2019) argue, wearables reconfigure how individuals interpret bodily sensations and performance, translating these into quantifiable metrics that feed back into user behavior. Thus, the device becomes part of a feedback loop of self-surveillance and capitalist rationality.In short, smartwatches operate at the intersection of ideology, economy, and embodiment. They are not passive reflections of technological progress nor deterministic forces driving social evolution; rather, they are dialectical artifacts—emerging from specific capitalist conditions and simultaneously reshaping those conditions through new forms of labor, consumption, and self-relation.

A Marxian approach does not merely critique their function but reveals the underlying structures of power and production that render such artifacts socially meaningful and economically exploitable in the first place.The discourse about the implications of the diffusion, development, and use of artificial intelligence (AI) in smartwatches can be framed through the lenses offered by the work of Karl Marx, specifically in regard to the three applications of technological determinism. This entails considering the potential implications of AI in smartwatches with respect to its diffusion and use; considering the implications of AI in smartwatches with respect to their design and production; and considering the implications of AI in smartwatches with respect to their character. Considering all three applications of technological determinism, there are some hints that the use of AI in smartwatches might have wider social and institutional

implications. The following discusses how the analysis of smartwatches can be extended using some of the notions derived from the work of Marx on the implications of technological change via the social-experimental method. There is an array of affordances and the potentiality of diffusion and use of AI in smartwatches that go beyond assisting individuals in coping with blind algorithms and taking care of health issues.

These potential affordances/implications involve ways of working with time, events, and information; ways of configuring a social and institutional reality; ways of configuring economic and technological conditions; configuring and engineering the monitoring of social, individual behavior, and social relations; configuring economic and financial stakes that would override fate; counteracts individuality; and denaturalizing social relations, institutional arrangements and long-standing practices. These implications require extensive envisioning and considerations in narratives and scenarios, and more extensive empirical explorations. The notion of pathways could be relevant within this larger horizon (H. U. Uzir et al., 2023).Marx wrote that 'in the invention of machinery a rust; in the automatic weaving sun, means, never had boughs, trunk or bark' (Fernando Rocha Antunes, 2017). The same occurred with watches, which having perfected machinery, were multiplied 'by this marvelous artifice', invented by the Americo strangers and first tried, tried and turned inside out by the artistry of the French. This passage suggests how watches reassembled themselves into a complex machine and produced themselves, without labor or alternative forms of production, but nevertheless obeyed the determined course of machines. Just look at it today, once more a sprocket in this mechanism, to see everything over here. Just listen to the automatic, almost consequential rigmarole of automatic distraction, when all the parts are in sync with one another. Social consequences on the development of society by market modalities are so profound and widespread that study or respect of every chain hypothesis taken alone is and must be superfluous.

The result of spotting errors—if responsible and no stopping behind the analysis—will move on. The mechanism tracing these social effects may be studied in three parts.Not conceivable, for instance, would be the daily massacre of the birds in Washington, where and when, in free nations, neither rifle officers are at hand, nor shotgun knows keep watch and wait. Traffic rules would probably—engineers as men with no natural authority nor physical force—prove ineffectual, if the car betting apparatus were designed and constructed as rigidly and illogically as locks and railroads fixing the traffic of smaller vehicles. As timber forests must achieve the appointed size, to furnish the material for ship-building, already would all continents be lumbered bare. The probable course of such expectable failures attests such potentialities for looking at things. These "but"s can of course be multiplied, but with plenty of lengths and to good effects. What is discussed here is the ontological necessity of philosophically altered social arrangements slowing progress to permit or improve cultural adjustments without heavy loss of properties, unifications, and habitual attunement. Whether these eventually function properly by means of certain privileged powers, laws, or geographical situations, matters little. What is inquired is simply whether behind such probabilities a sturdy and irregular mechanism would traverse a naturally sharp-synced trajectory.The proliferation of smartwatches and wearable technologies has attracted considerable academic and industry attention in recent years. These devices are no longer viewed as mere technological novelties but as integral tools in everyday life—affecting how users perceive their bodies, manage their time, and engage with broader digital ecosystems.

