



SMART BUILDINGS AND HUMAN RIGHTS: THE ROLE OF AI AND SENSOR TECHNOLOGIES IN PROTECTING OCCUPANT WELL-BEING.

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Abstract

The rapid integration of Artificial Intelligence (AI) and sensor technologies in modern buildings has transformed the way indoor environments are designed, managed, and experienced. Smart buildings now use interconnected systems to monitor temperature, humidity, occupancy, and air quality in real time to enhance occupant comfort and energy efficiency. However, the continuous collection and processing of personal and environmental data raises ethical and legal concerns about privacy, consent, and human rights. This paper examines the intersection between smart building technologies and human rights, focusing on how AI-driven sensor systems can both promote and potentially threaten occupant well-being. Drawing from literature on building automation, data protection, and ethical AI frameworks, the study explores the need for a human- rights-based approach to smart building design and management. The findings highlight that while AI and sensors can significantly improve thermal comfort, health, and productivity, the lack of robust data governance and transparency mechanisms may compromise user autonomy and privacy. The paper concludes that the future of smart buildings lies in developing ethical AI models and regulatory frameworks that balance technological innovation with the protection of fundamental human rights. Recommendations are made for architects, legal practitioners, policymakers, and engineers to adopt privacy-aware design principles and ensure that smart environments remain both intelligent and humane.

Keywords: Smart buildings; Artificial intelligence; Sensors; Human rights; Thermal comfort; Data privacy; Occupant well-being.

1. Introduction

The transformation of the built environment in recent decades has been largely driven by the emergence of smart buildings—intelligent systems that integrate digital technologies, artificial intelligence (AI), and sensor networks to enhance operational efficiency and occupant well-being. Through continuous sensing and adaptive control, these buildings collect environmental data such as temperature, humidity, carbon dioxide (CO₂) concentration, and occupancy to regulate indoor environmental quality (IEQ) and energy performance in real time (Kumar et al., 2023; Nair et al., 2024). As a result, building systems have evolved from static mechanical structures into dynamic environments capable of learning from user behavior and responding autonomously to changing indoor and outdoor conditions (Liu et al., 2022).

The convergence of AI and sensor technology has introduced new possibilities for creating personalized, energy-efficient indoor environments. Machine learning and predictive modeling now enable building management systems to optimize thermal comfort while minimizing energy consumption (Raji et al., 2023; Yu et al., 2023). For instance, AI-driven models can interpret occupant feedback and environmental data to predict comfort indices such as the Predicted Mean Vote (PMV) and adjust HVAC operations accordingly (Al Horr et al., 2024). Such advancements demonstrate the potential of data-driven architecture to improve health, productivity, and satisfaction within indoor spaces.

However, these technological developments also raise critical ethical and legal concerns. The proliferation of sensors and data analytics has introduced issues of privacy, surveillance, and data ownership that challenge traditional understandings of human autonomy within architectural spaces (GhaffarianHoseini et al., 2023; Jain & Singh, 2022). As sensors capture patterns of presence, motion, and even physiological responses, there is a growing risk of unintended data exploitation or misuse (Marikyan et al., 2021). The absence of transparent data governance frameworks amplifies these risks, particularly in regions with evolving digital-rights legislation.

In the context of developing countries, such as Nigeria, these challenges acquire additional complexity. Buildings in tropical climates face distinct environmental pressures—high temperatures, humidity, and inconsistent ventilation—that significantly influence thermal comfort and energy consumption. While AI- and sensor-based systems could provide adaptive comfort solutions suited to such conditions, their deployment must align with existing data protection and human rights frameworks, such as the Nigeria Data Protection Regulation (NDPR, 2019). Without adequate ethical safeguards, the same technologies designed to promote well-being may inadvertently compromise privacy, dignity, or equality among building users.

Accordingly, this study situates itself at the intersection of architecture, technology, and human rights. It seeks to examine how AI and sensor technologies can be leveraged to enhance occupant well-being in smart buildings while ensuring compliance with principles of privacy, autonomy, and data justice. By engaging both technological and normative perspectives, the research contributes to the global discourse on how to make intelligent buildings not only smarter, but also more humane.

