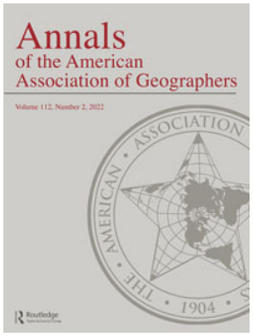

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Humanistic GIS: Toward a Research Agenda

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The accelerated proliferation of geographic information systems (GIS), especially in the last decade, has greatly expanded the connotation of GIS technology from primarily a diverse suite of digital objects, representations, and devices that create or make use of geographical information to a mediated means with which we humans experience, explore, or make sense of the world. The research perspective of humanistic GIS is proposed to better encompass the expanded category of GIS technology as well as the opportunities and challenges that go with it. Deeply rooted in humanistic geography, humanistic GIS offers a coherent and systematic framework that integrates existing fragmented humanism-related GIS studies and reorients the epistemological foundation by situating GIS in its mediation of human experience. This epistemological configuration not only categorizes GIS through its embodiment, hermeneutic, autonomous, and background relations with the involved human and place but it also provides an analytical structure for examining the intertwined implications of a particular instantiation of GIS. This newly proposed humanistic perspective demonstrates a sincere quest to develop and use GIS in ways that will be more empathetic and better for humanity. Through this article, both the GIS and geography communities are called on to envision a humanistic pathway for the next chapter of GIS. *Key Words: GIS, humanistic geography, humanistic GIS, phenomenology, postphenomenology.*

GIS[1] has been developing for almost seven decades, since the early 1960s, a time in which a small but growing scientific community came together to shape the ever-evolving concept of geographical information systems (Chrisman 2005). Over the years, it incubated an invigorating and comprehensive community of scholars from universities worldwide and fostered a flourishing global geospatial information industry. The productive interactions between GIS experts and industry pundits have fueled various innovative and practical research topics like autonomous driving (Vafaeinejad 2017), location-based services (Huang et al. 2018), and smart cities (Li 2021). These topics have profoundly influenced everyday life (e.g., navigation, contact tracing, personal health tracking, ridesharing, food delivery, etc.) and different aspects of society (e.g., pandemic reporting, city management, transportation operation, demographic surveying, etc.). When faced with these emerging technological trends, the connotation of GIS technology[2] itself has dramatically expanded, especially in the last decade, from primarily a vehicle that carries the representation of real-world phenomena (e.g., maps, virtual globes, digital earth, etc.) to a mediated means with which we humans experience, explore, or make sense of the world. For example, GIS technology (e.g., a Global Positioning System–enabled smartwatch) tracks georeferenced health conditions, interacts with pedestrians on the street (e.g., a self-navigated delivery robot), and controls traffic flow in real time (e.g., a city-wide spatial infrastructure). Today, many instantiations of GIS are immediately entangled in or apparently withdrawn from human experience, because of the wide range of digital objects, representational artifacts, and spatial infrastructures that now comprise the broad category of GIS.

To better understand this expanded category, the GIS community has conducted a tremendous amount of research to conceptualize various GIS-involved human behaviors and praxes to theoretical frameworks such as human dynamics (Shaw, Tsou, and Ye 2016; Nara et al. 2018; Yuan 2018; Shaw and Sui 2020), humanities GIS (Bodenhamer 2007; Harris, Bergeron, and Rouse 2011; Travis 2014), public participation GIS (Elwood and Ghose 2001), and people-based GIS (Miller 2003). Simultaneously, the epistemological reorientations and methodological innovations of place have gradually emerged, like

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place-based GIScience (Gao et al. 2013), GIS of place (Giordano and Cole 2018), placial analysis (Cho and Yuan 2019), or splatial framework (Shaw and Sui 2020). Also, Sui and Goodchild (2001, 2003, 2011) initiated the groundbreaking effort to characterize GIS as a medium and thus to explore its social implications. Nevertheless, none of these efforts have holistically conceptualized the expanded category of GIS, particularly its relevance to the users' emplaced experiential knowing and doing. I noticed that humanistic geography offered an experiential perspective to explore human interaction with the situated place, but the mediating role of GIS technology has not been considered. Although phenomenologists, particularly Heidegger, Ihde, and their followers, have provided enlightening thoughts on the impacts of technologies, the places where such impacts occur have not been sufficiently studied. Therefore, by introducing a critical examination of humanistic geography and the phenomenology of technology, this article presents a new research perspective that allows scholars to explore GIS through its user's experience of place. Because this perspective is deeply rooted in humanistic geography, it is referred to as humanistic GIS. Moreover, this term resonates with the ongoing humanistic turn in computer science. Human interests have become a priority in the design, development, and use of computer systems, especially those related to artificial intelligence (AI), and new theoretical concepts like humanistic AI (Gruber 2021), human-in-the-loop (Zanzotto 2019), and human-centered AI (Riedl 2019; W. Li, Batty, and Goodchild 2020) have been widely discussed and implemented. These human-centered perspectives have urged computer scientists to place particular emphasis on social justice and equity with regard to any computer system. This humanistic turn also reminds the GIS community of the importance of envisioning a humanistic pathway, because computer science has been considered a major force behind the development of GIS (Sui and Morrill 2004).

