AI and the Right to Housing

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Abstract

This chapter considers the implications of AI for the right to housing. It argues that the intersections between AI and housing cover areas as wide as real estate finance and the (broader) finance and insurance industry; aspects of the built environment; to management and interventions at the level of the individual dweller such as control of thermostats and smart doorbells. While much of the literature on housing and AI focuses on ways that AI can negatively impact experiences of housing and home, this chapter also draws readers' attention to AI as means through which enjoyment of the right to housing can be advanced. The chapter defines the right to housing in international law, then explores the ways that AI technologies can have both positive and problematic applications in the field of housing. We argue that human rights law provides standards through which we can attempt to regulate such technologies and provide a framework of principles against which to evaluate them.

Keywords: AI; right to housing; home technologies; human rights and AI; justice

1 Introduction

The aims and implications of Artificial Intelligence (AI)[1] and its applications to housing are global in scope,[2] as are the aims and implications of human rights, which are embedded into international law as global standards. Moreover the applications of AI to housing are potentially vast, spanning from the panoramic, to the granular. The intersections between AI and housing cover areas as wide as real estate finance and the (broader) finance and insurance industry; aspects of the built environment, from urban planning to refuse collection to transport; to the management and interventions at the level of the individual dweller (with a myriad of tiny daily impacts in, over and around the home) such as control of thermostats and smart

[1] For the purpose of this chapter, we treat AI as being automated decision making or alerts, based on a range of different computer methodologies. For the concept of AI and definitional matters, see also chapter x

[2] See Mara Ferreri and Romola Sanyal, 'Digital Informalisation: Rental Housing, Platforms, and the Management of Risk' (2021) Housing Studies (advance), 2.

doorbells. There is no aspect of housing that AI might not impact, given the scope of its applications and rapidity of its development. For these reasons, an evaluation of the intersections between AI and the right to housing is both pressing and timely.

Although national and supra-national law-making bodies are actively considering the implications of AI for human rights, the impacts on the right to housing have not, so far, been addressed in any detail.[3] Scholars are also only beginning to discuss AI and the right to housing.[4] This is also an area that is so far, underexplored in UN human rights standard setting and other benchmarking or monitoring processes. For example, the UN Special Rapporteur on Adequate Housing's recent report on Housing Discrimination and Spatial Segregation does not discuss the impact of AI,[5] despite AI's deep implication in housing discrimination as discussed below, although the UN Special Rapporteur on Extreme Poverty and Human Rights is attuned to the issue in the broader social welfare context.[6]

While much of the literature on housing and AI focuses on ways that AI can negatively impact experiences of housing and home, in this chapter we also wish to draw readers' attention to AI as means through which enjoyment of the right to housing can be advanced. We begin

[3] See eg European Union Agency of Fundamental Rights, 'Getting the Future Right: Artificial Intelligence and Fundamental Rights' (European Agency of Fundamental Rights, 2020); European Commission, 'Proposal for a Regulation of the European Parliament and of the Council: Laying Down Harmonised Rules on Artificial Intelligence' (Artificial Intelligence Act) and Amending Certain Union Legislative Acts (21/4/2012) COM(2021) 206 Final.

[4] See, eg,Yin Xu and Hong Ma, 'Research and Implementation of the Text Matching Algorithm in the Field of Housing Law and Policy Based on Deep Learning' (2021) Complexity; Gellers, Joshua Chad and Gunkel, David, Artificial Intelligence and International Human Rights Law: Implications for Humans and Technology in the 21st Century and Beyond (April 1, 2022). Gellers, J.C. & Gunkel, D. (2022). "Artificial Intelligence and International Human Rights Law: Implications for Humans and Technology in the 21st Century and Beyond." In A. Zwitter and O.J. Gstrein (Eds.), Handbook on the Politics and Governance of Big Data and Artificial Intelligence. Cheltenham, Available at SSRN: https://ssrn.com/abstract=4072896. See also Project Evict, which is using data analysis to gather information on evictions and connect it to an analysis of the right to housing, see < https://www.eviction.eu/data-science-eviction-law/ >.

[5]See Report of the Special Rapporteur on adequate housing as a component of the right to an adequate standard of living, and on the right to non-discrimination in this context, Balakrishnan Rajagopal, *Discrimination in the Context of Housing* (14 October 2021) A/76/408.

[6] See Brief by UN Special Rapporteur on extreme poverty and human rights as Amicus Curiae in the case of NJCM c.s. / De Staat der Nederlanden (SyRI) before the District Court of the Hague (case number C/09/550982/HA ZA /18/388).

the chapter by defining the right to housing – concentrating specifically on the right under the ICESCR, as the international standard for the right, and also the right under the Revised European Social Charter given the vigorous debates over balancing AI and human rights in Europe. We then turn to discuss first, uses of AI that impact negatively on the right to housing; and second beneficial applications of AI for the right to housing.

Our conclusion is that AI technologies have both positive and highly problematic applications in the field of housing. While many of the technologies may themselves be neutral,[7] their use will unfold in a world of pre-existing unequal power relations, biases, and structural inequalities. As such, their uses may very often exacerbate these inequalities and biases, leading to the violation of human rights, including the right to housing. However, human rights law provides standards through which we can attempt to regulate such technologies and provide a framework of principles against which to evaluate them.

