Review Article GU J Sci, Part B, 12(4): 715-734 (2024)

Gazi University

Journal of Science

PART B: ART, HUMANITIES, DESIGN AND PLANNING

http://dergipark.gov.tr/gujsb

Exploring the Future of Housing-Technology Interaction with Literature

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Article Info

Received: 25/09/2024
Accepted: 17/12/2024

Keywords

House,
Home,
Future,
Technology,
Transformation

Abstract

This research aims to examine the interactivity between house and technology and explore the prominent subjects and concepts about imagining the future of houses. For this purpose, it is utilized systematic literature approach based on bibliometric analysis which involves qualitative and quantitative methods. According to this, research codes (house, home, technology, future, and transformation) are determined, and these codes are examined in different combinations on the Scopus database. These data are analyzed by the maps and diagrams obtained by the VOSviewer program, and their densities, temporalities, and relationalities are spotted, and focus articles are examined in detail. According to recent research findings, key themes shaping the conceptualization of the future of housing include the Internet of Things (IoT), digital technologies, artificial intelligence (AI), smart homes, and smart buildings. Moreover, a deeper analysis of papers reveals that concepts such as digital domesticity, ubiquity, smart home devices, and physical mobility are emerging as critical areas of inquiry in envisioning the future of the home. These developments significantly influence housing's future impacts on security, privacy, and a sense of belonging within both architectural and social contexts.

1. INTRODUCTION

Technological developments have triggered a change in every discipline from the past to the present. They have affected life in different fields, from social dynamics to individual experiences, architecture, city, and house in different contexts and scales. Thus, they changed and transformed life in diverse ways. Various opinions and products have become prevalent through televisions, computers, the internet, and artificial intelligence, and these developments have changed humans' time, space, and perception. Interpreting how the planet, cities, and houses respond to these continuous changes is critical for predicting future changes and transformations.

According to Riley [1], the house is both the leader's architecture and current situation and the herald of the future direction [2]. So, the house has been on the researchers' agenda; it has been seen as a research field in various disciplines, from sociology to architecture, city planning, policy, economy, and philosophy. Because the issue of the house identifies the space including all people throughout their lives but in distinct roles. This is because understanding of this issue necessitates understanding that goes beyond itself [3]. The reason for this could be associated with having meanings beyond being a space. Daily practices and experiences ascribe different meanings to the house. These are attachments, identity, representation, etc. However, these meanings are not stable; they evolve in line with time and time features. Technological developments have transformed life and all activities from the smallest to the largest scales, from the past to the present, and will continue to do so. Therefore, investigating, conceptualizing, and interpreting this relationship is significant.

This research is based on this interaction and its aims are examining the literature in depth, synthesizing existing knowledge, and exploring prominent issues and concepts in this context. Firstly, a theoretical framework is presented. Cross-evaluations and the studies in this part mentioned here are important in terms of constructing the research. This section places the topic on a conceptual footing and distinguishes

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this article from a passive literature review. The next section presents the research strategy, and the research questions and the research method concerning these questions are explained in detail. In the second section of the article, the findings of the research conducted are presented from a systematic perspective, and in the third section, all findings are evaluated holistically and determinations related to the research questions are made.

1.1 Literature Review and Theoretical Framework

In this part of the study, the concepts of house, technology, and future, which are the focus of the research, are examined, with particular emphasis on their etymological roots, and the positions of these concepts relative to each other are discussed through literature According to the Etymonline Dictionary [4], both the concept of 'house' and 'home' originate from the Proto-Germanic language, derived from 'hus,' which initially meant 'hide.' These terms broadly refer to a dwelling or shelter, a structure designed to serve as a residence. However, the term 'home' evolved to be more inclusive, incorporating the suffix 'khaim,' which signifies residence rather than mere shelter (Figure 1). 'Home' is defined as 'the house, apartment, etc. where you live, especially with your family,' 'property that you can buy or sell,' 'family you come from,' and 'a place where people or animals live and are cared for.' In contrast, 'house' is defined as 'a building that people, usually one family, live in, according to the Cambridge Dictionary [5]. While 'house' is associated with physical space or a building, 'home' is also tied to family, origin, and life experience. Therefore, 'house' functions primarily as a physical space, whereas 'home' is a concept associated with the living experience and space.