Although the term *humanistic* GIS might be new to readers, a few related aspects are no doubt familiar and have been greatly promoted in the development of this discipline. For instance, digital geohumanities has extended literature analysis and encouraged scholars to apply GIS analysis and visualization in the arts and humanities (Lane 2016). Qualitative GIS has promoted a mixed use of quantitative and qualitative methods for geographical inquiries (Cope and Elwood 2009). Critical GIS has been used primarily to examine the social implications of GIS through critical social theories (Harvey, Kwan, and Pavlovskaya 2005). The GIS/2 movement has rewired GIS to preserve human differences and the diversity of the world (Sieber 2004). It is worth noting that Sui (2001, 2004) also visioned a humanistic flavor of GIScience, but it primarily tried to revitalize the aesthetic tradition within GIS using scientific means. As shown, some of these themes focused on GIS applications in humanities, some highlighted the qualitative or humanistic methodology, and some examined the social implications of GIS. None, however, originated from humanistic geography or derived from a fundamental humanistic epistemology. Thus, humanistic GIS provides a much-needed coherent and systematic framework to integrate these fragmented humanism-related research themes. In other words, humanistic GIS does represent a certain facet of critical GIS, qualitative GIS, or digital geohumanities and relates to some humanism-related GIScience topics (e.g., human dynamics, people-based GIS, place-based GIScience, etc.), but it is not a part of or a new direction within either of them. No less important, humanistic GIS represents a shift from those earlier waves of making or doing GIS (e.g., qualitative GIS, GIS/2, etc.), when GIS was further removed from human experience, because GIS was primarily a technology of research and representation—not also as immediately mediating everyday emplaced human life as it is today. Thus, humanistic GIS shows a unique ethos and deserves a distinct identity rather than being seen as merely part of existing GIS themes.

A new research agenda will take little effect if does not come from within, as suggested by Schuurman (2000) in her influential article, "Trouble in the Heartland." With more than fifteen years of experience in GIS research, project development, and spatial analysis, I propose this humanistic perspective on my grounded praxes of GIS and critical reflection on a humanistic pathway. The remaining sections of this article elaborate on the main concepts of humanistic GIS, including its crucial role of GIS-mediated human experience, the taxonomy of place–human–GIS relations, and the analytical structure for exploring the implications of GIS technology. This humanistic perspective urges users to engage with GIS technology carefully and critically. It also reminds developers to act responsibly

when designing GIS algorithms, operations, or software tools. In conclusion, I summarize this perspective and call on the GIS community to envision a humanistic pathway forward.

Humanistic Perspectives in Geography

Humanism, which originated in fifteenth-century Italy, is an essential philosophical perspective with a complex intellectual history. Many different and even contradictory modes of humanism have arisen over the years. Today, it is commonly accepted as a philosophical stance that makes careful, critical, and responsible use of intellectual knowledge and life experiences, thereby improving human life and the world (Davies 2008). Unlike positivism, the prevailing theory embraced by most GIS scientists today, a humanistic perspective views human beings as subjects rather than objects by emphasizing human experiences. From an epistemological standpoint, humanists are called to enter another's taken-for-granted world, feel through the other's body, and use such an experience as a valid source of scientific exploration (Davies 2008; Herrick 2010).

Inspired by this humanism tradition, humanistic geography appeared and became prominent in the 1970s. This research perspective put human at the center of geographic inquiries and claimed that a comprehensive understanding of the geographical world must depart from individual and group experiences. The term *humanistic geography*, coined by Tuan (1976), encompasses many diverse research themes that promoted a thorough understanding of various human experiences in this geographical world, although previously relevant discussions existed (Relph 1970). As the primary companion to humanism, phenomenology enlightened a generation of humanistic geographers, such as Relph, Tuan, Buttimer, Seamon, Ley, and Samuels, who forged a research pathway at the intersection between human geography and humanism (Pickles 1985). Some key concepts essential to humanistic geography, such as lifeworld, taken-for-granted world, dwelling, and human-being-in-the-world, were derived directly from phenomenology. For example, Tuan (1971) argued that geographers should integrate the concept of human-being-in-the-world into their research because it incorporates environmental, geographical, and place aspects of human experiences. The notion of taken-for-granted world, examined by Buttimer (1974), shaped the geographical knowledge of which people were not consciously aware. Buttimer (1976) also defined the notion of lifeworld as the taken-for-granted world of everyday living. Furthermore, Seamon and Larsen (2020) summarized the following four central conceptual and methodological themes of humanistic geography that appeared in the 1970s and 1980s: (1) constructing a multidimensional model of human experience, (2) developing an open and empathetic methodology rather than applying conventional scientific methods to the less accessible aspects of human experience, (3) prioritizing first-hand human experience and life, and (4) acknowledging two complementary types of humanistic research: explications of human experiences and interpretations of social worlds. With both its theoretical construction and methodological aspects, this developing humanistic perspective has expanded the scope of research in modern geography.

Among the many research subjects studied by humanistic geographers, place has received the most attention. Tuan (1979) interpreted "sense of place" as a set of subjective feelings an individual attaches to a place. Along this line, Tuan (1974) used the term *topophilia* to describe the strong affective bond to one's geographical surroundings. During this period, Seamon (1979) studied "place ballet," the regularity of different natural or urban environments, to explore how one incurs a sense of place. Relph (1976) put forth another significant work on this subject when he argued that place brings a subconscious intimate affective bond to an environment, which often goes unnoticed unless changes occur, as when one is prohibited from entering workplace due to quarantine. On the contrary, the term *placelessness*, coined by Relph (1976), describes a place lacking emotional attachment. His work on place provides a lucid interpretation of why this research domain is important for everyday life. In light of various phenomenologist interpretations of place, Casey (1993) and Malpas (2018) further argued that place is a primary ontological structure made up of both human experience and the world in which the experience is revealed. In this regard, one is always a "human-being-in-place." This important insight inspired Seamon to explore the united structure of human-beings-experiencing-place, sometimes referred to as "lived emplacement," which emphasizes the inherent complexity and dynamics of human experience and further describes the general process by

which a place and experiences therein unfold over time (Seamon 2015). In a similar vein, inspired by Merleau-Ponty's body-subject, Seamon (1979) studied environmental embodiment that represents active bodily awareness of a particular place. Following Whitehead's organismic philosophy, Seamon (2018) perceived place as a process involving the human, the situated place, and other entanglements as an organic whole (Whitehead 1981). This organismic view conceptualizes geographical entities (e.g., space or place) as living structures. As implied by Jiang (2021), both the place in the geographical world and the experience of it in human minds are living structures. To what extent that experience of place is reflected by the underlying living structure deserves further research.