2 Defining the Right to Housing in International Law

The right to housing has been recognised as part of international human rights law since its inclusion in the 1948 Universal Declaration of Human Rights. It is now codified in, or implied into, several international and regional human rights treaties,[8] and numerous national constitutions.[9] The international standard is the ICESCR, ratified by over 170 states. This treaty

[7] But see the longstanding debate about the politics of technologies, eg Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (University of Chicago Press, 1986); Merrit Roe Smith and Leo Marx, (eds) *Does Technology Drive History?: The Dilemma of Technological Determinism* (MIT Press, 1994).

[8] These human rights instruments are discussed in more detail in Jessie Hohmann, *The Right to Housing: Law, Concepts, Possibilities* (Hart 2013) Rights' (Ch 1); The Right to Housing in Subject-Specific International Conventions' (Ch 2) and 'The Right to Housing in Regional Covenants' (Ch 3).

[9] See M Oren and R Alterman 'The Right to Adequate Housing Around the Globe: Analysis and Evaluation of National Constitutions' in Sandeep Agarwal (ed), *Rights and the City: Problems, Progress and Practice* (forthcoming, chapter on file with author). The most well known and influential of these are the South African and Indian Constitutions, discussed further in Hohmann, see above note 6, Ch 4.

includes the right to adequate housing – more than mere shelter – as part of the broader right to an adequate standard of living, in Article 11(1):

> The States Parties to the present Covenant recognize the right of everyone to an adequate standard of living for himself and his family, including adequate food, clothing and *housing*, and to the continuous improvement of living conditions…

The Committee on Economic Social and Cultural Rights (CESCR, Committee) which oversees the implementation of the Covenant by State Parties, has defined the right as, at root, 'a place to live in peace, dignity and security.'[10] This means that the right is about more than four walls and a roof. Adequate housing connects to community, to rights to political and public life, to self-expression (even self-determination) and privacy.[11] In its authoritative statement on the content and scope of the right, the Committee has stated that adequate housing is made up of seven essential elements, all of which must be present to at least the level of a minimum core. These are: legal security of tenure; availability of services, materials, facilities and infrastructure; affordability; habitability; accessibility; location; and cultural adequacy.[12] Implicit within Article 11(1) – and explicit within the ICESCR as a whole[13] – is the requirement for non-discrimination in housing. States' obligations for the right (in Article 2(1) of the Covenant) further clarify its scope. These obligations include a mix of immediate and longer-

[10] UN CESCR, 'The Right to Adequate Housing (Article 11(1)): Committee on Economic, Social and Cultural Rights, General Comment 4' (1991) E/1992/23, para 7.
[11] See further Hohmann, see above note 6, part II (on privacy, space, and identity). On self-determination see 'Report of the Special Rapporteur on Adequate Housing as Component of the Right to an Adequate Standard of Living, and on the Right to Non-Discrimination in this Context' (17 July 2019) A/74/183.
[12] General Comment 4 (n 8) para 8; see for further discussion Hohmann, see above note 6, 2013 20-29.
[13] ICESCR, Art 2(2). Non-discrimination is also a norm of customary international law, and as such not subject to the standards of progressive realisation contained in the covenant, but imposes an obligation of immediate fulfilment. On immediate obligations and discrimination see UN CESCR 'General comment No. 20: Non-discrimination in Economic, Social and Cultural Rights (art. 2, para. 2, of the International Covenant on Economic, Social and Cultural Rights)' 2 July 2009, E/C.12/GC/20 para 8.

term obligations arising from Article 11 and Article 2(1). Immediate obligations include those which do not entail major resources, such as the repeal of discriminatory laws, and the regulation of private sector actors such as the real estate and construction industry,[14] and enabling people to access adequate housing without undue legal and political barriers. Beyond immediate obligations, the ICESCR requires states must move toward *full* realisation of the right for all, using the maximum available resources at their disposal. To do so may require positive action such as subsidising housing for those unable to access it in the market, and more broadly ensuring a social system in which the vulnerable and marginalised are able to live in peace, dignity and security, which may require broader social welfare measures (such as social security) the protection of other social rights (such as the right to decent work) and steps toward a more just and equitable society.[15]

In Europe,[16] the right to housing is also recognised under the Revised European Social Charter (the 'Social Charter') in Article 31, which the European Social Committee has interpreted robustly. This right imposes three obligations. First, under Article 31(1), the state is to promote access to housing that is of an acceptable standard. The second, under Article 31(2), is an obligation for the prevention of homelessness, and its reduction over time, with the ultimate aim being its elimination. The third obligation, corresponding to Article 31(3), is specifically concerned with affordability for those without adequate resources.

The Social Committee has taken notable steps to explain the scope of the right to housing in its collective complaints jurisprudence.[17] It has defined adequate housing as '[a]

[14] On obligations to regulate private actors and the repeal of discriminatory laws see 'Report of UN Special Rapporteur on Adequate Housing as a Component of the Right to an Adequate Standard of Living, and on the Right to Non-Discrimination in this Context' (14 October 2021) A/76/408 para 9. For a detailed treatment of obligations under the covenant see M Sepúlveda Carmona, *The Nature of the Obligations Under the International Covenant on Economic, Social and Cultural Rights* (Intersentia 2003).

[15] See Hohmann, above note 6, Ch 1.

[16] Note also the right to housing assistance in the EU Charter of Fundamental Rights. Charter of Fundamental Rights of the European Union 2012/C 326/02, Art 34(3).