Technology is increasingly transforming the 'house' and 'home' concepts. Both mean more than the etymological meanings. For example, the advent of smart home technologies -including automated lighting, climate control, and security systems- has fundamentally changed the way we perceive and interact with the built environment. Today, simply a static physical structure, the house has become an interactive, responsive system that can adapt to its inhabitants' needs, preferences, and behaviors. These technologies extend the concept of 'house' by embedding functionality and adaptability of the building itself. Furthermore, innovations such as voice activated assistants, smart appliances, and IoT devices create a integration between the physical space and humans. So, the concept of 'home', associated with living experiences, is changing parallelly. This blurring of boundaries between the built environment and technology transforms the house from a passive shelter into a dynamic, active participant in the daily lives of its occupants. As these technologies evolve, they not only improve comfort and convenience of physical space (house) but also transform new forms of living (home).

The Metapolis Dictionary expands on the relationship between concepts like architecture, urbanism, technology, and society, facilitating an exploration of 'house' and 'home' beyond traditional definitions. In the Metapolis Dictionary [6], 'home' is defined as a universal iconic reference, a place of belonging that defines and surrounds the residence, serving as both a place of ownership and identity. Furthermore, technological innovations -such as the integration of computers, televisions, and smart systems- are seen as expanding the concept of 'home' from a physical shelter to an interactive, fluid environment. In this sense, 'home' becomes an intermediate space that is continuously redefined through technology. Imagination and innovation are no longer just about design; they now also involve the creation of spaces that are responsive and adaptive, serving as interfaces for communication and interaction. While 'house' traditionally refers to a functional, physical space, it is increasingly seen as a place of desire, versatility, and quality of life. The integration of technology influences this evolution, creating new possibilities for how we will live and where we will live. As we examine the connection between 'house' and 'home,' it becomes evident that these concepts are deeply interconnected, with technology as a transformative force enhancing both. The distinction between 'house' as a physical structure and 'home' as a living experience becomes more difficult to define as technology continues to shape and redefine these spaces.

In summary, the transformation of 'house' and 'home' goes beyond physical spaces, highlighting their interconnectedness in a World increasingly shaped by technology. The role of technology in this transformation cannot be underestimated, because technological advancements provide to reimagine and redefine the living and its spaces. Therefore, to completely understand 'house' and 'home', it is necessary

to consider both the physical and conceptual dimensions together. This requirement made it necessary to address both concepts in the research to make this study more holistic.