Phenomenological Interpretations of Technology

Although humanistic geographers have been deeply influenced by Heideggerian phenomenology, they have seemingly neglected Heidegger's profound efforts in the philosophy of technology. Heidegger (1977) examined technology as its relationship with being and the world. Technology was considered to be a power that "sets upon" nature or "frames" human society. The world is a standing reserve that stores up a collection of commodities and stays ready for manipulation. The essence of technology, according to Heidegger, is one way among others in which reality can be revealed.

Understanding technology through its essence has been questioned because it neglects the diversity and complexity of the world. In the realm of GIS, Leszczynski and Crampton also discussed this neglect. In their exchange on GIS ontology, Crampton further suggested developing a cross-cultural "anthropological GIS" to explore various instantiations of GIS being-in-the-world (Crampton 2009; Leszczynski 2009a, 2009b). Rather than concentrating on the essence of technology, Ihde (1995) developed his own thoughts after postphenomenology based on Heideggerian philosophy of technology. Ihde considered that technologies are always technologies-in-use and should be examined in a larger context. He argued that technology freely varies into different identities depending on its situated contexts. This contextuality allows scholars to examine the different meanings of technology. This multiplicity of meanings and identities indicates the inherent ambiguity of how technology can be used. Therefore, rather than following Heidegger's approach to the essence of technology, Ihde asked another question about the possible forms of revealing a technology makes possible.

To answer this question, Ihde shifted his attention to the relations between human beings and their worlds through the mediation of technological artifacts. In this mediation, human beings and technologies coconstitute each other. Ihde (1990) considered human–world relations as an epistemological structure for all kinds of human experiences and the intellectual knowledge therein. Rosenberger and Verbeek (2015) further contended that there is no direct relationship between human beings and their worlds, and only indirect means exist. Ihde (1990) summarized four types of human–world relations. The first is embodiment relation, in which technology is the medium of the human perceptual experience of the world, thus transforming the perception and bodily sense. The second is named after hermeneutics—this type represents the perceived world. The third is alterity relation, in which technology is experienced as another independent being. The background relations, the fourth type, forms when technology becomes a part of the world and withdraws from immediate human experience.

Human experience of the world can be explained by a common tendency known as the figure–ground perception, in which the observed object becomes the figure to focus and everything else is perceived as background. The figure is naturally distinguished when focused, whereas the background fades into a less important place (Wagemans et al. 2012). This inherent perceptual tendency of humans has influenced Ihde's analytical approach to examining the implications of technology. He proposed an amplification–reduction structure to capture how the technology affects human perceptions and praxes. As Ihde (1990) asserted, technology that augments human capabilities will simultaneously reduce others. Insofar as the impacts on the human body, technology enhances some sensations while simultaneously filtering others. Such microlevel impacts and sensations can accumulate to the macrolevel impacts on society. In other words, technologies can also enhance certain societal implications while it makes others obsolete.

Heidegger, Ihde, and many of their followers have provided an expanding compendium on technology,

which could inspire a potential new research direction that examines GIS technology in its relationship to the user and the perceived environment, whereas a humanistic explanation of place provides a theoretical perspective for how to approach the relationship between an observer and the perceived environment. By building on these two interrelated theoretical pillars, a humanistic perspective for GIS is developed, as detailed in the following sections.

GIS-Mediated Experience: Human, GIS, and Place

In humanistic GIS, human experience serves as a primary epistemological entry for theoretical and practical exploration of GIS. Although humanistic geography also emphasizes the crucial role of human experience, it is largely ignored in studies of how GIS enhances or distorts human experience. In this regard, humanistic GIS extends humanistic geography because GIS is considered to be an inseparable medium capable of changing the structure of human experience. This section includes an interpretation of this structure and the primary elements of GIS-mediated experience.

Experience, whether it is mediated by GIS or not, is enacted by a human being. A human, as a biological system, has multiple sensory organs, like eyes, ears, skin, nose, and mouth. When we humans perceive the world, a sensory organ gathers information about the stimulus. Although visual sensation is mostly used to experience a GIS technology (e.g., reading a map, watching a virtual globe), other senses are still used. For example, a driver hears how far the next turn is from a car navigation system, and a Google Earth VR player touches the virtual mountains through the controllers. In addition to the five primary senses, the human body possesses other sensory systems like body balance, position, movement, pain, and temperature. For example, the vestibular system in the inner ear provides the senses of spatial orientation and coordinates body movements. Beyond a biological system, we humans exist within a social context as well. Suppose a traveler uses a map to learn about the social fabric of a neighborhood. While reading the map, visual signals are parsed into signs, symbols, and patterns—a process that involves a physiological reaction to the mediation of the map. With the processed raw information, the traveler also evaluates the travel conditions using the contours of elevation, examines the degree of colonialized or gentrified levels using the street names, and estimates the economic value based on the land use types. All of these aspects constitute how a traveler experiences a map and what can be experienced. As shown, the process of map-mediated experience is both bodily relevant and socially constructed.