[17] The Committee has implied the standards of adequate housing into other provisions of the Social Charter that have a more marginal reference to housing, including Article 16's protection of the family. See *European Roma*

dwelling which is safe from a sanitary and health point of view, that is, possesses all basic amenities, such as water, heating, waste disposal, sanitation facilities and electricity; is structurally secure; not overcrowded; and with secure tenure supported by law'.[18] In its decisions the Committee has also defined affordable housing,[19] and has noted that affordability should not be measured with reference to the average person, but the poorest.[20] With regard to eviction and the right to housing, the Committee has held that evictions must be undertaken 'in conformity with the dignity of the persons concerned'.[21] Procedural guarantees are necessary.[22]

The Committee has clarified that the state must take a number of steps to demonstrate compliance with the right under the Social Charter.[23] Like obligations under the ICESCR, states parties are required to move toward full realisation of adequate, affordable housing, and ensure that their legislative and policy frameworks promote access to housing for all. Where people are unable to access housing in the market, the state may need to subsidise or otherwise provide housing through positive measures.

With a clearer picture of the right to housing's scope and the obligations it entails, we now turn to discuss AI and its applications in the sphere of housing, specifically discussing their implications for the right to housing.

Rights Centre v Greece, Complaint no 15/2003, decision on the merits of 7 February 2005, para 17; *Centre on Housing Rights and Evictions (COHRE) v Italy*, Complaint no 58/2009, decision on the merits of 25 June 2010, para 115. This bold interpretive move has made an 'almost peripheral' reference to housing a central housing rights provision under the Social Charter. See Urfan Khaliq and Robin Churchill, 'The European Committee of Social Rights: Putting Flesh on the Bare Bones of the European Social Charter' in Malcolm Langford (ed), *Social Rights Jurisprudence: Emerging Trends in International and Comparative Law* (CUP 2008) 429, 448.

[18] *European Federation of National Organisations working with the Homeless (FEANTSA*) *v France*, Complaint no 39/2009, decision on the merits of 5 December 2007, para 76. See also *ERRC v Greece*, ibid., para 16. This has been expanded to include access to fresh water. *European Roma Rights Centre v Portugal*, Complaint no 61/2010, decision on the merits of 30 June 2011, para 36.

[19] *FEANTSA v France*, ibid., para 124 *COHRE v Italy*, see above note 16, paras 41-42.

[20] *European Federation of National Organisations Working with the Homeless (FEANTSA) v Slovenia*, Compliant n. 53/2008, decision on the merits of 8 September 2009, para 72.

[21] *COHRE v Italy*, see above note 16, para 67.

[22] *Centre on Housing Rights and Evictions (COHRE) v France*, Complaint no. 63/2010, decision on the merits of 28 June 2011, para 41-42.

[23] See *FEANTSA v France*, ibid., para 56.

3 The Application of AI in the Housing Sphere

3.1 AI and Violations of the Right to Housing

It is becoming increasingly clear that AI and its uses in the field of housing can have discriminatory effects, which undermine efforts to realise a right to housing. Among these are platforms which connect landlords and tenants, or house-mate with house-mate; services that offer automated tenant screening services, even automated evictions; and practices of 'algorithmic redlining'. These specific examples, which we discuss further below, sit within a broader global financial sector – a political economy – which also increasingly relies on AI. For example, a range of platforms seek to aid those with capital wishing to invest it in real estate. These are normally geared to large investors or funds but can have smaller scale applications too.[24] These AI tools are engaged at multiple scales, in service of the financialisation of real estate.[25] Financialisation itself, as the UN Special Rapporteur on Housing has pointed out, is detrimental to the ability of ordinary people, and especially those with low income, to access adequate housing.[26] The linking of housing into broader global financial circuits, for the purpose of making money for investors in those circuits, is thus a challenge for the right to housing generally.[27] One of the significant roles played by AI here is in accelerating the rate of transactions,[28] through which AI further attenuates the relationship between housing and its use value, as a place to live in peace, dignity and security. The human-

[24] Joe Shaw, 'Platform Real Estate: Theory and Practice of New Urban Real Estate Markets' (2020) 41 Urban Geography 1037. 1048-1049.
[25] Desiree Fields and Dallas Rogers, 'Towards a Critical Housing Studies Research Agenda on Platform Real Estate' (2021) 38 Housing, Theory and Society 72, 81.
[26] 'Report of the Special Rapporteur on Adequate Housing as Component of the Right to an Adequate Standard of Living, and on the Right to Non-Discrimination in this Context' UN DOC A/HRC/34/51 (18 January 2017)
[27] Ibid.
[28] Michael A Peters and Tina Besley, 'Critical Philosophy of the Postdigital' (2019) 1 Postdigital Science and Education 29; Sarah Keenan, 'From Historical Chains to Derivative Futures: Title Registries as Time Machines' (2019) 20 Social & Cultural Geography 283.

centered basis of human rights insists instead on the importance of the relationship between the person and the home as living space.