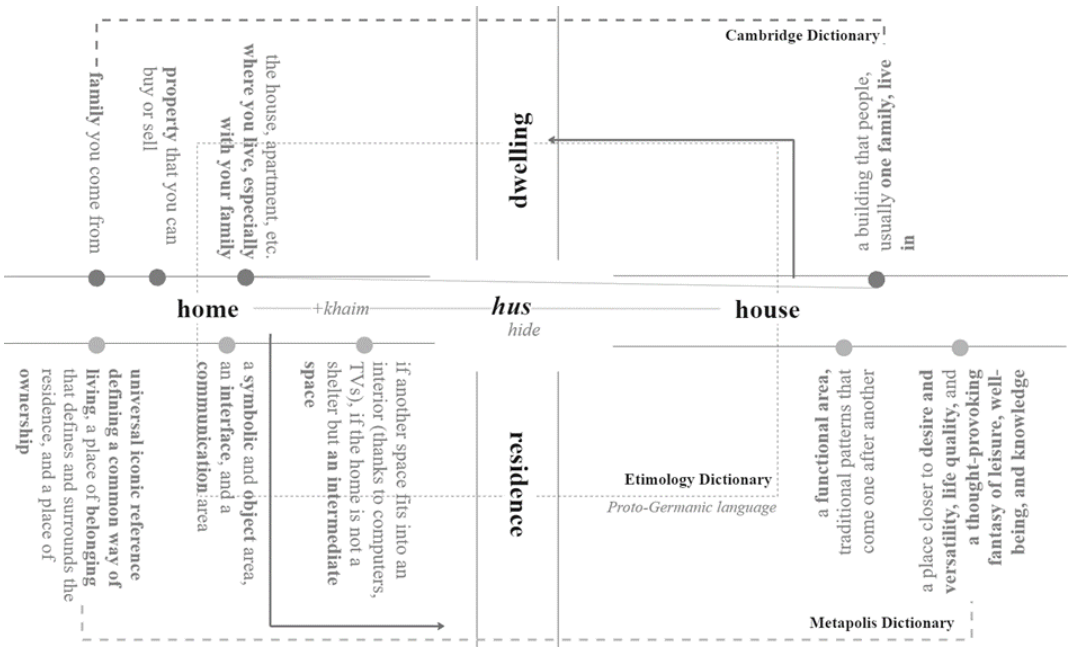

Figure 1. *Etymological Perspective on 'Home' and 'House'*

In architecture, a house, when viewed formally, refers to physical structures designed for people to live in and open spaces associated with these structures [7]. These physical structures also contain social and cultural meanings (different views of home, domesticity, daily routines, family rituals, and lifestyles). In other words, a house is not only a physical structure but also a complex set of needs, desires, and meanings. This is because is that the form and spatial organization of the house are shaped by its cultural environment [8]. On the other hand, since thought and social relations are also determinants in the physical change of space, the house should also be examined with its environment, life, the uses of objects, and their formal aspects [9]. There are many studies, discussions, and approaches on the house and its definition in different ways in the literature. Especially when it comes to the meaning and interpretation of house, different concepts that are similar to each other, sometimes replace each other, can be used instead of each other, or indicate a transformation are added here. The conceptual ground expands with the concepts of shelter, home, and home. Tanyeli [10], explained the relationship between dwelling, house, and home by pointing out a transformation of social change. According to him, "From the 19th century onwards, the home ceased to be a house and turned into a sublimation, even sanctification, referring to the nuclear bourgeois family. In the 20th century, the home was defined as a space that was no longer personalized, adopted, or identified with the family, and the apartment was accused of this. The reason for this was the collapse of the social stereotype that could be called the identification of the family with the house." Işıkkaya [11], explained the transformation of home into the house in the 20th century concerning capitalism: "Since the home did not turn into a product until the 20th century, it is not perceived as a house in the current sense. While the home referred to emotion, which was a multifunctional, original, private, multi-stakeholder, crowded sacred space in the pre-modern period, in the 20th century it turned into a house that contained certain functions, that we benefited from, that we had fewer ties with, and that we used for a limited time."

Houses transform into homes along with the life they inhabit. House as a pure space, and especially urban houses, establishes a connection with many other areas of life by creating an interaction between the structure and the program over time and space. A house should not be understood as a static physical construction unit. Because even if the inhabitants do not intend to create a home, this housing always indicates a social dimension [12].

Estimating the future home could be possible by using the method which is dwelling experiences used by Lawrance based on today's home architecture, technology usage, and space. It is an undeniable fact that

today's technological advances have affected and reshaped whole life, the relation of production and consumption, experiences, architecture, space, and objects, and the way of doing and thinking: In the last 100 years, devices that have been integrated into homes and life with the promise of making people's lives easier (refrigerators, washing machines, dishwashers), entertainment and communication sources (radios, televisions, computers, telephones) and increasingly more advanced (smart) versions of these devices... Don't they directly change the meaning of house as well as physically? Werner, Altman and Oxley [13], could answer this question by saying that changing the meaning of home could be read with human acts. Dovey [14], defined home as a relation between human and environment rather than part of an environment. At this point, home is the node between the city and human and it's dynamic change could be explained with laces in this node. Also, this dynamic transformation occurs the new needs, lifestyles, spaces, regulations in city, architecture. Technological advances and social, political, cultural changes which trigger these advances are critical on this issue.

Word of technology occur with "tekhne" and "logos" in Greek. While "tekhne" means art and craft, "logos" means wisdom and logic. Technology means knowledge, equipments and methods on science and industry in Cambridge Dictionary [15]; equipments that humans invented to inspect and change their environment and its knowledge in TDK [16]. Nightingale [17], separate the approaches on technology in two groups: First one -mostly used by engineers- is filling the blanks with artificial functions, second one -mostly used by philosophers- the product of a desired problem-solving process through ideas or design that transform the world. Technology changes not only production but also humans' lives and it can make easier or more difficult. As Benjamin [18] stated, the ruptures/crises experienced with technology shape human nature not only superficially but also deeply and upwards. Technology is one of the crises that led the world to transformation, and in fact, it is the thing which has changed and transformed human life the most since the 18th century. Moreover, the role of technology in this change is greater than ever today and its weight is increasing. Technology will be the most important dynamic that will shape the future. Reichenbach [19] defines the time order as before and after, the time direction as past, present, and future, and asks: "In what sense is the future different from the past?" The answer to this question can be explained by the crises that trigger transformation. The continuity of technological developments, which is one of these crises, also makes the change continuous and characterizes the change by intersecting with other events [20].