Experience is always about something else: This "aboutness" directs one's experience to a targeting place. The target of GIS-mediated experience is conceptualized as a place for a few reasons. First, a place is scalable. It can be as small as a chair, a house, a road, or even as large as a town, a country, or even the whole world. Second, a place is dynamic. It can be relocated and transformed, as a venue moves to other locations over time (Knopp and Brown 2021) or the urban area sprawls. Third, a place can be physical, virtual, or even a hybrid of the two. A physical place is usually located on the surface of the Earth and consists of material locales, whereas a virtual place often exists virtually, unnecessary to contain material locales (Zhao and Huang 2020). The locales of place can also be made up of nature, landscapes, human beings, animals, nonhumans, or even the entire world. Also, space in humanistic GIS can be conceptualized as the spatial structure, pattern, or context of place. This configuration allows scholars to examine emotional attachments to different types of locales and spaces.

Thus, a place exists in various forms as one perceives it through the interactions with others in person, in place, or digitally. For example, #Seattle on Twitter, Facebook, or Instagram indicates a virtual place (a topic) in which all of the posts contain the keyword #Seattle. People experience the virtual place #Seattle by interacting with other online users virtually. Another example is augmented reality, such as the virtual Stonewall monument with an augmented virtual rainbow. This augmented reality place includes both physical and virtual locales where visitors immerse themselves in this hybrid place either in person or digitally (Fitzgerald 2021). A more complex example is place-based digital media, which exists at a certain physical location and offers a digital interface for interaction. An observer interacts with such a place both in person (by touching the screen) and digitally (by interacting with displayed content).

Therefore, GIS-mediated human experience has been abstracted into a structure of three integral

parts: human, GIS, and the place. With this structure, a GIS is approached not in the conventional dualistic manner between human (subject) and place (object) but by the underlying mediating relations. This new structure of mediation embodies an organic whole rather than a simple combination of these three elements. In this sense, humanistic GIS adopts an organismic worldview that transcends the conventional mechanistic worldview. As an organic whole, GIS is not an entity or identity of its own. Rather, it is the product of how it is used and a mirror of its users; its functions can be revealed only when it is being used.

Human–GIS–Place Relation: GIS as Embodiment, Hermeneutics, Autonomy, and Background

The complexity and dynamics of the world can be understood as a network of relations between human beings and places, if "place" is defined as an inclusive ontological entity that represents nature, landscapes, animals, nonhumans, sentient beings, or other things. Latour's actor-network theory is a generative epistemological framework for interpreting this network of relations formed through the involved GIS or other technologies, as well as human and nonhuman actors (Latour 1996). For example, S. Zhang et al. (2021) used actor-network theory to examine how the Facebook check-in function[3] became the center of a cyberprotest and unveiled the network of relations among all of the human and nonhuman actors. Whereas this network perspective can be the basis of a humanistic investigation at the macrolevel, the GIS-mediated experience serves as a humanistic entry point from the microlevel. This mediated experiential structure places GIS between human and place and further helps scholars examine its practical and social implications.

$$\text{Human} - \text{GIS} - \text{Place}. \tag{1}$$

Equation 1 denotes a baseline for the GIS-mediated experience. In this equation, a human, from the first-person point of view, perceives a place through the mediation of GIS technology, and the GIS technology freely moves at different "positions" within the formula while maintaining its place between the human and place entity. As GIS approaches the human, it will become a part of the human body. As it approaches the place, GIS will become a part of the situated environment, creating a digital environment or a smart city. As shown, the position of GIS in the equation can imply the nature and functions of GIS. By examining different positions, I can find four primary types of GIS: embodiment GIS, hermeneutic GIS, autonomous GIS, and background GIS.

Embodiment GIS

This type of GIS is united with its user. As shown in Equation 2, GIS and its user are in a pair of parentheses, indicating these two entities are organically united. The GIS extends the user's capabilities without the user's awareness of it. The arrow indicates how this symbiosis interacts with the perceived place.

$$(\text{Human} - \text{GIS}) \rightarrow \text{Place}. \tag{2}$$

Most wearable devices, such as Google Glass, smart watches, and virtual reality (VR) headsets, fall into this category in that they become part of the wearer's body after a short period of adjustment (Kamel Boulos et al. 2017). For example, Google Glass allows wearers to perceive the geographical scene in front of them through the mediation of the glasses. A built-in projector visualizes additional geographical information such as local business or real-time traffic. As shown, GIS is "partially transparent," meaning that the wearer can immediately see through the Google Glass and focus on the surrounding environments. The transparency is considered partial because the wearer still feels certain features of the glasses like the legs or frame, albeit on the periphery of the focal plant.

Embodiment GIS breaks the boundary between human and GIS by creating a symbiosis of the two, thus forming a GIS cyborg. Inspired by the notion of cyborg,[4] Haraway (1987) developed digital feminism, which highlighted the subjectivity of technology and promoted a wave of feminist perspectives regarding the use of GIS (Kwan 2002; Schuurman 2002). GIS should be investigated only while in use because it is only then that it reflects the intentions of its creators and users. For example, a person might have different identities depending on social media platforms; one's Twitter identity (social networking related) is different from one's Slack identity (work related). In this sense, a GIS cyborg, or embodiment

GIS in general, constantly reminds us of the subjectivity of GIS.

Hermeneutic GIS

This type of GIS acts as a representation of the depicted place and allows its reader to perceive the place through it. As shown in Equation 3, the parentheses denote the representing and represented relationships, and the arrow indicates that the reader only perceives the depicted place rather than a real one. It must be noted that maps and geovisualizations (e.g., paper-based atlases, online maps, virtual globes) are hermeneutic by nature. Similar to the visual representation, an auditory map that informs visually impaired individuals of place names and routes ahead is also a hermeneutic GIS due to the acoustic representation of place (Rice et al. 2005).

$$\text{Human} \rightarrow (\text{GIS} - \text{Place}). \tag{3}$$

Hermeneutic GIS is considered opaque because reading a map does not constitute a firsthand experience as would visiting a place. Geospatial data are numerical representations of a depicted place. No matter which specific geographic data formats are used, vectors or rasters, they cannot entirely reproduce the experience of being there in person. So, map generalization is unavoidable for cartography and GIS. Ihde (1990) described this phenomenon as an "enigma" because a place cannot be immediately experienced but only through a third party (Adams, Hoelscher, and Till 2001). Despite this unavoidable enigma, hermeneutic GIS, in turn, simplifies real-world phenomena so that excessive details will not cognitively overload the readers.