'Algorithmic redlining' is also of serious concern. It both sits within and perpetuates a financialised housing system. This practice occurs where big data use by both public and private actors perpetuates the practice of excising minorities from access to housing credit or finance.[29] Algorithmic redlining relies on pre-existing discrimination – such as the data from historic redlining. At the same time, its reliance on big data and automated decision making from other areas compounds the discrimination, as it gathers in other discriminatory scoring and targeting technologies,[30] such as those discussed further in paragraphs below. Algorithmic redlining removes accountability on the basis of discriminatory intention, instead dressing discriminatory effects in the legitimating clothes of objectivity, even if the criteria for decisions are unknown, as they are when neural nets are used. A 2020 US case *Connecticut Fair Housing Center v CoreLogic Rental Property Solutions* serves as an example. The applicant challenged the decision, made through an automated screening process, to deny her disabled son access to housing because of a shoplifting charge brought against him (but subsequently dropped) before his disability. The Court was unable to find that CoreLogic's algorithmic decision-making tools either did *or* did not breach the Fair Housing Act, even while finding that the application used, CrimSAFE, 'may be, but is not necessarily as a matter of law, a proximate cause of housing discrimination'. [31] In other words, the Court chose not to look inside the 'black box' of the AI to determine if discrimination did in fact occur, even when the effect appeared discriminatory.[32]

[29] James A Allen, 'The Color of Algorithms: An Analysis and Proposed Research Agenda for Deterring Algorithmic Redlining' (2019) XLVI Fordham Urban Law Journal 219.
[30] Ibid., discussing the interaction between housing finance and, for eg, payday loans.
[31] *Connecticut Fair Housing Center et al v CoreLogic Rental Property Solutions* [2020] District Court of Connecticut 3:18-CV-705 (VLB).
[32] For a discussion of the Court's difficulty in examining the 'black box' in the Dutch SyRI case, see Rachovitsa and Johann, 11.

Another way in which AI can work against realising the right to housing is in the realm of a number of services that use big data, sourced from social media, rental contracts and the supporting documentation required to enter a tenancy (such as bank statements), on a host of platforms that offer to match tenants with landlords, and house mate with house mate. A suite of highly profitable companies provide automated credit, reference, and employment checks derived from a range of data sources to landlords.[33] For those whose life trajectory reflects dominant narratives of 'good' or acceptable behaviour, the automation of these checks can be straight forward, albeit significantly increasing the cost of a rental transition. For example, one website allows tenants to purchase a product called RentCheck, where tenants can 'request to be endorsed as an awesome renter by your previous property managers'.[34] This renders something previously required as a matter of due diligence by new landlords into a product that must be purchased by the tenant. For renters, particularly those whose life trajectory differs from the mainstream, the loss of an opportunity to self-represent and explain can cost them the opportunity for housing. This is directly contrary to the right to housing requirement of accessibility for disadvantaged and marginalised groups.[35] These tenant screening services can clearly enable private parties and institutional landlords to discriminate against tenants on grounds prohibited under human rights law (such as race), while simultaneously reinforcing structural biases and spatial segregation on a more systemic level.

Automated decision making extends into the realm of software promising to manage all aspects of a tenancy, not only finding a tenant but automating maintenance and the ongoing landlord tenant relationship. Some firms even promise automated eviction triggered by

[33] see, for example, 'Renter Resume | Free Rental & Tenancy Application Form Online' <https://www.rent.com.au/resume> accessed 23 February 2022.
[34] ibid.
[35] UN CESCR, *General Comment No. 4: The Right to Adequate Housing (Art. 11 (1) of the Covenant)*, 13 December 1991, E/1992/23, para 8(e).

algorithm.[36] Such automated eviction contravenes the strict procedural requirements around eviction, as well as undermining security of tenure, both recognised as crucial elements of adequate housing in human rights law. [37]

Finally, a host of technologies involving the 'smart home' and the internet of things can be used to surveil and manage tenants in ways that violate the home's nature as a private space,[38] and that might undermine elements of the right to adequate housing including security of tenure, and cultural adequacy, for example, even as they may make housing more accessible, as we discuss further below.

These forms of AI and their discriminatory applications have concerning implications for the realisation of the right to housing. They deserve attention and critique, as well as regulation, to ensure that they are not used in contravention of the right. However, while they are the most commented on and visible of negative impacts on the right to housing, it is important to point out that AI's applications in the field of housing are not confined to concerns about discrimination. AI can be used to remake the urban[39] – and rural – infrastructure of our States changing the shape of cities and societies as a consequence. Accordingly, we must not only pay attention to the specific, but also to the background landscape of finance, infrastructure, and political economy, as noted at the beginning of this section.

4 AI as a Means Through Which to Realise the Right to Housing

[36] For a discussion, please see Erin McElroy, 'Property as Technology: Temporal Entanglements of Race, Space, and Displacement' (2020) 24 City 112.
[37] See UN CESCR, *General Comment No. 7: The Right to Adequate Housing (Art.11.1): Forced Evictions*, 20 May 1997, E/1998/22; General Comment No 4, see above note 33, para 8(a).
[38] For a comprehensive discussion of AI and privacy rights, see the chapter by Cofone et al and the one by González in the present volume. See also Hohmann (n 6) Ch x 'Privacy'.
[39] See Shaw for an argument that platform real estate is a quintessentially urban phenomenon Shaw (n 28) 1055–6.

Despite this concerning picture, it would be wrong to suggest that all AI works against the realisation of the right to housing. Acknowledging the importance of technological advance in helping improve the human condition, we turn to discuss three instances where AI might be used to realise or ensure the right.