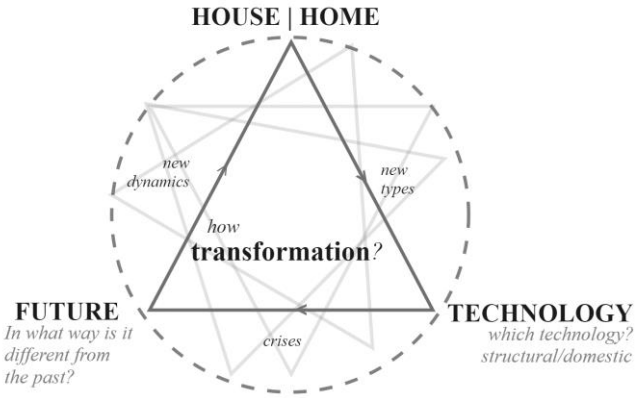

Figure 2. *Conceptual Ground*

It can be said that technological advancements, defined as a crisis by Tanyeli[1], are the movements and direct the time. Crises (wars, earthquakes, technological improvements) bring new things and obligate adaptations. Transformation is an ordinary production of this process. The etymological roots of 'house,' 'home,' and 'technology,' discussed earlier, reflect the evolution of these concepts from functional and physical definitions to inclusive, experiential, and interactive meanings. This shift highlights how the intersection of technology with other crises shapes the transformation of living spaces, contributing to the redefinition of the house and the home. The new situations and dynamics which occur with technology

[1] Tanyeli comprehends "cris" as a deformity on the working system in the book which is "*Mimarlık Düşünmek İçin Verimli Arızalar*" and cris neither possibility or breakdown. Health and technology crises are unpredictable, and they cause the adaptations to new lifestyles and pose the new perceptions.

and its co-existence with other crises, and the transformation based on these is critical to the issue of the change of the house (Figure 2). So, how do researchers perceive this topic?

2. METHOD

This research aim is to bring out the prominent topics and concepts about relationality between the concepts of house, technology, and future and determine the tendencies in literature. According to this aim, this research utilizes the method of bibliometric analysis (Figure 3).

Bibliometric analysis is a quantitative research method systematically examining and interpreting academic literature. This method involves assessing various attributes of published works, such as authorship, publication trends, citation patterns, and thematic evolution within a specific field of study. Bibliometric analysis method reveals the transformation of a specific field while also providing foresight into future developments in that area [21]. These kinds of research, examining the literature systematically, are valuable because they make visible the current research area's dynamics and tendencies. In this research, bibliometric analysis is utilized to uncover the relationships and trends between the concepts of house, home, technology, transformation, and the future. So, it helps to identify patterns and predispositions in the literature while also revealing gaps that may support further investigation.

This research tries to answer these questions: 1) Which subjects and concepts have the relationship between housing, technology, and the future been examined by researchers? 2) How can researchers' approaches to the relationship between house, technology, and the future be systematized? 3) How has the future of the transformation of house with technology been evaluated by researchers?

When the concepts related to the research topic have been addressed in the literature have been examined, it has been seen that there may be alternative routes for the literature research to be conducted due to the comprehensive nature of the topic. This determination has added another question to the study. 4) Which keyword should be used to analyze the literature on the relationship between house, technology, and the future? (house/home) In this article's context, to occur the more holistic perspective, both concepts are examined in different routes, and these routes and process-flow diagram are shown in Figure 3.

