Te Awa Tupua: Sacred Rivers and Cooperative Urban AI Ecosystems

Nitin Sawhney
Aalto University
Dept. of Computer Science,
Konemiehentie 2, Room B345
02150 Espoo, Finland
nitin.sawhney@aalto.fi

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Abstract
Cities today are dynamic urban ecosystems with evolving physical, social, cultural, and technological infrastructures. Cities are increasingly embracing data-driven infrastructures and algorithmic decision-making to improve urban planning and operational efficiency as well as mobility, sustainability and safety for its residents. In this paper, I argue for a critical lens into how these inter-related urban technologies, big data and policies, constituted as *Urban AI Ecosystems,* can offer both challenges and opportunities in terms of their social, political and ecological impact. I examine these issues through three intersecting urban crises: climate change, pandemics, and racial discrimination, with the many contested conditions and responses emerging. I anchor my arguments using a rights-based discourse which I believe offers a crucial framework for critically examining and configuring the roles, values and ethical implications for all stakeholders including human, AI and non-human entities within an urban ecosystem.

Author Keywords
AI; HCI; Algorithmic Infrastructures; Big Data; Urban Ecosystems; Crisis; Ethics; Rights; Discrimination;

CSS Concepts
• Computing methodologies ~ Artificial intelligence ~ Philosophical/theoretical foundations of artificial intelligence

Introduction: Urban AI in Crisis

Cities are increasingly embracing data-driven infrastructures and algorithmic decision-making to improve urban planning and operational efficiency as well as mobility, sustainability and safety for its residents. Much of the current discussion around the use of big data, computational systems, and artificial intelligence (AI) in urban spheres, centers around so called "smart cities" and intelligent infrastructures that implicitly assume benign intentions from public and private actors involved, while the ethical implications for data-driven urbanism in society are crucial [1].

Our cities are confronted today by multiple intersecting crises, for example from the ongoing challenges of 1) climate change, inequity, affordable housing and inclusive employment for poor marginalized residents and migrant communities, 2) unprecedented adverse health and economic effects of the emerging COVID-19 pandemic, and 3) the systemic discrimination and violence against Blacks and other historically marginalized groups due to structural racism. The effects of these crises are in many ways ameliorated, amplified or mediated through the use of technologies, algorithmic infrastructures, and policies enacted in urban spaces, often affecting the most marginalized segments of the population in far more severe ways.

As a human-centred design researcher I have examined the critical role of technology, civic media, and urban interventions in crisis and society. I do this by engaging user experience design, participatory research, ethnography, and multi-modal approaches for complex contexts of human-machine interaction. I previously conducted research at MIT and The New School and have been involved in several tech startups engaged in AI, crisis and clinical informatics in the public domain. Since joining Aalto University in spring 2020, I have developed a new course on *Human-Centred Research and Design in Crisis*[1], which has informed in part my analysis for this paper. In addition to my academic research, I have co-directed documentary films around issues of political conflict in Gaza and Guatemala, and curated exhibitions showcasing the work of artists and activists engaging such issues critically in their work.

In this paper, I argue for a critical lens into how inter-related urban technologies, big data and algorithmic infrastructures, and inclusive policies for cities can be designed, adopted and better understood in their social, political and ecological urban context. I examine these issues through three intersecting urban crises: climate change, pandemics, and racial discrimination, with the many contested conditions and responses emerging. This allows us to consider speculative scenarios and pose critical questions about how we as a research community can critically re-conceptualize a notion of "Urban AI", as comprised by big data, algorithmic infrastructures, technologies, and policies increasingly adopted by cities; I believe we must do so in part by 1) conducting participatory and ethically-engaged research and design practices, 2) developing *Cooperative Urban AI Ecosystems* embracing human, AI and non-human agency, and 3) devising inclusive policies for oversight, open access, and governance that support ecological justice (social and environmental) in the urban sphere. A rights-based discourse allows us to critically confront and seek creative approaches to addressing emerging ethical concerns for Urban AI in more concrete ways, as I propose through three speculative crisis scenarios.