Understanding consumer behavior in this context has therefore become essential, especially as wearables blend utilitarian function with socio-symbolic meanings. Recent scholarship suggests that consumer adoption and sustained use are heavily influenced by the convergence of both perceived affordances and socio-cultural framing of the technology (Alshehri et al., 2023; Chung et al., 2020). Wearable technology, and particularly smartwatches, are now situated at the intersection of personal identity, health self-regulation, and digital sociality.Building upon the perceptual view of affordances—originally developed in ecological psychology and later adapted for human-computer interaction—it is argued that the visible and actionable characteristics of smartwatches activate users' perceptual and cognitive responses. These responses in turn shape attitudes toward the device and influence usage patterns. Attributes such as sleek design, biometric tracking, and seamless smartphone integration all contribute to the formation of user

intent and behavior (Lee & Kim, 2022). From a cultural-materialist perspective, these affordances are not merely technical—they are embedded with meanings that reflect and reproduce societal norms, including those related to productivity, health consciousness, and status signaling. Market dynamics have also played a pivotal role in shaping consumer expectations. From their niche status in the early 2000s to their mass-market popularity in the 2020s, smartwatches have undergone a significant cultural transition.

According to IDC (2023) global shipments of smartwatches reached over 140 million units in 2022, demonstrating robust growth particularly among health-focused consumers and younger demographics. This surge has fueled ongoing research into motivations for use, including utilitarian motives (e.g., activity monitoring, notifications), hedonic motives (e.g., entertainment, personalization), and symbolic motives (e.g., identity expression). As wearable technologies become more embedded in lifestyle practices, their social role is increasingly indistinguishable from their technical capabilities.This study contributes to a more granular understanding of smartwatch adoption by conducting a content analysis of user-reported motivations and perceptual cues. Findings show a convergence with earlier research on mobile media use, yet smartwatches present new tensions between functionality and form. On one hand, they are often perceived as limited extensions of smartphones; on the other, their embodied presence and real-time feedback foster intimate relationships with users. These ambivalences are reflective of broader patterns in media evolution, where devices simultaneously enhance and constrain user agency (Kim & Sundar, 2021). The challenge, then, is not only technical design but also how these devices align with users' evolving expectations and socio-digital routines.Artificial Intelligence (AI) has redefined the capabilities and conceptual boundaries of smartwatches. As AI becomes increasingly integrated into consumer wearables, smartwatches are transitioning from passive tracking devices to interactive, context-aware assistants. This paradigm shift reflects a confluence of economic, political, and cultural forces, echoing Marxist concerns about how technological development is intertwined with systems of power and production.

As Uzir et al. (2023) argue, the evolution of AI in wearables cannot be isolated from the social and ethical implications that arise from ambient data collection, user profiling, and predictive algorithms. Smartwatches thus stand as microcosms of broader debates surrounding technological determinism, surveillance capitalism, and the political economy of data.From a Marxian dialectical materialist standpoint, the AI-smartwatch nexus is illustrative of the contradictions between user autonomy and systemic control. AI features such as biometric analytics, adaptive notifications, and voice-driven virtual assistants operate under the guise of personalization, yet they also extend the logics of productivity and commodification into the body. These devices do not simply serve users—they shape user behavior through subtle nudges, reminders, and algorithmic filtering. This has given rise to what can be termed ambient algorithmic governance, whereby social interactions, emotional states, and physical routines are increasingly monitored and modulated by wearable AI (Lupton & Jutel, 2021). Recent advancements in natural language processing (NLP) have further elevated the capabilities of smartwatches. Voice-based AI agents now enable conversational exchanges that simulate social companionship, transcending mere command-based interfaces. Instead of one-way information retrieval, smartwatches now offer dialogic interaction, emotional tracking, and anticipatory responses. This development transforms the user-device relationship, reinforcing emotional dependency while simultaneously expanding the market for affective computing. As noted by Rieger et al. (2022). AI-driven wearables are increasingly positioned not only as functional tools but as affective actors within users' intimate lives. Despite their benefits, these technologies present dilemmas in terms of ethical design, autonomy, and data justice.