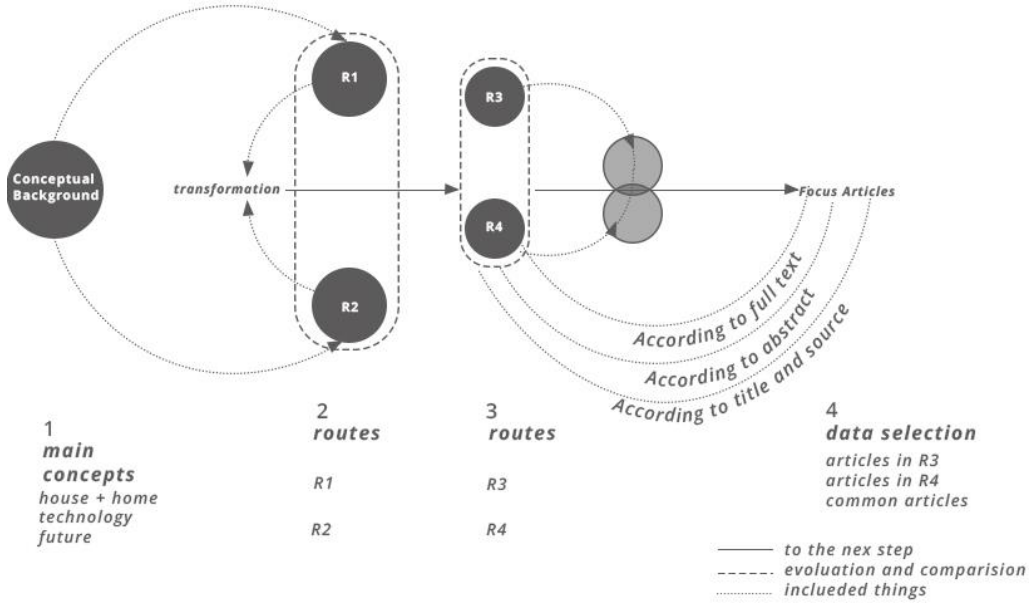

Figure 3. *Bibliometric and Content Analysis Flow Diagram*

To interpret the different sides of the research topic, thematic analysis method (Braun & Clarke, 2006) which based on determining, analyzing and revealing the thematic patterns on data, is used, research codes are identified as house, home, technology, future and transformation and these codes are examined with different combinations. This research was run between November 19, 2023 – January 6, 2024, and it

is limited to period (2020-2023), English publications which encompass these words in their abstracts and keywords and articles, proceedings and book series on Scopus database. 12.576 publications have been attained and their statistical and numerical data have been investigated. These data have been analyzed with maps and diagrams produced via the VOSviewer program, and usage densities, temporalities, and relationalities of the concepts are detected. Furthermore, data attained via Vosviewer have been grouped by researchers and findings interpreted. To expand and deepen the research context, 11 articles related to this research's approach have been identified and analyzed in detail (Table 1).

Table 1. *Research Steps: Bibliometric (1) and Content/Thematic Analysis (2), Scopus, 2000-2023*

Research Steps	Research Scopes	Research Routes	Research Codes	Tools	Outputs
1. Bibliometric Analysis	Article, Proceedings, Book Series (in English)	R1	*House, technology, future*	*Density Map Network Map Overlay Map*	*Concepts used most (n>5) Groups of topics researched most*
		R2	*Home, technology, future*		
		R3	*House, technology, future, transformation*		
		R4	*Home, technology, future, transformation*		
2. Content, Thematic Analysis	Focus Articles (in English)	R3 - R4		*Articles (title, full text) Source, discipline*	*Relationality of topics and concepts and arguments about them*

Research steps can be explained briefly. In the first stage, the conceptual background is revealed through network, density, and overlay maps attained via VOSviwer. Concepts of home and house were evaluated together and traces in the literature of how these concepts interacted with technology and the future have been examined separately. To do this, limited to period, database, language, and paper types, Route 1) [house, future, technology] and (Route 2) [home, future, technology] have been determined and searched. Network visualization maps have been created for both routes by analyzing the most used word, current concepts are determined with overlay maps via VOSviewer software. In the next step, the outputs of these maps have been compared, and similarities and differences have been determined. After that, Route 3 [house, future, technology, transformation] and Route 4 [home, future, technology, transformation] were created by adding the concept of "transformation" and analyzed and compared like Route 1 and Route 2.

In the second stage, firstly articles articles, attained with R3 and R4 have been examined according to topics, scopes, methods, channels, keywords, and primary approaches. Then, articles encountered in the previous stage have been listed, and the most interrelated to this research have been selected and analyzed content-wise. Finally, all data have been analyzed holistically, and the relation between home and house and their transformation concerning the future and technology has been questioned. Prominent topics and concepts have been detected and transformations of home and house in parallel with technology have been questioned.

3. FINDINGS

In this section, findings detected in the literature review have been explained in line with the above-mentioned by being systematized.