[1] Course website: *https://hcrdcrisis2020.wordpress.com*

Right to the City, Right to Livelihoods: Sustaining Urban Ecosystems in Mediating Climate Crises

Cities today are dynamic urban ecosystems with evolving physical, social, cultural, and technological infrastructures. Henri Lefebvre in his book *Le Droit à la ville* proposed the notion of the "right to the city" [2] to reclaim the city as a co-created space and mediate its socio-economic and spatial inequities. Lefebvre bemoaned the effects of capitalism in commodifying urban life, shared governance, and social interactions in the city [3]. David Harvey has since argued that the *right to the city* is far more than an individual liberty to access urban resources, but a means for citizens to exercise collective agency in transforming urban space and the processes of urbanization [4]. Harvey proclaims that "the freedom to make and remake our cities and ourselves is one of the most precious yet most neglected of our human rights."

This notion of *right to the city* should not simply apply to de facto citizens, but to all residents and non-human inhabitants of these changing urban ecosystems. There are many ways in which these rights are manifested today. For example, built monuments and heritage sites in cities are often designated as historical landmarks, while indigenous peoples, cultural artifacts like languages, and many vulnerable animal species are designated as legally protected. There is also an emerging drive to afford legal rights to vulnerable ecological entities. The Whanganui river in New Zealand, revered as sacred by the Māori indigenous peoples, was granted legal personhood on March 20, 2017 [5]. New Zealand's parliament passed legislation declaring that *Te Awa Tupua* (the river and all its physical and metaphysical elements) is an indivisible, living whole, and henceforth possesses "all the rights, powers, duties, and liabilities" of a legal person [6]. The river sustains many communities including the Māori tribes and the "Pakeha" (non-Maori New Zealanders), so their collective *right to livelihood* is intertwined with such legal protection and preservation. The symbolic declaration has fostered a form of shared identity and stewardship of the river, gradually displacing historical distrust with reconciliation and cooperation.

In the context of climate crises in cities, these trends offer crucial means for recognizing and embedding a broader rights-based framework in urban ecologies. Designing Urban AI ecosystems, that inevitably affect both human and non-human entities, provokes critical responses for engaging a wider sphere of stakeholders and devising means for honoring their rights to support new forms of cooperative agency. For example, data-driven urban systems that monitor and manage the flow of water transport systems in city rivers could autonomously regulate their usage and pollution. The systems would do so by warning, reducing capacity or dynamically changing tolls for private boats and public ferry traffic at certain times of day or during the year.

By treating the river as a legitimate actor, the city's algorithmic infrastructures, with a distributed network of environmental sensors, could monitor, forecast and readily act on the river's changing ecological health, thereby preserving its rights as a legal entity in the urban ecosystem. It is unlikely that such systems would be entirely autonomous but would regularly rely on the domain expertise of environmental engineers, with municipal agencies and environmental advocacy groups ideally providing oversight in a cooperative manner.

Right to Information, Right to Privacy: Contestations in the COVID-19 Pandemic

Access to information empowers citizens by informing them of their rights to voting, education, basic healthcare, and government services provided by the city. The *right to information* is considered vital for transparency, reducing corruption, and government accountability. Nearly 120 countries have laws enabling it, though in practice such information is not easily made available to all citizens, without legal advocacy and investigative journalism. In the midst of the global crisis around the COVID-19 pandemic since early spring of 2020, many governments provided clear and timely updates on the virus' epidemiological spread and public healthcare guidelines along with restrictions for physical distancing and urban mobility, in effect reducing the rate of infections. Other countries and state agencies that have intentionally hidden or obfuscated such public health statistics, while adopting less restrictive mobility measures have endangered the lives of their citizens.

In addition to widely available testing and well-prepared healthcare infrastructures, the right to information and data-driven epidemiological analysis, has been paramount to how some cities and countries successfully responded to the pandemic. Going forward as another wave of infections arise, public health agencies must continually build on such experiences while using statistical data analysis and AI/machine learning to improve modeling and prediction of epidemiological spread in urban contexts using data collected by hospitals and healthcare providers.

Another critical tool emerging in fighting the COVID-19 pandemic is *Contact Tracing* [7,8] for identifying and isolating persons who may have been in contact with infected individuals. While contact tracing has been conducted by teams of healthcare individuals, there has been a push to develop digitally-enabled contact tracing on mobile phones using either location-based or proximity-based anonymous data [9]. Systems using GPS-based location tracking and centralized data storage are particularly susceptible to privacy concerns. Norway recently halted its contact tracing app and deleted all data collected from over 600,000 active users after the Norwegian Data Protection Authority raised concerns about the disproportionate threat to user privacy from capturing location-based data [10].