2.0 Literature Review

2.1 Concept of Smart Buildings

Smart buildings are digitally enabled environments that use interconnected systems to enhance operational performance, sustainability, and occupant comfort. The concept has evolved from the automation of simple building functions to highly intelligent ecosystems that learn from user behavior through artificial intelligence (AI) and the Internet of Things (IoT) (Marikyan et al., 2021). Early stages of building automation in the 1980s focused primarily on mechanical controls for heating, ventilation, and air conditioning (HVAC). However, the modern smart building integrates data analytics, real-time monitoring, and adaptive algorithms to achieve user-centered and energy-efficient environments.

Design principles of smart buildings emphasize interoperability, scalability, and sustainability (Jain & Singh, 2022). Systems are designed to communicate through a centralized platform that enables automated decision-making based on sensor data and occupant input. For instance, AI-based building management systems (BMS) can automatically regulate lighting and ventilation according to real-time occupancy patterns, reducing energy waste. In developing regions such as Nigeria, these technologies are gaining attention for their potential to improve environmental comfort in universities, offices, and residential facilities while addressing tropical climatic challenges. The concept, therefore, represents a convergence of architecture, digital engineering, and human well-being.

2.2 Artificial Intelligence Applications in Building Management

Artificial Intelligence has become a cornerstone of smart building operations, offering the ability to process large datasets and support intelligent decision-making. In building management, AI algorithms are widely used in predictive maintenance, adaptive comfort control, and energy optimization (Zhang et al., 2023). Predictive maintenance involves analyzing sensor data to identify potential equipment failures before they occur, allowing timely intervention that reduces downtime and operational costs.

Adaptive comfort control systems use AI to personalize thermal and lighting conditions according to individual or collective user preferences. For example, a building equipped with temperature and occupancy sensors can train machine-learning models to predict optimal indoor conditions for different periods of the day. This not only enhances comfort but also improves productivity and reduces energy consumption. In

terms of energy optimization, AI can integrate with renewable energy systems—such as solar panels—to predict energy demand and supply balance, thereby contributing to sustainable building operations (Yigitcanlar et al., 2021).

Despite these benefits, AI-driven building management systems raise concerns about transparency and accountability, particularly regarding how data are collected, analyzed, and used to make decisions that affect human comfort and privacy. As AI becomes more embedded in architectural systems, understanding its governance implications becomes crucial to ensure that efficiency does not compromise ethical standards.

2.3 Sensor Technologies and Occupant Monitoring

Sensor technologies form the foundational layer of smart buildings, serving as the primary means through which environmental and human-centered data are collected. Common sensors include thermal sensors (which measure temperature and heat flow), motion sensors (for detecting presence and movement), CO₂ sensors (to monitor indoor air quality), and humidity sensors (for controlling moisture and thermal comfort). These devices provide continuous data streams that enable real-time environmental control and adaptive decision-making (Liu et al., 2022).

Modern sensor networks rely on wireless connectivity and cloud storage, allowing for large-scale data aggregation and analysis. This connectivity supports intelligent control of HVAC systems, lighting, and security functions. However, the same mechanisms that enhance building intelligence also introduce privacy vulnerabilities. Motion detectors, facial recognition cameras, and biometric systems can inadvertently capture identifiable data about occupants, raising ethical and legal questions about consent, ownership, and data security.

Furthermore, in educational and institutional settings, the use of occupancy sensors to monitor attendance or space usage can create a sense of surveillance if not properly regulated.

Consequently, while sensor technologies enhance building responsiveness and efficiency, they must be implemented with careful consideration of data minimization and ethical management principles.

2.4 Human Rights and Data Ethics in the Built Environment

The intersection between smart technologies and human rights introduces significant ethical challenges, particularly concerning privacy, autonomy, and informed consent. As smart buildings increasingly rely on occupant data for operation, individuals may lose control over how their personal information is collected and used (Mittelstadt, 2019). Continuous data

monitoring can reveal sensitive information such as daily routines, health status, and behavioral patterns. Without adequate safeguards, such data practices can infringe upon the fundamental right to privacy as recognized under Article 12 of the Universal Declaration of Human Rights (UN, 1948).