The challenge for developers and scholars alike is to ensure that these devices do not merely replicate exploitative capitalist imperatives under the guise of innovation. Drawing on Marx's foundational inquiries into alienation and material production, this study proposes a critical framework for evaluating AI-on-smartwatches, focusing on three interlinked areas: (1) the commodification of biometric data, (2) the reproduction of social hierarchies through algorithmic bias, and (3) the erosion of meaningful consent in pervasive data ecosystems. These issues are not technical glitches—they are systemic features of how capitalist development manifests in emerging technologies.Karl Marx's three applications of technological determinism may be used to frame the discussion of smartwatches' AI dissemination, development, and

usage. This includes analyzing the possible effects of AI on smartwatches' dissemination, use, design, manufacture, and character. All three uses of technological determinism suggest that smartwatches with AI may have social and institutional ramifications. Here, Marx's ideas on technological evolution and the social-experimental approach are applied to smartwatch analysis. Smartwatches have several affordances and the possibility for AI spread and application beyond helping those with blind algorithms and health conditions.

These potential affordances/implications involve ways of working with time, events, and information; configuring a social and institutional reality; configuring economic and technological conditions; configuring and engineering the monitoring of social, individual, and social relations; configuring economic and financial stakes that would override fate; counteracting individuality; and denaturalizing social relations, institutional arrangements, and These consequences demand significant story and scenario planning and empirical research. Pathways may apply to this bigger context (H. H. Uzir et al., 2023).Marx stated that 'in the development of machinery a rust; in the automatic weaving sun, means, never has boughs, trunk or bark' (Fernando Rocha Antunes, 2017). Watches, with refined mechanism, were multiplied "by this marvelous artifice" devised by American strangers and first tried, tried, and turned inside out by French artists. This text indicates how timepieces reassembled into a complicated mechanism and manufactured themselves without labor or other means yet followed machine rules. Check it out now, a sprocket in this system, to see everything. Listen to the automated, almost consequential rigmarole of automatic distraction when all pieces are in harmony. Social effects of market modalities on society are so extensive and widespread that studying or respecting any chain concept alone is unnecessary. Spotting errors—if responsible and no analysis stop—will go on. Three elements might explain these social consequences. The daily bird slaughter in Washington, where rifle cops and shotgun experts are few in free nations, is inconceivable. If car betting equipment were planned and built as strictly and illogically as locks and railroads for smaller vehicles, traffic laws would likely fail. Engineers are powerless. Timber forests must reach the required size to supply shipbuilding materials, therefore all continents would remain naked. Such perspectives are shown by the likely trajectory of such failures.

Naturally, these "but"s can be repeated, but in length and to good effect. Philosophically transformed social arrangements must halt growth to allow or better cultural changes without losing qualities, unifications, and habitual attunement. Whether things work properly through privileged powers, legislation, or geography is unimportant. The question is whether a robust and irregular mechanism would follow a sharp-synced trajectory behind such probability. Recent attention has focused on AI's societal and ethical consequences. Automation of individual and society functions is causing conflict that undermines political and social stability. Solutions mostly include morally safe "systems" that automate human-set norms. AI impacts every element of life in many civilizations. Here, we focus on human-like AI. The goal is to discuss social and ethical issues related to social networks, intelligent transportation systems, intelligent personal assistants, emotion and affect recognition systems, and social interaction robots. Public views may help design safer systems. Hegel, Marx, and Habermas offer political philosophy and ethics perspectives on these issues (Müller, 2020). AI impacts every element of life in many civilizations. Here, we focus on human-like AI. The goal is to discuss social and ethical issues related to social networks, intelligent transportation systems, intelligent personal assistants, emotion and affect recognition systems, and social interaction robots. Public views may help design safer systems. These issues are investigated through Hegel, Marx, and Habermas' political philosophy and ethics. The purpose is to critique human-mimicking AI, which has focused too much on technology and too little on politics, ethics, and social risks.

Hegel, Marx, and Habermas' primary recommendations show inherent issues with any attempt to replace the human realm with machine and/or rule-based systems, a concern only briefly addressed in technical AI and robotics literature. It also shows how business and research professionals handle these issues and how key industrial actors were either oblivious of them, dismissing them as solvable elsewhere, or assuming their response would improve mankind. Against the instrumentalization of society, the primary findings demand for philosophically informed AI societal debates.This study compares Marx's three "faces" of technological determinism (TD) to determine how they may improve modern technology's social

influence. Cataloging TD's three faces is the first step. Next, it discusses each face and its social impact across time, asking how Marx would evaluate them. Finally, Marxist lessons on rethinking and using modern technology for good and evil are discussed (Fernando Rocha Antunes, 2017). Each face's detailed explanation helps explain what makes it a TD face. Face 1 is "mentalism." The emergence of powerful technology forces new mental states. (1) The face's stock tale involves a technology that changes a society's social skill or control. (2) The face has a formal definition. A mentalistic view attributes the following feature to the entrance of a technology: (i) A language cannot be comprehended without a mental state, which renders its interpretation illogical. (ii) A technology is unproliferated only when its carriers cannot be humanly interpretable as an object for qualitatively separate action or social control.