3.1. Route 1 (R1): House, Future and Technology

• 3166 publications (1213 proceedings and 1180 articles) have been attained with a survey including the keywords (house+future+technology) in their keywords and abstracts' parts among publications after 2000 on the Scopus database.
• These publications have been examined via VOSviewer software; it has been detected those concepts of human, technology, automation, construction industry, and energy efficiency have become prominent, and the Internet of things, concepts of smart buildings, and greenhouse gas follow them.
• Network map has occurred with the same data. The network map shows the relationship between concepts and usage density. It reveals the most used and repetitive concepts and concepts, used together, codified with the same color. According to this, In R1, there are 5 groups, and this grouping has been marked manually on the map (Figure 5). These groups have been named with the most used concepts: G1: Automation, G2: Human, G3: Construction Industry, G4: Energy Efficiency, G5: Greenhouse Gas.
• Vosviewer Software shows the temporality of the frequency of usage of concepts via overlay map. In line with this mapping, the distribution of concepts, which have become prominent since 2010, is G1: Internet of things, security, integration; G2: wellness, covid 19, children's algorithms, telehealth; G3: printers, estimation, health risk, BIM; G4: zero energy buildings.

3.2. Route (R2): Home, Future and Technology

• 9010 publications (3814 proceedings and 3084 articles) have been attained with a survey including the keywords (home+future+technology) in their keywords and abstracts' parts, among publications after 2000 on the Scopus database.

• These publications have been examined via VOSviewer software; it has been detected that concepts of human, automation, and COVID-19 have become prominent, and quality of life and communication follow them.

• A network map has occurred with the same data, and according to these, 5 groups have been detected for R2. This grouping has been shown manually (Figure 5), and groups have been identified with prominent concepts: G1:c Automation, G2: Human, G3: Covid-19, G4: Quality of Life, and G5: Communication.

• Vosviewer Software shows the temporality of the frequency of usage of concepts via overlay map. In line with this mapping, the distribution of concepts, which have become prominent since 2016, is G1: Internet of things, smart homes, artificial intelligence, machine learning, virtual reality, sustainability, climate change, and energy; G2: flexibility, health, fragility; G3: working from home, technology usage; G4: mobile applications, wearable sensors.

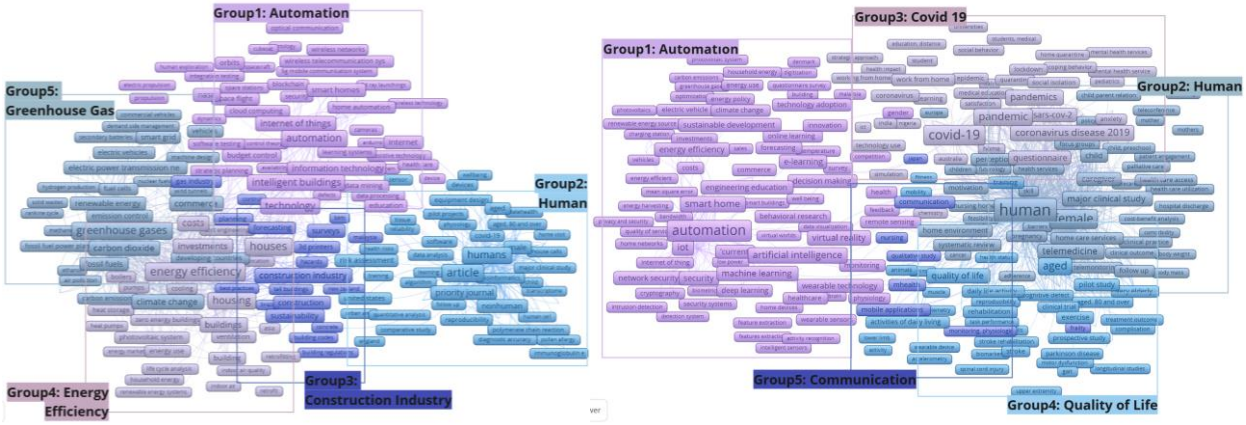

Figure 5*. Data groups of Route 1 and Route 2, respectively, from left to right (Network maps were obtained via VOSviewer with a minimum word limit of 5 and were grouped manually by Author.)*

3.3. Comparison of R1 and R2

In this part, outputs of R1 and R2 have been compared to each other (Figure 5) and findings with the comparison conclusion have been asserted item by item.