Autonomous GIS

This type of GIS is regarded as either an independent agent or a place. As shown in Equation 4, the slash symbol represents the dual role of GIS. Autonomous GIS is a quasi-other in that humans interact with it while it establishes itself as a place. It is referred to as "quasi" because minimum human intervention is still required even if the intervention is transient or unobservable. For example, an indoor navigation–enabled robot vacuum can clean an entire room independently; however, a person must turn it on, no matter whether it is executed remotely via a mobile screen or through a timer previously programmed in its control system.

$$\text{Human} \rightarrow \text{GIS} / \text{Place}. \tag{4}$$

The developing convergence of automation and GIS has fueled an increasing number of autonomous GIS applications that are similar to human intelligence. For example, GeoAI is an autonomous GIS that performs independently and demonstrates great capacity for comprehending the geographical world. It "learns" geographical knowledge through processing a large-scale data set of unstructured geographical information. For example, land object recognition, as a common function of GeoAI, identifies different objects such as buildings, roads, or lakes from aerial images at an accuracy level that is comparable to humans but at a much faster pace (Zhu et al. 2017).

Robots are another major type of autonomous GIS, such as unmanned aerial vehicles, self-driving cars, food delivery robots, or robot vacuums. After an operator activates them, they are capable of independently carrying out tasks. For example, the DJI drone is a commercial unmanned aerial vehicle that flies independently and avoids collisions intelligently. This collision avoidance function depends on a main camera and forward-positioned dual optical sensors. The main camera creates an instant map that keeps the tracked object in the center of the frame, and the dual sensors model a precise 3D simulation of the tracked object in quasi-real time (DJI 2020). When approaching an obstacle, the drone adjusts in advance to avoid hitting the obstacles. In addition to being an independent agent, this drone can be thought of as a place because it exists in a location and contains locales to which people develop emotional attachments. Even when the drone is flying, it is still at a specific location momentarily and has material locales such as the main camera and sensors. Also, people, or at least its owner, have developed a certain emotional attachment: "I love this drone because it easily captures the transient moments of life." So, this DJI drone is an autonomous GIS that interacts with humans as an independent agent and manifests itself as a place.

Background GIS

Background GIS becomes a part of a place and is not apparent to its user. When a background GIS is running, the user is influenced by it but barely notices. As shown in Equation 5, the @ symbol indicates that the GIS technology is a part of a place, and the parentheses imply that the user interacts with the place where GIS technology becomes a part of it.

$$\text{Human} \rightarrow (\text{GIS} @ \text{Place}). \quad (5)$$

Technologies such as digital environments, smart cities, and smart homes are categorized into background GIS. One common feature of this type is the integration of the Internet of Things, which is intended to reduce unnecessary human intervention (Vermesan and Friess 2013). For example, a smart city comprises a complex autonomous infrastructure made up of multiple subsystems to optimize city operations, like traffic control, power plants, and disease prevention, to name a few. Among them, the traffic control subsystem consists of a network of vehicle detection loops installed in the pavement that detects the comings and goings of vehicles and changes the traffic lights accordingly. This network of loops has become an integral part of the urban environment (place). When a car moves over a segment of pavement with a built-in loop, the driver is barely aware of the data being collected by the environment; however, the driver will be influenced by the optimized traffic control (Bhaskar et al. 2015). The use of detection loops is just one example of many. A smart city consists of various similar intelligent methods for advancing city operations. In addition to material GIS as seen in a smart city, background GIS is an example of how GIS theories or models fundamentally frame the human experience of place. According to Couclelis (1992), a person might refer to different geographical views, an object or a field, while perceiving a place. During the momentary observation, the immediate perception is framed by a GIS data model (e.g., point, polygon, pixel, or matrix). So, in the observer's mind, the place has been backed by the GIS model.

A GIS does not remain in a fixed human–GIS–place relation permanently. Instead, it freely varies to any combination of the four types. For instance, the self-driving Tesla is a GIS because its functioning depends on geospatial data and analysis. When a driver turns the steering wheel, this causes the vehicle to turn synchronously. Thus, the driver's experience of turning the steering wheel has been extended to the vehicle, exemplifying an embodiment GIS. While the vehicle is on the road, an avatar—a red arrow—moves along the map displayed on the navigation screen. The avatar is a representation of the vehicle, or an example of a hermeneutic GIS. When the autopilot system is on, the vehicle drives without any human intervention. Thus, the vehicle becomes a quasi-other that can be regarded as an autonomous GIS. With eyes closed, the "driver" might feel like he or she is sitting on a couch in a living room rather than in a moving vehicle. In this sense, the vehicle has withdrawn into the background, and the driver is not even aware of the vehicle's presence. At this moment, the car manifests itself as a background GIS (Dikmen and Burns 2016). As described earlier, the driver's experience of this vehicle freely varies among the four relations; the function of GIS also varies according to the specific experience. This example further emphasizes that GIS should not be viewed in isolation; rather, it must be analyzed when in use. Only in this way would people not be fooled by any momentary status of a GIS.