Prior to the technology, new mental states were impossible.Karl Marx held two minor posts in 1841. He was a Berlin University Philosophy Faculty member and degree student. Philosophical students who joined the Faculty had to read a "Oath of Fealty" in Latin or German in front of the Senate. "In a world where all that is solid melts into air, it is new technologies that constitute that air and Karl Marx that reign supreme." Karl Marx returned to the forefront of human thought during these turbulent times as new technologies and their social effects expanded worldwide. Chinese researchers, inspired by Karl Marx, have studied smart wear technologies, particularly smart watches, and raised large technological issues. During the Industrial Revolution, Marx recognized four major changes that transformed the world from traditional to contemporary. Marx's triple face of technological determinism—the consequences of new technologies on production modes, the superstructure of society, and the state—was examined. Smart watches were created by applying computer technology to the human body and structure. Marx considered them a new mode of production that changed worker mobilization, organization, and collaboration across sectors and industries. Due to people's quick adoption and compliance with new technology to manage their time and space, the superstructure side has changed most. Like most new technology, Smart watches themselves have paradoxical consequences on societal stability that require governmental intelligence to handle.Consumers respond to media and technology based on their gratifications. The latest and most essential media layer is smartwatches. greater knowledge and enjoyment have led to wiser living, creating greater media contact in daily life. Future study should improve inductive methods and examine additional technical and media situations.

Applied settings need many uses & satisfying theoretical models (Krey et al., 2016).Many factors can impact media or technology adoption. Consumers employ generic media technologies when they become accessible. Emerging technologies' visibility and congruence with user demands have caused numerous well-known cascades of effect. Taste-based diffusion models are based on technology-user fit. Many old and generally new media technologies have been studied using these well-structured methods. Given the unlimited variety of present and emerging technologies, creating new cultural orientations for understanding and justifying their adoptions is pointless. Instead, study the design and deployment of new technologies, then cultural orientations in reaction to media. New technology is quickly popularized through new media or a new application layer of current media. It shows how closely media and method are linked. However, adoption-based splinters behaviorally assess individual relationships and adopt spread and development strategies. Many splinters and other formalizations of cultural impacts on technology uptake are undetermined. First and foremost, proving the impact works is non-inductive. Even if an impact has been shown for late adoptions of an existing technology, it cannot be immediately applied to test the same technology at its introduction since consumer awareness may affect adoption.

Future Directions in AI and Smartwatch Technology

With the upsurge of technology, wearable gadgets like smartwatches have obtained a foothold in the vibrant ecosystem of devices that continue to permeate homes and cities. Lawn and secluded areas around museums, public libraries, and historic sites are the backdrop to an airing sensor web that encompasses all humankind. Yet, plausibly the most significant mark left on the building of smartwatches is the artificial intelligence (AI) feature, which enables them to smarten-up services executed in a data-centric world. Smartwatches with AI have presently started to go beyond merely carrying devices and became sophisticated cognizance devices, capable of incorporating a broad range of modern innovations available to them and

blending them into a competitive service corporeal platform facilitating both sensor and power sources. Smartwatches using AI-based data mining techniques should not merely be perceived as facilitators or ancillary devices but acknowledged as innovative devices with the agency to redefine the nature of human behaviors and the preservation of the smart city ecosystem (Zhang, 2023).This conceptual paper is placed at the intersection of technology and cultural studies. The paper provides a literature review on wearable technology, AI, and the techno-cultural notions of the three faces of technological determinism by Marx.