Ethical principles such as transparency, accountability, and fairness are critical in ensuring that smart building technologies serve human needs without exploitation. Data ethics emphasizes that users should be informed about what data are collected, why they are collected, and how they are stored or shared. AI systems must be explainable, and their decision-making processes should be auditable. This aligns with the broader concept of human-centered AI, which prioritizes human dignity, freedom, and agency within technological design. In this regard, integrating data ethics into architectural practice is not optional but essential for creating humane and trustworthy digital environments.

2.5 Legal Frameworks and Data Protection Regulations

a) Domestic Legal Framework:

1. Nigeria Data Protection Act (NDPA) 2023: The principal legislation governing data protection in Nigeria is the Nigeria Data Protection Act (NDPA) 2023, signed into law by President Bola Ahmed Tinubu on 12 June 2023. The NDPA establishes a comprehensive legal framework for regulating the collection, processing, storage, and transfer of personal data, including biometric and behavioural data generated in smart buildings. It reinforces fundamental rights by requiring lawful processing, informed consent, data minimization, and transparency from data controllers and processors. The Act also creates the Nigeria Data Protection Commission (NDPC) to oversee compliance, enforce sanctions, and ensure that emerging technologies operate in line with privacy and human rights standards.
2. The Constitution of the Federal Republic of Nigeria 1999 (as amended): This provides the overarching legal framework for safeguarding fundamental human rights, which underpins data protection and ethical technology use. Section 37 guarantees the right to privacy, protecting citizens against unlawful interference with their homes, correspondence, and personal information. In addition, Sections 33, 34, and 42 protect human dignity, freedom from discrimination, and equality before the law, while Section 41 ensures freedom of movement. These rights collectively establish that smart building technologies, AI systems, and data collection practices must respect privacy, autonomy, dignity, and non-discrimination, ensuring lawful and ethical deployment.

3. The Nigeria Data Protection Regulation (NDPR) 2019: This issued by the National Information Technology Development Agency (NITDA), provides detailed operational guidelines for implementing data protection in Nigeria. It complements the constitutional right to privacy and establishes obligations for data controllers and processors regarding the collection, storage, and processing of personal data. The

NDPR mandates informed consent, purpose limitation, data minimization, and security measures to protect sensitive information, including biometric and behavioural data. It also provides enforcement mechanisms, penalties for non-compliance, and frameworks for data breach reporting, ensuring that public and private entities handle personal data responsibly and ethically.

4. The Cybercrimes (Prohibition, Prevention) Act (Amendment) 2024: This strengthens Nigeria's legal framework against cyber threats and enhances data protection measures. It criminalizes unauthorized access, hacking, identity theft, and the misuse of personal and sensitive data, including information collected by smart technologies and AI systems. The Act imposes obligations on organizations to secure electronic data, implement cybersecurity measures, and report breaches promptly. By providing clear legal consequences for cyber offenses, the law safeguards the confidentiality, integrity, and availability of personal data, complementing existing frameworks such as the NDPR and the NDPA to ensure privacy and security in digital environments.

5. The Freedom of Information Act 2011: The Freedom of Information Act 2011 promotes transparency and accountability in public institutions by granting citizens the right to access information held by government agencies. In the context of data protection, it establishes a balance between public access to information and the protection of personal and sensitive data. The Act mandates that information that may compromise individual privacy, security, or proprietary rights must be withheld, thereby safeguarding personal data while ensuring openness in governance. It complements privacy laws by clarifying boundaries for disclosure and reinforcing the legal principle that data handling must respect human rights and confidentiality.

b) International Legal Framework:

1. General Data Protection Regulation (GDPR) EU: The GDPR sets global standards for data protection, emphasizing consent, transparency, purpose limitation, and data subject rights. It regulates the collection, processing, and transfer of personal data within and outside the EU. For smart buildings, GDPR principles require informed consent, secure storage, and

accountability for AI-driven data systems, influencing Nigeria's NDPR and NDPA by providing a model for aligning technological innovation with human rights protection.