4.1 Disaster Risk Reduction

Natural disaster presents a perennial risk to many billions of people,[40] a risk significantly exacerbated by anthropogenic climate change.[41] Floods, droughts, bush or wildfires, and major storm events threaten housing stock, reduce the utility of areas, thus impacting access to, and the quality of, housing. Protecting the right to housing in the context of natural disasters has long been a focus of the UN Special Rapporteur's on housing, one that the Special Rapporteurs note will only become more urgent in the face of climate change, rapid urbanization, and population growth.[42] The city of Jakarta, for example, is particularly vulnerable to the impact of flooding, and has been subject to regular, major flooding events since the 1990s.[43] The city sits on a delta, which is highly polluted and many of the canals are lined with informal settlements.[44] The city's flooding is expected to become significantly worse in coming decades,[45] directly impacting the ten and a half million people who called the city home in 2020.[46]

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[40] Peijun Shi and others, 'World Atlas of Natural Disaster Risk', *World Atlas of natural disaster risk* (Springer 2015).
[41] Maarten K Van Aalst and others, 'The Impacts of Climate Change on the Risk of Natural Disasters' (2006) 30 5.
[42] See Raquel Rolnik, *THE HUMAN RIGHT TO ADEQUATE HOUSING IN* (Flavia Zorzi Giustiniani ed, Routledge 2018) 181,; Report of the Special Rapporteur on Adequate Housing as a Component of the Right to an Adequate Standard of Living, and on the Right to Non-Discrimination in This Context, Miloon Kothari, UN Doc. A/HRC/7/16 (13 February 2008) paras 2, 81–86.
[43] Christopher Silver, *Urban Flood Risk Management: Looking at Jakarta* (Routledge 2022).
[44] ibid.
[45] Hiroshi Takagi and others, 'Projection of Coastal Floods in 2050 Jakarta' (2016) 17 Urban Climate 135.
[46] Badan Pusat Statistik, 'Sensus Penduduk 2020 - 2020 census Indonesia' <https://sensus.bps.go.id/main/index/sp2020> accessed 2 December 2021.

AI is being used to respond to this risk, particularly using social media and sensor informed platforms that alert citizens and government to flooding events as they occur. Developed following significant flooding in 2013 and 2014, are projects such as Peta Jakarta and PetaBencana.[47] PetaBencana, which utilises CogniCity software, pulls data from several sources. Using the Twitter API,[48] the platform contacts users who have geotagged a tweet with 'flood' or 'banjir' via a message, asking them to confirm if there is a flood in their area. Users are asked to provide information on specific location, depth of water, to upload an image, and any other information. The platform also pulls government GIS (geographic information system) data, and government field officers can add information, while also pulling data from government APIs streaming rainfall data and data from gauges on pumps, waterways, and floodways. This information is processed to present a map outlining flood risk to both public and government. The platform can then 'develop predictive tools to ready [Jakarta] for future disasters and become more resilient in day-to-day operations'.[49] The data can be used to inform city policy that responds to flood risk to residents' housing. This directly responds to the need for housing to be habitable – that is, safe for the residents to live in.[50] It also may, indirectly and depending on state policy responses, respond to elements of location and of access to materials, services, facilities and infrastructure.[51] This is if responses take into account protecting current housing (and its location) through improved flood response infrastructure. In these ways, it can further enjoyment of the right to adequate housing.

[47] Peta Jakarka the product of a partnership between BPBD (Jakarta regional disaster management agency), Jakarta Province, Twitter, and the SMART Infrastructure Facility at the University of Woolongong PetaBecana is being developed by the Urban Risk Lab at the Massachusetts Institute of Technology, which is furthering development of the CogniCity software platform

[48] An API is an Application Programming Interface. It is the point of contact between to applications. In this instance, the Twitter API is the interface that allows users to engage with the tweets posted to Twitter.

[49] 'CogniCity' (*Intellegent City Software and Soloutions*, 15 September 2016) <https://icos.urenio.org/applications/cognicity/> accessed 2 December 2021.

[50] General Comment 4, see above note 33, para 8(d).

[51] Ibid., para 8(f) and (b).

On the other hand, the data may be used to displace residents in flood prone areas, without adequate consultation or attention to the communal aspects of living that the right to housing also seeks to protect. They may be displaced due to an assessment of high risk, or their homes may be removed to make place for disaster mitigation infrastructure that primarily services others. This links in with the gaps in the data that the platform captures. PetaBencana, like all data-processing tools, demonstrates inherent limitations to what data is utilised, and its accessibility and utility. Somewhere between one to two percent of all tweets, worldwide, are geotagged.[52] This means most of all possibly relevant tweets are not captured by the PetaBencana platform. Given that using location services costs battery life (and when using apps, data), and accessing Twitter in the mode anticipated by the platform a smart phone, we would imagine that areas frequented by poorer Jakartans are less represented on the platform. This is of particular concern because government attention flows because of platform suggestions, with the National Emergency Management Agency using the platform to inform actions.[53] This could result in potential protection of the housing of those who are better off, rather than according to actual housing need, and pushes against the right to non-discrimination in housing in post-disaster settings.[54] Nonetheless, while gaps in data creation might create imperfect maps, the enthusiastic uptake of the PetaBencana platform by the Indonesian government speaks to its actual utility. Flooding events can be highly localised and occur very rapidly, outflanking the capacity of government officials to respond in time. Real-time information improves decision making and leads to high quality predictions, improving disaster response, with the real potential to contribute to the enjoyment of the right to safe, habitable housing.