Implications of GIS: Intertwined Amplification and Reduction

As GIS technologies become a part of everyday life and are integrated into society, their implications become even harder to unveil, especially when people are more likely to focus on obvious influences while neglecting others that have faded into the background. If no additional analytical method is used, it is highly likely that some hidden effects will be ignored. Thus, humanistic GIS draws on Ihde's amplification–reduction structure to examine the implications of technologies (Ihde 1990). This analytical structure implies that a GIS strengthens some capabilities of human existence and simultaneously diminishes others. By understanding this intertwined structure, we can develop a holistic understanding of the implications of a GIS. It is worth noting that the objective of this section is not to exhaustively uncover all of the implications of a GIS. Perhaps this would be impossible to do because the impacts are almost infinite—each GIS freely varies in its relationship with the involved human beings and the geographical environments. So, this section mainly demonstrates the utility of the amplification–reduction structure in uncovering often-ignored implications.

Physiological Discomfort

Although most instantiations of embodiment GIS augment the senses, they might also cause physiological discomfort. Wearing a device on a human body is unnatural; the protective mechanisms of the

human body might reject the contact from a foreign object and make the wearer feel uncomfortable, resulting in headaches, nausea, disorientation, or vomiting. This discomfort is not a new problem, as it has plagued test pilots, drivers, and astronauts who practice in simulators. Due to the popularity of wearable devices for gaming or industrial design, people became aware of this discomfort, referred to as motion sickness. Take the wearer of a VR headset as an example. The physiological discomfort is induced by conflicting inputs from the visual and vestibular systems (Akiduki et al. 2003). Based on a set of experiments, Munafo, Diedrick, and Stoffregen (2017) found that female wearers are at a greater risk of motion sickness when playing VR games.

Fake Geographical Information

Mapmakers might take advantage of the enigma to produce fake geographical information. Monmonier (1991), in his classic book *How to Lie with Maps*, discussed this kind of inconsistency. Propaganda maps distortedly portrayed actual situations to lower the enemy troops' morale (Herb 2002); fictitious geographical entries, like paper towns or trap streets, appeared on map to protect the copyright (S. Zhang 2015); and colonial maps deliberately excluded the territories of minority groups (Aalbers 2014; Alderman, Inwood, and Bottone 2021). To challenge these misrepresentative maps, Black, indigenous, women, and LGBTQ+ communities redrew maps to speak for their well-being and existence using a grassroots cartographical strategy called countermapping (Peluso 1995; Maharawal and McElroy 2018). Such fake geographical information can be created on digital platforms as well. Zhao and Sui (2017) examined various fake locational information that Twitter users intentionally produced. Zhao and Zhang (2019) found that Pokémon Go players spoofed their mobile trajectories to overcome the spatial disparity of game resources, although the game company denounced these strategies as cheating. With GeoAI, the geographical features on aerial imagery can be manipulated, such as changing roads to rivers. Because the falsified features are uncannily realistic, it is nearly impossible to spot them with the human eye. In this way, fake aerial imagery could cause serious national security issues if used for malicious purposes (Zhao et al. 2021).

Displacements and Dislocations

According to an estimation from McKinsey, 375 million workers worldwide (approximately 14 percent of the global workforce) will be forced to change jobs by 2030 due to the influence of automation, robotics, or AI (Manyika et al. 2017). These autonomous GIS are poised to eliminate occupations like digitization operators, model builders, and relevant GIS experts; however, in the meantime, new opportunities might emerge, like geospatial data annotators. The job displacement might also bring unintended consequences to geographical knowledge. When a GeoAI system is used for land object recognition, bias in the geographical annotations will transfer to the recognition function. If a data annotator is not familiar with luxury mansions with swimming pools, tennis courts, and archery ranges, it is likely to label these places recreation centers. Such a bias could come from differences in race and ethnicity, socioeconomic status, cultural tradition, and many other factors (Zou and Schiebinger 2018).

Digital Panopticon

Although a background GIS like a smart city improves the efficiency of existing city operations, it could also make the city management process buggy, brittle, and hackable or even lock in the city development (Kitchin 2014). Among these potential issues, citizens worry about a smart city transforming into a "Digital Panopticon" if misused (Norris 2005; Kitchin, Lauriault, and McArdle 2015). Skynet is a mass surveillance subsystem that has been built in many smart cities in China. Developed in 2005, the number of surveillance cameras in Skynet had reached 200 million in public spaces all over China by 2019. With the additional AI-powered face recognition algorithm, China's Skynet is capable of capturing the image of each pedestrian and identifying who the pedestrian is in milliseconds (Xu 2018). Thus, this mass surveillance, accompanying spontaneous self-surveillance, and anxiety about this misuse are growing concerns about background GIS.

Message from Humanistic GIS

Humanistic GIS carries an important message for using, developing, or living with GIS technologies, although similar messages have been conveyed by

other critical GIS scholars. For example, Smith (1992) urged GIS developers to be critically aware of the potential damage their algorithms could inflict due to the misuse of GIS algorithms in the Gulf War. Kitchin and Dodge (2014) encouraged scientists to pay attention to code and software within the spatial formation of collective life. In addition, Martin and Schuurman (2020) provided guidance to scholars regarding how to collect large amounts of geospatial data from social media and use them for qualitative GIS studies. Humanistic GIS develops a similar message but from a human-centered logics and uses GIS-mediated experience as the epistemological entry point.