2. International Covenant on Civil and Political Rights (ICCPR): Article 17 of the ICCPR guarantees individuals protection from unlawful or arbitrary interference with privacy, correspondence, and family life. It establishes human rights obligations for states to regulate personal data collection and usage. In smart buildings, ICCPR principles guide policies ensuring that occupant monitoring via sensors and AI does not

violate privacy, autonomy, or personal dignity, forming a benchmark for aligning national legislation with international human rights norms.

3. African Union Convention on Cyber Security and Personal Data Protection (Malabo Convention): The Malabo Convention provides a regional framework for data protection, cybersecurity, and digital rights across African states. It mandates lawful data collection, privacy safeguards, and secure cross-border data transfers. By harmonizing data protection standards, the Convention supports Nigeria's NDPR and NDPA, ensuring that smart building technologies, AI systems, and IoT devices comply with ethical data handling and protect individuals from misuse, cyber threats, or privacy violations.

4. OECD Privacy Guidelines: The OECD Privacy Guidelines establish principles for responsible personal data processing, including collection limitation, data quality, purpose specification, security safeguards, and accountability. These guidelines provide a global benchmark for ethical AI and smart building data practices. They influence national policies, encouraging transparency, consent, and security measures, while helping Nigeria align its regulatory frameworks with international best practices in protecting occupant privacy and personal information in digitally monitored environments.

2.6 Gaps in Existing Research

Although research on smart buildings, AI, and human comfort has expanded considerably, there remains a significant gap in integrating technological innovation with human rights protection. Most studies emphasize performance outcomes such as energy efficiency, indoor environmental quality, and system automation without sufficiently addressing the social and legal implications of continuous occupant monitoring (Yigitcanlar et al., 2021).

Few frameworks explicitly connect AI-driven environmental control with privacy-preserving mechanisms or legal accountability structures. Moreover, research in developing contexts like Nigeria remains limited, particularly regarding how national laws like the NDPR can be operationalized to regulate AI and sensor data in the built environment.

This research gap highlights the need for interdisciplinary studies that combine architecture, computer science, and law to formulate ethical and legal frameworks for responsible technology adoption. Addressing these gaps will not only improve occupant well-being but also ensure that technological advancement aligns with global human rights standards.

3.0 Research Methodology

This study adopts a qualitative research design grounded in a systematic literature review and normative legal analysis. The methodological approach combines the identification and synthesis of existing research on artificial intelligence (AI), sensor technologies, and data privacy in smart buildings with the development of a conceptual legal framework to address ethical and regulatory gaps. This design is appropriate because the topic lies at the intersection of technological innovation and human rights, where both empirical findings and normative legal reasoning are required to formulate practical recommendations (Marikyan et al., 2021; Jain & Singh, 2022).

4.0 Discussions

4.1 Data Sources and Search Strategy

The study draws on peer-reviewed journal articles, policy reports, and international legal instruments published between 2015 and 2025. Databases such as Scopus, Web of Science, ScienceDirect, and Google Scholar were systematically searched using key terms and Boolean combinations, including:

- i. Artificial intelligence and smart buildings
- ii. Sensor technologies and occupant privacy
- iii. Thermal comfort and data protection
- iv. Building automation and human rights
- v. AI ethics and data governance.

Additionally, policy documents and legal texts were reviewed to establish the regulatory context for data governance in smart building systems, including the Nigeria Data Protection Regulation (NDPR, 2019), the EU General Data Protection Regulation (GDPR, 2018), and international frameworks such as the Universal Declaration of Human Rights (UDHR, 1948) and the OECD Principles on Artificial Intelligence (2021).

4.2 Inclusion and Exclusion Criteria

To ensure methodological rigor, inclusion criteria were limited to studies and reports that:

1. Discussed applications of AI and sensor technologies within the built environment;
2. Examined ethical, legal, or social implications of occupant data collection; and
3. Provided empirical or theoretical insights relevant to user privacy and well-being.