[52] Stephan Schlosser, Daniele Toninelli and Michela Cameletti, 'Comparing Methods to Collect and Geolocate Tweets in Great Britain' (2021) 7 Journal of Open Innovation: Technology, Market, and Complexity 44.
[53] PetaBencana, 'Software – PetaBencana.Id' <https://info.petabencana.id/research/software-2/> accessed 2 December 2021.
[54] Rolnik (n 47).

4.2 Remaining in place

We turn now to our second example of how AI-utilising technology can improve the experience of, and access to, housing. Australia,[55] Europe,[56] the USA,[57] and China[58] – amongst others – are experiencing rapidly ageing populations. This presents several challenges for ensuring the right to housing for older persons, as well as persons with disabilities, both of whom the UN CESCR recognises as entitled to special consideration to ensure their right to housing.[59] Here, we focus on those who desire to remain living in their existing houses for as long as possible, despite requiring significant support to do so. We highlight how ambient AI informed technology, that is, tech embedded into the house and operating without direct or immediate input from users, can make both home and life-in-general safer; it will extend the time older persons can remain in their homes before requiring supported housing.[60] This responds importantly to the strong link between the right to housing and the concept of home. While the right to housing does not protect a home per se, the seven elements of the right combine to protect housing that is freely chosen, individually meaningful and connected to the local community (through the elements of location and cultural adequacy for example). Similarly, people with disabilities that require constant supervision or supportive assistance may be able

[55] 'Twenty Years of Population Change | Australian Bureau of Statistics' (17 December 2020) <https://www.abs.gov.au/articles/twenty-years-population-change> accessed 4 December 2021.
[56] Eurostat, 'Population Structure and Ageing - Statistics Explained' (*Eurostat: statistics explained*, June 2021) <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Population_structure_and_ageing> accessed 4 December 2021.
[57] US Census Bureau, '65 and Older Population Grows Rapidly as Baby Boomers Age CB20-99' (*Census.gov*, 25 June 2020) <https://www.census.gov/newsroom/press-releases/2020/65-older-population-grows.html> accessed 4 December 2021.
[58] Xizhe Peng, 'Coping with Population Ageing in Mainland China' (2021) 17 Asian Population Studies 1.
[59] General Comment no 4, para 8(e).
[60] L Yamshon, 'AI Technologies May Drive Down Demand for Seniors Housing in the Short Run' [2019] National Real Estate Investor.

to avoid having to live in care, in line with the right to independent living under under Article 19 of the Convention on the Rights of Persons with Disabilities.[61]

We recognise much of this technology is nascent – one recent meta-analysis finding no 'convincing proof of a clear effect'[62] for ambient health monitoring. Nonetheless, the enormous financial and economic incentives for reducing the costs of aged and supportive care indicate the likelihood of continuing advancement in this sphere and may lead in important ways to the fulfilment of the right to housing as a human right. It is particularly important in recognising that states have an obligation to ensure that housing is accessible for groups with special needs or who are vulnerable such as older persons and persons with disabilities,[63] and that many situations of supported housing or institutionalised care can lead to a range of human rights violations.[64]

In this section, we discuss a proposed platform for ambient assisted living for people with dementia in the early stages of cognitive decline. The AnAbEL platform is our exemplar, as it seeks to deal with shortcomings in existing ambient technology.[65] The platform seeks to meet two needs. It helps people with dementia maintain their independence for as long as possible. It also supports caregivers, as families may need to have someone take time away from work to support older family members. This technology will potentially reduce their need to be absent from the workplace while ensuring the safety of those they care for.

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[61] UN General Assembly, Convention on the Rights of Persons with Disabilities, A/Res/61/106.
[62] Ju Wang and others, 'Unobtrusive Health Monitoring in Private Spaces: The Smart Home' (2021) 21 Sensors 864, 863.
[63] General Comment No 4, para 8(e).
[64] As revealed for example by the recent Australian Royal Commission into Aged Care Quality and Safety see Royal Commission into Aged Care Quality and Safety Final Report (26 February 2021) available at https://agedcare.royalcommission.gov.au/publications/final-report. See also Linda Steele et al, Human Rights and the Confinement of People Living with Dementia in Care Homes (2020) 22(1) Health and Human Rights Journal 7.
[65] Designed by scholars from the Research Group on Development of Intelligent Environments. Department of Computer Science, Middlesex University and the Centre for Public Health and Risk Management at the same university.

The proposed system focuses on key safety domains: eating, drinking, sleeping, and bathing. The operating system draws information from several sensor systems throughout the house: an infra-red movement detection system, detection of the use of electrical devices, sensors that identify if doors – cupboards and fridges, for example – are open, if lights are on or off and pressure sensors to determine if a bed, sofa, or chair is being used. GIS information from the user's mobile is also imported into the system. After being provided with information about user timetables, the system then uses information gathered from ambient sensors built into the house to make assessments about when it needs to alert, in the first instance, the user, and when to escalate to the caregiver. Interaction with users is via mobile phone. The system needs to make multiples sets of decisions. In the first, it needs to interpret what input data means. Eating, for example, needs to be inferred from information pulled from the above sensors – perhaps a sequence of door openings, a presence in the kitchen, and sitting in a particular place. Secondly, the system needs to decide what departures from routine are usual. For example, does going to bed later than usual amount to an event of concern? Leaving the house, a task that might be fine at 11am, might be problematic at midnight.