Exposure Notifications, a decentralized proximity-based contact tracing framework for use with Bluetooth-based mobile phones, was created by Apple and Google [11]; it handles privacy by anonymizing personal identifiers and is being adopted by many public health authorities. However, there are still many lingering concerns about the privacy and security implications of contact tracing using mobile phones. A proposed alternative considers using anonymous physical tokens with more accurate UltraWideBand technology [12]. Researchers have also proposed improving privacy by collecting anonymous statistics and conducting epidemiological modeling to monitor the probability of infections over time [13,14].

Many computer vision researchers have proposed monitoring of crowds using video cameras installed in public spaces to analyze crowd behavior and physical distancing measures, while supporting some forms of privacy preservation [15]. While these would rely on people's spatial and movement patterns instead of facial recognition, there are implications for privacy and agency in public, harkening a dark surveillance state.

The *right to privacy* allows for selectively revealing oneself to the world and is considered a fundamental human right. While the concept varies according to culture and context, it often enshrines protection of one's personal and confidential data, as well as their locations, movements, communication exchanges, and transactions. In the digital realm, the right to privacy is supported by most European Union (EU) countries through compliance with the *General Data Protection Regulation* (GDPR). *MyData* initiatives embraced by many cities offer a policy declaration to "empower individuals by improving their right to self-determination regarding their personal data", as a human-centric paradigm for data sharing [16].

Interestingly, these principles have not yet been applied to non-human entities; yet there may be a case for doing so in complex urban ecologies. Embedding frameworks for both open information access and robust privacy policies can allow cities to develop more trusted, secure and flexible Urban AI ecosystems that preserve privacy while enabling novel ways to securely share information with algorithmic data infrastructures.

One such city-wide system we have proposed, *Voice for Urban Mobility*, would offer voice-enabled symptom monitoring and urban mobility services via mobile apps and public kiosks to vulnerable residents and travelers between Helsinki, Finland and Tallinn, Estonia [17]. In the midst of the COVID-19 pandemic and urban crisis, the system would offer responsive, inclusive and accessible services to residents and travelers to assess their ecological health and well-being, adopt effective urban behavioral changes, and support safe mobility within and across cities to mitigate these effects.

The project would provide secure personalized voice-enabled services for travelers and families to monitor their collective symptoms in *Urban Well-being Diaries*, while assessing ecological measures of physical, mental and urban well-being in their daily lives. It would guide travelers and vulnerable residents (esp. patients, elderly, migrants, and the disabled) in seeking health and urban mobility services via mobile apps and *Urban Voice Portals* installed in heavily-visited public places like libraries, train stations, ferry ports, health clinics and markets in Helsinki and Tallinn. No personal data would be elicited at the public kiosks. All data on users' mobile devices would be decentralized and encrypted to protect user privacy using GDPR principles. Secure data sharing with family members, healthcare providers, and authorized city agencies would be supported using *MyData* principles, currently adopted by both Finland and Estonia. While this is a concept proposal, we hope to design and prototype the mobile and voice-enabled services to conduct a small-scale pilot for participatory research to validate the approach in urban contexts.

Right to Equality and Non-Discrimination, Right to Free Assembly: Racial Profiling, Predictive Policing, and Urban Protests

Discrimination is a multi-faceted social phenomenon that cuts across many public, private and socio-cultural spheres of society. While explicit forms of racism as manifested in violence against Blacks and historically marginalized groups are being more widely reported in the media today, many discriminatory practices are implicitly embedded in the systems created and used by the state, private companies, and civil society on a daily basis. These serve to further disenfranchise marginalized individuals and communities in areas of health, education, housing, employment, and political

participation among others facets of civic life. The *Universal Declaration of Human Rights*, adopted with the founding of the United Nations in 1948, and many subsequent international conventions have declared the *right to equality and non-discrimination* for all people without distinction as to race, sex, language or religion; these principles were expanded to specifically combat discrimination against women, indigenous peoples, and people with disabilities among others, or discrimination based on sexual orientation and gender identity.

Algorithmic decision-making systems today are rife with both explicit and implicit biases that entrench such discrimination in the civic and urban spheres of people's lives. In a recent book mathematician and data scientist Cathy O'Neil critiques the widely held assumption that big data reduces or eliminates human bias and subjectivity, while predictive models are simply "opinions embedded in math" [18]. She details the many ways in which algorithms often perpetuate or even worsen inequality and injustice. MIT researcher Joy Buolamwini has investigated how facial recognition algorithms have deeply flawed gender and skin-based biases, often incorrectly classifying them over a third of the time in the *Gender Shades* project [19].