Publications were excluded if they:

1. Focused purely on technical aspects of AI algorithms without human-centered analysis,

2. Were non-English or lacked full-text access, or
3. Repeated earlier studies without offering new insights.

A total of 72 documents were initially identified; after screening abstracts and full texts, 45 key sources were selected for detailed review and synthesis.

4.3 Data Analysis

The analysis employed thematic synthesis, which involves identifying, comparing, and categorizing key themes across the reviewed literature (Braun & Clarke, 2019). The process focused on three primary thematic domains:

1. Technological mechanisms: how AI and sensors operate in collecting, processing, and interpreting occupant data;
 2. Ethical and privacy implications: patterns of risk, misuse, and user perception; and
 3. Legal and policy responses: existing laws, governance mechanisms, and identified regulatory gaps.
- Qualitative insights from these themes were triangulated to establish how technological design influences human rights outcomes and where legal safeguards are insufficient or absent.

4.4 Development of the Proposed Legal Framework

Following the thematic synthesis, a conceptual legal framework was developed to guide ethical AI and data governance in smart buildings. The framework integrates principles from data protection law, AI ethics, and human-rights-based design. It emphasizes four pillars:

1. Transparency: ensuring that building occupants are aware of what data are collected and how they are used;
2. Consent and Autonomy: empowering users to control their personal information;
3. Accountability: defining responsibilities for data handlers, architects, and system developers; and
4. Security and Fairness: ensuring safe storage and non-discriminatory use of data.

This framework is not merely descriptive but normative—it proposes policy reforms and design guidelines adaptable to the Nigerian context, with global relevance for ethical smart building governance.

4.5 Human Rights Implications of Smart Building Technologies

The rapid deployment of Artificial Intelligence (AI) and sensor-based systems in modern buildings has introduced a new dimension to human rights discourse. As smart buildings increasingly use interconnected technologies to monitor environmental conditions, manage energy consumption, regulate access, and track occupant behaviour, they directly influence a range of fundamental rights guaranteed under domestic and international law. While these technologies offer significant benefits in promoting safety, comfort, and operational efficiency, their intrusive data collection capabilities raise complex human rights concerns that demand close regulatory attention. Some of the human rights concerns are:

1. Right to Privacy

Right to privacy is seen as one of the most important rights in a just democratic society. The Right to determine how much information to reveal about oneself and to be able to control same in the face of emerging new technologies.¹ Privacy is the most comprehensive of rights and the right most valued by the civilised man, the right to be left alone². The Right to keep to oneself, if one so desire. One has the duty or right to determine who to let in to one's personal space. Privacy as a 'concept encompass two different but related aspects, it relates to the right or the ability of individuals to determine how much or what information about themselves is to be revealed to others', secondly' it relates to the idea of autonomy, the freedom of individuals to perform or not to perform certain acts or subject themselves to certain experiences³. Right to privacy is a fundamental right and a hallmark of democracy and free society⁴.

1 Adeyemi, DM, Right to Privacy and the Internet in Nigeria (KolaDaisi University Press,Ibadan, Oyo State, 2023)

2 Justice Blackburn in Bowers V. Hardwick 478 US 186, 198: Cooley, Tort (2nd ed. 1888)

3 Johnny H Killian & Leland E Beck.1981. The constitution of the United States of America, Analysis and interpretation (United States Government Printing office, Washinton p 1582-3

4 L.A Bygrave.2001 'The place of privacy in data protection law' 24 UNSW Law Journal 278.

This right is protected under section 37 of the 1999 constitution of the Federal Republic of Nigeria:

'The privacy of citizens, their homes, correspondence, telephone conversations and telegraphic communications is hereby guaranteed and protected'

Also Article 12 of the Universal Declaration of Human Rights provides:

'That No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence nor attacks upon his honour and reputation. Everyone has the right to the protection of the Law against such interference or attacks'.