There are other, similar systems under development and in use. For example, there is research on the use of wearable devices that capture user gestures, which could help persons with limited movement to interact with the technologies in their homes.[66] Another, outside-the-house example helps people with cognitive disabilities to access and navigate a transport system.[67] Presenting a map with an array of transport options, the device proposes a public-transport map, based on GPS information. If the user departs from their proposed route – catching the wrong bus, for example – there is a machine informed intervention. This technology might not appear immediately connected to the realisation of the right to housing

[66] Amritha Purushothaman and Suja Palaniswamy, 'Development of Smart Home Using Gesture Recognition for Elderly and Disabled' (2020) 17 Journal of Computational and Theoretical Nanoscience 177.
[67] S Carmien, M Dawe, G Fischer,A Gorman,A Kintsch, JF Sullivan, 'Socio-Technical Environments Supporting People with Cognitive Disabilities Using Public Transportation (2005) 2 ACM Trans Comput-Hum Interact 30 .

occurring as it does outside the home. However, it points to the fact that realisation of the right to housing requires a home located where there are adequate and accessible transport links, community services, and opportunities to leave the home and move into the public sphere beyond.[68] It also points to the interconnections between all rights, not only economic and social (such as the right to work and to social security) but to civil and political rights such as freedom of movement and association.

There are, as with all technologies, concerns. Isolation is a major problem for any person who is older or has a debilitating disability.[69] There is an obvious temptation in a world of cost-cutting, economic rationalism, and tech-centric interventions that the very human need for meaningful emotional contact will be disregarded. While remaining in place or asserting the degree of independence that one wants supports the right to housing, the need for meaningful social integration is also related to the right. The right is not realised if people are ghettoised or are unable to experience both the public and private sphere. In fact, housing – and rights to and in it – sit at the crucial juncture of the public and the private, and the right will not be realised if people are confined to their housing against their will, no matter how adequate that housing otherwise is.[70] Striking a balance between these countervailing objectives must support the objectives of individuals involved, including residents and caregivers, and not driven by class-based opportunity or funding related-imperatives.

4.3 Sanitation

[68] On the location of the right to housing at the intersection of the public and private, see also Jessie Hohmann 'Conceptualising domestic servitude as a violation of the human right to housing and reframing Australian policy responses' (2022) 31(1) Griffith Law Review 98; Hohmann (n 10) 145-165.
[69] Oliver Hämmig, 'Health Risks Associated with Social Isolation in General and in Young, Middle and Old Age' (2019) 14 PLoS One e0219663; Stephen J Macdonald and others, '"The Invisible Enemy": Disability, Loneliness and Isolation' (2018) 33 Disability & Society 1138.
[70] Hohmann (n 10) 145–165.

The availability of services, including sanitation, is an inherent aspect of the right to adequate housing.[71] Failures of sanitation extend far beyond simple access to a toilet or latrine. The World Health Organization reports that, as of 2017, only 45 percent of the world's population use a 'safely managed' sanitation service, and two billion people do not have access to even basic toileting facilities, with over 670 million people still defecating openly (that is, in public – in gutters, bushes, on the beach or the like).[72] Residents of informal settlements are particularly likely to lack access to adequate sanitation facilities.[73] While connection to a sewerage system remains gold-standard, attaining this goal involves a high cost, challenges around land tenure, and political considerations.[74] This means that sanitation issues at the informal settlement level are often more effectively dealt with at the household or community level, and often entail regular emptying of on-site reservoirs, sometimes on a daily basis.[75]

Because waste collection is expensive and time-consuming, there are significant incentives to devolve this responsibility to the individual household (for example, using a septic system), or eschewing a regularly scheduled pick up service in favour of just-in-time latrine emptying. Here we discuss a machine learning system, trained using historical use data and weight sensors, which estimates how full latrines are. This information was used to predict latrine overflow events and thus to facilitate dynamic scheduling. When tested by a private sanitation collection service in an informal settlement in Nairobi, the system was useful for managing lower-use latrines, and able to predict overflow events with a high degree of

[71] UN CESCR, *General Comment No. 15: The Right to Water (Arts. 11 and 12 of the Covenant)*, 20 January 2003, E/C.12/2002/11. An implied right to water and sanitation arises from Art 11(1) and 12 of the ICESCR.
[72] World Health Organizaiton, 'Sanitation Fact Sheet' (*World Health Organization*) <https://www.who.int/news-room/fact-sheets/detail/sanitation> accessed 5 December 2021.
[73] Sheela S Sinharoy, Rachel Pittluck and Thomas Clasen, 'Review of Drivers and Barriers of Water and Sanitation Policies for Urban Informal Settlements in Low-Income and Middle-Income Countries' (2019) 60 Utilities Policy 100957.
[74] Ibid.
[75] Ibid.

accuracy.[76] Because many users of container-based waste services pay privately for the collection of their waste,[77] and poverty has a direct impact on access to and use of sanitation services,[78] even small improvements in collection efficacy have a potential impact on sanitation outcomes. On the other hand, such private responsibility should not detract from state responsibility toward those in informal settlements for appropriate, adequate facilities (as required by the UN CESCR's General Comment Number 4,[79] to ensure that people can access adequate housing – that is, housing that in the terms of the right does not endanger the safety of the residents including through poor sanitation, that has all appropriate facilities, and that it not built on polluted sites (including sites polluted by effluent).