With such glaring racial and gender discrepancies, decision-making systems relying on such flawed algorithms for surveillance, identification or policing would misclassify many marginalized people as criminals, leading to racial profiling. Researchers at UCLA found that Amazon's commercially available facial recognition software, *Rekognition*, incorrectly matched dozens of students and faculty to actual criminals, the vast majority of them being people of color [20]. A similar test conducted by the American Civil Liberties Union (ACLU) with members of the U.S. Congress also wrongly classified many of them with criminality, the overwhelming majority of the false positives being that of Black and Latino legislators [21]. While some would argue that more comprehensive training data would address such biases, I believe the very act of designing AI infrastructures of power and control, embedded in our urban realm and everyday life through public and private surveillance or provision of services, continually perpetuates discriminatory practices and inequity.

The global outcry and widespread *Black Lives Matter* (BLM) protests amplified since late-May 2020, following the recent killing of George Floyd and ongoing violence against Blacks and people of color by the police, has brought greater scrutiny to the use of facial recognition and racial profiling by law enforcement agencies. Since then IBM has decided to stop offering general purpose facial recognition or analysis software [22]. In March 2020, Microsoft divested its stake in an Israeli company AnyVision following controversy over facial recognition targeting Palestinians in the occupied West Bank [23].

Racially-biased policing has also led to a scrutiny of AI-based programs for *Predictive Policing*, pioneered by the Los Angeles Police Department (LAPD). These algorithm-driven systems analyze crime data to find patterns predicting where in the city crimes are likely to be committed to re-direct police resources. In 2011, the LAPD deployed a tool, *PredPol*, which they helped develop for location-based analysis of historical crime data [24]; however, critics have pointed out that such data is overwhelmingly biased towards communities of color whom the police has regularly stopped, detained, frisked and arrested. *Stop LAPD Spying Coalition* stated that "because historic crime data is biased through the

practice of racialized enforcement of law, predictive policing will inherently reinforce and perpetuate this structural racism." [25] Analysis conducted by the *AI Now Institute* at NYU of predictive policing data across three U.S. cities showed that using it in jurisdictions with extensive histories of unlawful police practices elevates the risks that "dirty data" would lead to flawed or unlawful predictions, in turn further perpetuating criminal injustice for these communities [26,27].

The recent protests have not only highlighted these concerns at the national and global stage, but have also shown how police have violently targeted protesters themselves, most of them disproportionately Black and people of color. World-wide protest movements have continued exercising their *right to free assembly* despite the imposition of curfews, violence and police surveillance to identify and target protestors for arrest. The networks of surveillance cameras using AI-enhanced facial identification of protestors in public spaces in China and the U.S. have turned them into technologies for countering protests and oppression of dissent. However, mobile video in the hands of citizens and protestors too have offered testimonial evidence circulated widely in the media to hold law enforcement agencies accountable for their actions. However, this alone is insufficient for justice, as historically such video testimony has rarely led to police convictions [28]; they must be backed by stronger laws for oversight and reform of law enforcement, as currently being debated.

Rethinking Urban AI Ecosystems

Supporting open, vibrant, and pluralistic urban spaces in cities, free of oppressive and discriminatory practices towards all its residents, requires radically altering how we imagine the role of law enforcement, state, private and city residents and how they can participate in multi-faceted aspects of urban civic life. Technologies and digital infrastructures devised to support these complex urban ecologies must also share emerging values, principles, and cooperative sensibilities, that honor the rights and responsibilities of all stakeholders. The three scenarios of urban crises discussed here highlight the many inter-related challenges, ethical implications, and opportunities for critically rethinking the role of algorithmic infrastructures, big data, novel technologies, and inclusive policies that collectively constitute what I refer to here as Urban AI ecosystems.

In this paper, I have anchored my arguments using a rights-based discourse which I believe offers a crucial framework for critically examining and configuring the roles, values, and implications for all stakeholders (human, AI and non-human entities) within an urban ecosystem. It suggests that envisioning Urban AI in cities requires inclusive approaches, embracing an ecosystem of rights and social contracts, and designing for ecologies of cooperation and contestation [29,30]. As we consider how sacred rivers like *Te Awa Tupua* serve as living infrastructures of natural ecosystems, we recognize how they remain resilient through the inter-generational stewardship of diverse communities relying on them for their livelihoods. Sustained Urban AI ecosystems must similarly be designed, deployed, and used through cooperative and inclusive initiatives.

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