These provisions collectively underscore the principle that individuals must retain control over information about themselves, especially in spaces as intimate and personal as their homes, workplaces, and private environments. Smart building technologies challenge this principle by introducing a dense network of digital devices that continuously monitor the environment and the behaviour of occupants. Modern buildings now incorporate sensors in lighting systems, HVAC units, elevators, access control systems, smart electricity meters, and even bathroom fixtures. These devices often operate silently and autonomously in the background, collecting and transmitting data without the occupant's awareness. Through this pervasive sensor ecosystem, buildings can track movement patterns, biometric identifiers, energy-use habits, room occupancy levels, and even behavioural indicators, such as how often a person uses certain facilities or how long they spend in specific areas. Over time, smart environments can create highly detailed behavioural profiles sometimes more intrusive than what governments

employers could collect through conventional forms of surveillance. This continuous and often invisible data capture raises serious legal and ethical concerns.

Smart building technologies, despite their potential benefits, pose a significant threat to privacy when deployed without adequate safeguards. Ensuring compliance with constitutional and international human rights norms requires robust legal frameworks, transparency measures, occupant consent mechanisms, and strict accountability for data processing activities. Without these protections, smart buildings risk becoming environments where technological convenience comes at the cost of fundamental human rights.

2. Right to Dignity of Human Person

Smart building technologies also affect the right to dignity, a core human right that underpins all other freedoms and protections. The right to dignity requires that every individual be treated with respect and valued as a human being, not reduced to a set of data points or behavioural metrics. However, in smart environments, AI systems increasingly analyze patterns of behaviour, movement, and interaction within a building. These systems may use predictive algorithms to assess occupancy patterns, emotional states, productivity levels, or engagement with specific spaces. While often justified as tools for optimizing efficiency, safety, or comfort, they also have the capacity to create deeply intrusive forms of digital profiling that strike at the heart of human dignity.

When smart buildings treat the behaviour of occupants as data to be monitored, interpreted, and optimized, individuals' risk being viewed not as rights-bearing persons but as components of an automated system.

This is especially concerning in workplaces, schools, and residential complexes that rely heavily on sensor and AI technologies. In such environments, data-driven insights can be used to make judgments about an individual's work ethic, concentration, emotional stability, or reliability. These forms of algorithmic evaluation can subtly influence managerial decisions, shape expectations, and pressure occupants to conform to certain behavioural norms.

Moreover, the constant awareness or suspicion that one is being monitored even if the observation is indirect or automated can produce psychological discomfort. Occupants may modify their behaviour, avoid certain actions, or suppress natural expressions out of fear of being judged or misinterpreted by AI systems. This creates an atmosphere of self-surveillance, where individuals feel compelled to behave in a "machine-friendly" manner rather than freely and authentically.

Such environments undermine the dignity that human rights frameworks seek to protect. Dignity is incompatible with conditions where individuals feel monitored, judged, or manipulated by opaque technological systems. Therefore, safeguarding dignity in smart buildings requires transparency, strict limitations on behavioural analytics, human oversight, and ethical guidelines that prioritise the person over the data.

3. Right to Freedom from Discrimination

The Right to Freedom from Discrimination is significantly engaged when AI-driven systems are responsible for access control, surveillance, and behaviour monitoring within smart buildings. These technologies, particularly facial recognition and behavioural analytics, have been consistently shown to exhibit racial, gender, and age-related biases. Numerous studies demonstrate that facial recognition systems often misidentify or fail to recognize individuals with darker skin tones, women, elderly people, and minority ethnic groups. When such biased technologies are integrated into smart buildings, they can lead to discriminatory outcomes such as unjust access denial, increased security alerts, or disproportionate scrutiny of certain groups.

In residential estates, for example, a biased facial recognition system may repeatedly fail to authenticate tenants or visitors of specific demographic backgrounds, subjecting them to embarrassment, delays, or unnecessary questioning. In workplaces, biased behavioural analytics may flag certain employees more frequently for “suspicious” behaviour due to algorithmic misinterpretation, resulting in unfair treatment or disciplinary actions. Within government buildings, such biases could restrict equal enjoyment of public services.