As indicated previously, the three entities—human, GIS, and place—are integral parts of the mediated experience and coconstitute each other. This united structure of mediation implies that GIS technology gives shape to human existence and helps us humans constitute ourselves. The self-constitution through mediation, in turn, shows that we humans are aware of the mediation and the possibility of taking further countermeasures. With the accelerated proliferation of GIS in society and everyday life, there is nowhere to hide from being influenced by the mediation of GIS and other technologies. For example, someone can decide not to buy or drive a Tesla vehicle but cannot avoid being affected by a transportation network that carries an increasing number of self-driving vehicles. Also, if one decides to place one's trust in a self-driving vehicle, one might not be able to avoid being taken to a dead end due to outdated navigation data. Thus, neither suspicion nor blind reliance is helpful; people need to develop a stance toward the specific GIS in use, either actively or passively.

Foucault's concept of "care of the self" sheds light on a feasible plan to develop a stance (Kelly et al. 2013). Through the concept, Foucault implied that pursuit of a person's well-being relies on a stance toward the self, others, and the world. During the pursuit, the person takes care of the relationships with others and the world and shapes the self in careful relations. For example, to avoid driving to dead ends, it is helpful to be critical about planned routes, especially those that are rarely used. The driver can also make sure the navigation system is up-to-date before calculating any routes, at least for those destinations that the driver has seldom visited. In the careful engagement with the navigation system, this driver will avoid getting lost on unknown roads and, more important, improve the capability of dealing with similar cases. In this regard, people are encouraged to become involved in GIS mediation carefully and critically; in this way, they actively shape their GIS-mediated existences. GIS, in turn, will become more empathetic and better for humanity.

For GIS developers, humanistic GIS invites them to anticipate the imminent mediations of GIS technologies. Imagination is a powerful tool for predicting existing, potential, or even unintended GIS-mediated experiences. A careful examination of these experiences will allow developers to make necessary adjustments to GIS codes, models, or programs. For example, a GeoAI manager can proactively imagine the difference in data annotators' knowledge sets of the world. The imagined scenario allows the manager to diversify the collected training set by recruiting annotators of different races and ethnicities, socioeconomic status, or cultural backgrounds. In addition, a GIS software engineer can imagine the outcomes of satellite imagery manipulation. The imagined consequences will urge the engineer to develop a fact-checking tool to evaluate the authenticity of each image. These two cases demonstrate the significance of imagination in improving GIS technology.

Humanistic GIS acknowledges the drawbacks of GIS and thus urges developers to make responsible adjustments against unintended mediations, such as deliberately rewiring the GIS to avoid the unintended mediation. In other words, GIS explicitly nudge users to behave in a specific direction, like pressing the Save Edits button in ArcMap (Thaler and Sunstein 2009). Explicitly influencing its users via the hard-coded procedure in GIS is controversial, however, in that it seems to put human autonomy at stake. From a humanistic perspective, this focus on human autonomy will develop into a dry debate. GIS always mediates human praxes and experiences, although sometimes it withdraws into the background and people are unaware of its presence. GIS mediation does not mean giving up freedom. Thus, rather than seeking to eliminate the unavoidable impacts, developers should acknowledge the presence of GIS and make the best use of them. Furthermore, instead of pitting human autonomy against the powers of technology, GIS developers are encouraged to design responsible forms of mediation. To do so, humanistic GIS urges developers to equip with the

capacities to discover, interpret, and analyze the various possibilities of mediation, thereby designing a GIS in a critical, considerate, and empathetic way (Kiran and Verbeek 2010). Indeed, freedom cannot be safeguarded by being hidden from the mediations but by developing unrestricted relations to them and behaving responsibly toward the unavoidable mediations of GIS (Bergen and Verbeek 2021).

As we learned from the GIS version of Science War (Schuurman 2000), a call for change from within the GIS community will be more powerful; otherwise, the message for GIS users and developers will have little effect. I, as the author of this article, have more than fifteen years of experience in GIS research, project development, and spatial analysis. Moreover, I have become aware of the social implications of GIS with the aid of humanistic geography and critical GIS theories. Thus, this humanistic perspective has been developed after practical GIS experience and praxes, and I remain committed to this humanistic perspective and intend to improve it over time.

New Research Agenda for GIS?

Humanistic GIS is not entirely new, because it comes from humanistic geography and integrates the fragmented humanism-related GIS studies into a coherent framework. It also modifies the conventional connotation of GIS and reorients its epistemological foundation to better explain the practical functions and implications of GIS. Thus, this humanistic framework not only guides methodological developments and real-world praxes; it further offers moral and educational messages for GIS users and developers. Specifically, it avoids recognizing GIS as an isolated object but situates it in an experiential structure between its user and the perceived place. It also reemphasizes that the nature and functions of GIS can only be understood while it is being used. By analyzing various GIS-mediated human experiences, this article summarized four primary GIS types: embodiment, hermeneutic, autonomous, and background GIS. This taxonomy presents a generative approach for studying different aspects of GIS through analyzing its position in the human–GIS–place formula. In addition, inspired by the figure–ground perception of human experience, the amplification–reduction structure assists in the unveiling of the intertwined implications of GIS technologies, especially those that are often ignored.

Humanistic GIS provides a feasible pathway for GIS, as supported by the following arguments. First, it urges scholars to pay more attention to the biophysical and psychological processes of GIS-mediated experiences. GIS as a discipline should continuously learn from cognitive science, environmental psychology, and neuroscience to understand human perception of place and space. From a methodological perspective, an Electroencephalogram headset, as an embodiment GIS, can quantitatively examine the human experience of place (Aspinall et al. 2015). When a human subject perceives a place while wearing the headset, the headset measures the human brain's electrical reflex and thus infers the emotions about the place. Second, the taxonomy of the human–GIS–place relations expands the research scope of GIS from the focus on conventional hermeneutic GIS to broader research realms that include the other three GIS types, as GIS has transformed from primarily a representation of geographical information to a mediated means with which we experience, explore, or make sense of the world. Third, the proposed humanistic perspective also sheds light on potential research directions for hermeneutic GIS. By including human beings as an integral part of the geographical world, hermeneutic GIS can help scholars shift from a Cartesian mechanistic worldview to an organismic one. This transcendence of worldview imagines geographies not only as a two- or three-dimensional structure but also as topological objects that can be bent, twisted, and folded (Secor 2013). In this way, GIS can be rewired to represent geographic topologies (Jiang, Zhao, and Yin 2008; Jiang 2019) and geographical imaginations (Bergmann and Lally 2021). Moreover, this humanistic perspective has moral and educational implications. As most GIS technologies and scientific studies pursue geographic accuracy and algorithmic efficiency, humanistic GIS urges users to take care while engaging in GIS-involved activities and developers to responsibly design and code.