It develops a framework based on Marx's techno-cultural concepts that together provide a foundational picture of the matrix in which the radical development of wearable devices with integrated AI exerts its power. It seeks to unravel the techno-cultural interplay accompanying the introduction of new media technologies and their power as detached entities that deploy emergent social and cultural forces and provide a normative framework to understand their impact on societies (H. H. Uzir et al., 2023). In doing so, the paper explores how conceivable emergent cognitive behaviors, with regard to pace, range, and processes, imparted by new wearable technologies can reshape human society. It lays the groundwork for a wider inquiry on the prospective consequences for states, polities, and cultures through which these cognitive capacities are actualized. The three faces of technological determinism highlight how newly developed technologies can both empower previously dormant human capabilities, yet at the same time decrease the overall agency of humanity to mold the outcome of those emergent capabilities. This creates spaces for techno-revolutionary – either destructive or constructive – political and cultural upheavals in both the societal and global spheres. Emerging trends and technologies, mainly those related to artificial intelligence (AI), are shifting the dynamic of dominant areas in individuals' lives. Smartwatches could largely be included in this scenery of emergent and technological devices. Nonetheless, a summary of the "realms" from where the effects of technology over human lives are assessed is essential for understanding the effects of emergent technologies over lives, welfare, and society. outline three areas where technology is assessed: digital footprint, data analytics, and algorithm influence. Digital footprints include individuals' capabilities (often overemphasized) of deterministically predicting future behaviors from past ones, as social networking sites could predict an unknowing member's susceptibility to interpersonal influence and moods within days of becoming a member. Data analytics, on the other hand, refer to situations where past behavior is used to define present situations.

Alternatively, activity history (constant monitoring) is used to determine status within social classes, justifying resource allocation/investments. Lastly, algorithm influence arises from algorithm-enable situations where generally smart choices could be taken blindfolded. The force of this influence is outlined by algorithmic investments in stocks or refinement of strategies for on-line auction.The relevance of these three areas must be highlighted when it comes to understanding the effects of smartwatches over experiencing, living, and influencing individuals. Nowadays, the predictability of future behaviors from past ones is increasingly affect individuals' lives: companies attempt to foresee individuals' moods, level of self-esteem, fears, consumption behavior, and perceived relevance. Such efforts are performed using imagination constraints imposed either by pre-existing models or by the agency of devising encounters via controlled environments and/or loyalty-inducing apps. The dominant smart-watch brands pay a huge amount of money each year to social thinking specialized academics to devise encounters and shape members' self-categorization from avatar shapes to the motivational voice for work out. If defining and cultivating an attractive profile from personal data should not be considered wrong, the excessive control and filtering potential using predictions must be highlighted. Such excessive control/predictability is not only clearly manipulative, but also prevents ubiquitous and quality living as self-conception constraints individuals' reality construction processes to a limited portion of attainable experiences (Fernando Rocha Antunes, 2017).

IV.   CONCLUSION

This study has critically examined the integration of artificial intelligence (AI) in smartwatches through the analytical lens of Karl Marx's three faces of technological determinism. By conceptualizing smartwatches not merely as functional tools but as ideologically charged artifacts, the research has shown how these devices function simultaneously as autonomous agents of change, as socio-economic constraints

rooted in capitalist production, and as political instruments that reinforce dominant norms of efficiency, productivity, and behavioral governance. Grounded in Marx's historical materialism, this inquiry has demonstrated that AI-infused wearables are deeply embedded in digital capitalism's logic of data commodification, surveillance, and alienation. Rather than emerging neutrally or autonomously, smartwatches are produced and adopted within a system that exploits user labor, externalizes the body as data, and normalizes algorithmic control over everyday life. Through this dialectical analysis, the study reveals how technological determinism continues to shape public discourse around innovation, often mystifying the social forces and class relations that structure the production and consumption of AI technologies.

In addressing its primary objective, the study offers a rethinking of AI-smartwatches as products of historical-material conditions rather than isolated technological marvels. By mapping Marx's framework onto the contemporary landscape of wearable AI, this research contributes a theoretically grounded critique that challenges deterministic narratives and calls for greater political and ethical scrutiny of smart technologies. Smartwatches, as shown here, are neither liberatory nor neutral—they are materially implicated in reproducing the capitalist order. Yet, understanding this opens space for resistance. A critical awareness of how these technologies function ideologically allows for the possibility of designing and deploying AI in ways that serve human emancipation rather than control. Ultimately, this study calls for a shift in how we theorize, govern, and inhabit emerging technologies—rejecting techno-fatalism and reclaiming agency over the futures they construct.

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