These discriminatory effects violate constitutional guarantees of equal treatment and offend anti-discrimination laws that prohibit differential treatment based on race, gender, or other protected characteristics. When poorly designed or insufficiently tested algorithms are deployed, they risk reinforcing existing societal prejudices under the appearance of technological neutrality. Therefore, ensuring equality in smart buildings requires rigorous algorithmic audits, transparent testing, and strong legal safeguards against discriminatory outcomes.

4. Right to Freedom of Movement

7 Section 41 of the Constitution of the federal Republic of Nigeria, Another emerging concern is the right to freedom of movement, which can be subtly but significantly affected by the deployment of smart building technologies. Modern smart buildings rely on automated access systems, geofencing tools, and behavioural analytics to regulate how occupants move through different areas. While these systems aim to enhance safety, prevent unauthorized entry, and improve operational efficiency, they also possess the potential to restrict mobility in ways that infringe upon individual rights. If misused or poorly configured, automated access controls can deny individuals entry to essential spaces or confine them to specific zones without legitimate justification. Similarly, geofencing and continuous location tracking create digital boundaries that can be weaponized to monitor, control, or limit movement. The awareness that one’s movements are being constantly recorded may produce a chilling effect, discouraging occupants from using shared facilities, visiting certain areas, or expressing themselves comfortably in semi-public spaces. Such technological constraints ultimately threaten the openness and autonomy that freedom of movement seeks to protect.

5. Right to Autonomy and Informed Consent

Smart building systems affect the right to autonomy and informed consent, which requires individuals to knowingly agree to how their data is collected and used. In many smart environments, occupants cannot meaningfully control or refuse passive data collection. A tenant in a smart apartment, for example, may be unable to disable motion sensors, avoid facial recognition access, or opt out of AI-based energy controls. Such technological imposition forces individuals to accept monitoring as a prerequisite for residency or

employment. This lack of genuine choice erodes personal freedom and undermines the human-rights principle that individuals must retain agency over decisions affecting their lives.

In summary smart building technologies present a dual reality: while they hold immense potential to promote comfort, safety, and well-being, they also risk infringing on privacy, autonomy, dignity, equality, movement, and safety if deployed without adequate human-rights safeguards. A rights-based approach to smart building design requires transparency, explicit consent mechanisms, anti-discrimination audits, data minimization, robust security standards, and clear accountability frameworks. Ensuring that technological innovation respects fundamental rights will be essential for creating smart environments that are both intelligent and humane.

4.6 Ethical Considerations

Given that this study relies on secondary data, no direct human participation was involved. Nonetheless, all reviewed materials were properly cited and used solely for academic purposes. The proposed framework aligns with international research ethics, promoting responsible technological use, fairness, and respect for human dignity in the digital built environment.

5.0 Conclusion and Recommendations

Smart buildings have transformed traditional architecture into intelligent, responsive systems through the integration of Artificial Intelligence (AI) and sensor technologies. These systems improve energy efficiency and thermal comfort by learning from occupant behavior and environmental data. However, this progress raises critical human-rights concerns, particularly around data privacy, ownership, and informed consent.

The literature reviewed shows that while smart building research often emphasizes performance and sustainability, less attention is given to ethical and legal safeguards for users. Occupant data are frequently collected automatically, with limited transparency or accountability. This calls for a shift from technology-driven innovation to human-centered governance.

To address these concerns, this paper proposes a human-rights-based legal framework built on four key principles: transparency, informed consent, accountability, and data security. Such a framework would ensure that smart buildings respect user autonomy while maintaining operational intelligence.

In contexts such as Nigeria, existing instruments like the Nigeria Data Protection Regulation (NDPR, 2019) should be expanded to cover AI-enabled sensor systems, aligning with international standards like the GDPR (2018).

Ultimately, the future of smart buildings depends on achieving balance—where digital intelligence enhances human comfort without compromising privacy or dignity. Responsible governance will ensure that smart buildings remain both technologically advanced and ethically grounded.

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