Although humanistic GIS is promising, it is still possible that, at least in the short term, this new perspective will not satisfy either the GIS community or humanistic geographers due to its cross-disciplinary nature, especially considering the controversy between GIScientists and humanistic geographers in the late-quantitative revolution period as well as the intense debates within the GIS community in the

GIS version of Science Wars during the 1990s. In fact, the objective of this article is not to propose an impeccable agenda and thus to invite geographers and the GIS community to use it without proper analysis. Rather, it primarily offers a vehicle to allow more scholars to start thinking, along with me, about a possible humanistic future of GIS, thereby improving it together. For example, this article develops the humanistic GIS perspective on the revised human experiential structure. To develop it further, GIS scholars could explore how to incorporate the four central themes of humanistic geography and the recent studies on place that were reviewed earlier in this article (Seamon and Larsen 2020). Moreover, this humanistic perspective does not consider the experiences of animals, nonhumans, or even other sentient beings. Today, the accelerated penetration of GIS does affect animal or artificial behaviors; for instance, two self-driving vehicles that are moving toward each other on the highway might avoid hitting one another through their built-in autopilot systems, or a curious cat may enjoy playing with a navigation-enabled robot vacuum. To elaborate on these instances by humanistic GIS, new progress in postphenomenological geographies sheds light on the significance of examining nonhumans and beyond humans (Lea 2009; Ash and Simpson 2016). It also implies a fundamental ontological restructuring—from human experience to the affective force that composes and simultaneously deconstructs the understanding of the world. This change will enhance the capacity of humanistic GIS scholars to examine the experiences of nonhumans if such experiences do exist. After all, humanity shares the world with other species and artifacts, and caring for them is ultimately caring for humanity per se. As shown, a humanistic GIS perspective embraces constructive ideas and welcomes any critique to strengthen its capability to understand GIS in its constant mediation with humanity and the world. Indeed, a seminal idea is usually incomplete and sometimes radical or might even conflict with other well-developed research frameworks from the same discipline. The existence of such ideas is extremely significant to the future of a viable and sustainable discipline. Furthermore, a healthy discipline needs to nurture and preserve such ideas. In this sense, a humanistic GIS agenda will promote more meaningful conversations or intense debates within the GIS and geography communities.

Although this humanistic perspective has great potential to contribute to the future of GIS, its development seems a very challenging task. According to Seamon and Larsen (2020), "Few geographers are brave enough to call themselves humanistic today" (7). To cope with this challenge, Tuan (2018) suggested the following:

> Humanistic geography is neglected because it is too hard. Nevertheless, it should attract the tough-minded and idealistic, for it rests ultimately on the belief that we humans can face the most unpleasant facts, and even do something about them, without despair.

Humanistic GIS is no less hard; its development also requires more scholars who are committed to humanism-related studies, especially those who are tough-minded and idealistic. Humanistic GIS embodies such an idealistic nature. So, rather than portraying a "technodystopian" future of an increasingly GIS-mediated society (Leszczynski 2020), humanistic GIS recognizes unintended, sometimes even unpleasant mediations such as errors, bugs, glitches, or malfunctions. This recognition encourages people to take serious action to improve the status quo and thus to foster friendly, pleasant, or comforting mediated experiences. In this regard, humanistic GIS, carrying a similar mission as glitch politics (Russell 2020), encourages us humans to open up new spaces from those unintended digital mediations (Elwood 2021). This proactive attitude represents a humanistic lens—GIS is not just a tool or scientific method for geographic inquiries but a variety of ways we humans live on the "digital" Earth. With this humanistic agenda, we are encouraged to feel the ubiquitous GIS-mediated experiences, make GIS more empathetic for humanity, and advocate for a sustainable and poetic lifestyle in the ever-changing digital world.

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Notes

1. The acronym GIS can be interpreted differently, so it is necessary to clarify its meaning for this article and for the humanistic GIS perspective. The "GI" in GIS is consistently interpreted as geographic information, but the meaning of the "S" has varied over the years: system (Tomlinson 2007), science (Goodchild 1992), studies (Forer and Unwin 1999), or service (T. Zhang and Tsou 2009). In this article, GIS is an inclusive field that has been deeply engaged by the involved industries, academic communities, and even the entire human society over the years. Not only does it cover GIScience and technologies but it also includes the arts and humanities performed with geographic information technology and the critics toward the social, political, and cultural implications of geographic information due to its constant mediation between human beings and the world.
2. Multiple terms have been adopted to describe geographical information technology, like geospatial technology, GIT, and GIS technology, to name a few. Sometimes, the term GIS is used to indicate geographical information technology as well. To be consistent, GIS technology is used in this article because it is commonly used, and abbreviated, and it implies the natural linkages between the technology and the underlying science.
3. The check-in function can be regarded as a GIS technology because it enables users to post their own locations to the Facebook platform and offers a series of mechanisms to store, process, or analyze the contributed locational information.
4. Clynes and Kline (1960) coined the term *cyborg* to describe a creature that is half human and half machine.

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