Monitoring the cleanliness of shared toileting facilities can be an expensive, labour-intensive exercise, with 'a huge amount of money and manpower to maintain these public toilets'.[80] Here we draw the reader's attention to potential applications of AI as a mode of remedy. In one project, for example, sensors were used as an 'e-nose', to detect malodour; that is, bad smells associated with the malfunction or uncleanliness of the toilet facility.[81] The challenge presented to the system is differentiating between different types of odour, while correcting for the impact that humidity levels have on sensor receptivity. While still in the experimental phase, the system can differentiate between excreta types and other smells and has the potential to reduce the costs of sanitation monitoring in hard-to-reach places, while simultaneously, triggering cleaning processes when required.

[76] Nick Turman-Bryant and others, 'Toilet Alarms: A Novel Application of Latrine Sensors and Machine Learning for Optimizing Sanitation Services in Informal Settlements' (2020) 5 Development Engineering 100052.
[77] Caroline Jennings Saul and Heiko Gebauer, 'Digital Transformation as an Enabler for Advanced Services in the Sanitation Sector' (2018) 10 Sustainability 752.
[78] Christophe Bosch and others, 'Water, Sanitation and Poverty' [2001] Draft chapter. Washington DC: World Bank.
[79] UN CESCR General Comment No 4, (n 12) para 8(b).
[80] Prasad Deshmukh and others, 'Intelligent Public Toilet Monitoring System Using IoT' (IEEE 2020).
[81] Jin Zhou and others, 'Sensor-Array Optimization Based on Time-Series Data Analytics for Sanitation-Related Malodor Detection' (2020) 14 IEEE Transactions on Biomedical Circuits and Systems 705.

The commonality between the three potential uses of AI-informed technologies and insights vis-à-vis the right to housing focus is the mobilisation of individual or community resources in the face of, or against, an apathetic state. While we support any increase in the capacity of the ability of individuals to assert rights, we note they reflect an expectation that individuals need to actively claim their rights, often at their own expense. The reification of resilience has an increasing centrality to disaster recovery and climate adaptation.[82] The cultivation of actors that are 'confident and at home with contingency and the unexpected'[83] alleviates pressure on the state and non-governmental actors to facilitate rights, including the right to housing.

These tools are another opportunity for the state to revile from its obligations in favour of profit-seeking corporations, with little regard for the enjoyment of adequate housing by ordinary people.

5 Conclusion

The use of big data and artificial intelligence can have both problematic and positive impacts on the right to housing. The technologies' uses will be applied on top of already existing power relations, biases, and structural inequalities. It is power imbalances between tenants and landlords, the propertyless and the propertied, the enabled and the disabled, that create opportunities and potential for discrimination. Power relations may not change, only be

[82] Mark Duffield, 'The Resilience of the Ruins: Towards a Critique of Digital Humanitarianism' (2016) 4 Resilience 147; Mark Duffield, *Post-Humanitarianism: Governing Precarity in the Digital World* (John Wiley & Sons 2018).
[83] David Chandler, *Ontopolitics in the Anthropocene: An Introduction to Mapping, Sensing and Hacking* (1st edn, Routledge 2018) 142 <https://www.taylorfrancis.com/books/9781351335928> accessed 28 August 2019.

'masked in new ways' by these technologies.[84] The *novelty* of the risk of new technologies in the field of housing is often also overstated: as McElroy argues, for example, property itself has long operated as a technology of discrimination and dispossession.[85]

However, due to the structural inequalities and power imbalances that do exist, the application of AI in the field of housing does present serious challenges for the right to housing. So, for example, while technologies of the smart home have powerful potential to enable people to live in their homes for longer, with greater independence, safety and security, we must be attuned to the potential that these technologies will be used in those protective ways for first world, middle-class homeowners, while they are simultaneously used to surveil and discriminate against poor and racialized people in their access to housing. At the same time, disaster risk reduction technologies can be used to respond to unfolding disasters to minimise harm to people (and their homes) and to prepare areas to be more robust and protected, they might also more likely be used to map, see and know areas from which additional value can be extracted by the financially powerful, at the expense of the homes and security of existing populations, for whom the technologies just become another tool for eviction and relocation.

Given the array of opportunities and potential threats presented by the use of AI and other technologies, it is important to coalesce around an ideological stance to navigate the various options. We argue that, when it comes to decisions about directions that technologies take us, human rights are an important standard against which we can measure the acceptability of technological change. With respect to algorithmic systems, for example, human rights, including the 'rich discourse and practice' of Economic, Social and cultural rights,[86] we echo

[84] Shaw (n 28) 1054.
[85] see also Brenna Bhandar, *Colonial Lives of Property: Law, Land, and Racial Regimes of Ownership* (2018); Erin McElroy, 'Property as Technology: Temporal Entanglements of Race, Space, and Displacement' (2020) 24 City 112.
[86] Jędrzej Niklas,' Conceptualizing Socio-Economic Rights in the Discussion on Artificial Intelligence' (April 26, 2019). Available at SSRN: https://ssrn.com/abstract=3569780 or http://dx.doi.org/10.2139/ssrn.3569780, 3.

recent scholarship in stressing that human rights 'offers an organising framework for assessing algorithms, bringing the language of law and human rights back to the fore (instead of loosely used terms such as bias, harm) and emphasising the obligations of states.'[87] While human rights cannot be the only response to AI, importantly, human rights provide principles against which an evaluation can be made, and a common language and set of objectives to guide positive, human-focused change.

[87] {Rachovitsa and Johann p 8} and p 15; Niklas ibid.