- For R1, these concepts have been became prominent in groups: In G1_Automation: smart homes, buildings; in G2_Human: covid 19, tele-health, psychology, risk management; in G3_Construction Industry: building codes, construction, 3D printers, BIM; in G4_Energy Efficiency: ventilation, reinforcement; in G5_Greenhouse Gas: energy systems, renewable energies.
- For R2, these concepts have become prominent in groups: G1_Automation: smart homes, artificial intelligence, privacy, security; G2_Human: woman, child, home environment, flexibility, cooccurrence; G3_Covid 19: pandemic, working from home, social behavior, technology usage, simulation; G4_ Quality of Life: daily activities, elderly; G5_Communication: mobile applications, psychology.
- There are groups of automation and human in both searches. However, both concepts are related to different sub-concepts. For example, while R1 has been associated with the construction industry, energy efficiency, and greenhouse gas topics, R2 is associated with covid 19, life quality, and communication. Also, the concept of "automation" has been associated with smart homes, buildings, and security in R1 but with smart homes, artificial intelligence, and security in R2.

Table 2. *Concepts and groups that stand out with R1, R2*

R1 (*house+future+technology*)				
G1: Automation	**G2**: Human	**G3:** Construction Industry	**G4:** Energy Efficiency	**G5:** Greenhouse Gas
Smart homes, buildings, security	Covid 19, tele-health, psychology, risk management	Building codes, construction, 3D printers, BIM	Ventilation, reinforcement	Energy systems, renewable energies
R2 (*home+future+technology*)				
G1: Automation	**G2:** Human	**G3:** Covid 19	**G4:** Quality of Life	**G5:** Communication
Smart homes, artificial intelligence, privacy, security	Woman, child, home environment, flexibility, cooccurrence	Pandemic, working from home, social behaviour, technology usage, simulation	Daily activities, elderly	Mobile applications, psychology

R: Route, G: Group

3.4. Route 3 (R3): House, Future, Technology and Transformation

- 92 publications (32 proceedings and 34 articles) have been attained with a survey including the keywords (house+future+technology+transformation) in their keywords and abstract's parts, among publications after 2000 on the Scopus database. 7 belong to the Arts and Humanities category, including architecture.
- When these publications are examined on a density map, attained via VOSviewer, it is seen that the concepts of sustainable development, environmental technology, economic collapse, construction industry, and architectural design and energy become prominent.
- In the network map, with the same data (Figure 6), the relationality of concepts is seen. The same color codes are used in VOSviewer. In this respect, data obtained with the search of

"house+future+technology+transformation" are grouped and named according to the prominent concepts: G1_Sustainable Development, G2_Environmental Technology, G3_Ekonomic Collapse, G4_Construction Industry and Architectural Design, G5_Digital Transformation and G6_Energy (Figure 6).

• VOSviwer demonstrates the frequency of usage of concept on overlay map. According to the evaluation of this map, the distribution of concepts, which have become prominent since 2008, is G1: rurality, remediation, heating; G2: transportation, noise; G3: budget control; G4: construction, technological innovations; G5: marketing, cloud technology; G6: circulation, energy efficiency (Table 3).

3.5. Route 4 (R4): Home, Future, Technology and Transformation

• 213 publications (61 proceedings and 78 articles) have been attained with a survey including the keywords (home+future+technology+transformation) in their keywords and abstracts, among publications after 2000 on the Scopus database. 12 of them belong to the Arts and Humanities category, including architecture.

• When these publications are examined on a density map, attained via VOSviewer, it is seen that the concepts of digital transformation, human, artificial intelligence, automation, Internet of things, COVID-19, and sustainable development become prominent.

• In the network map, with the same data (Figure 6), the relationality of concepts is seen. The same color codes are used in VOSviewer. In this respect, data obtained with the search of "home+future+technology+transformation" are grouped and named according to the prominent concepts: G1_Covid 19 and Artificial Intelligence (concept have same color and size), G2_Automation, G3_Digital Transformation (Figure 6).

• VOSviwer demonstrates the frequency of usage of concept on overlay map. According to the evaluation of this map, the distribution of concepts, which have become prominent since 2016, is G1: pandemic, education, e-learning, home care; G2: smart homes, buildings, cities; G3: agriculture, energy efficiency, robotic technology (Table 3).

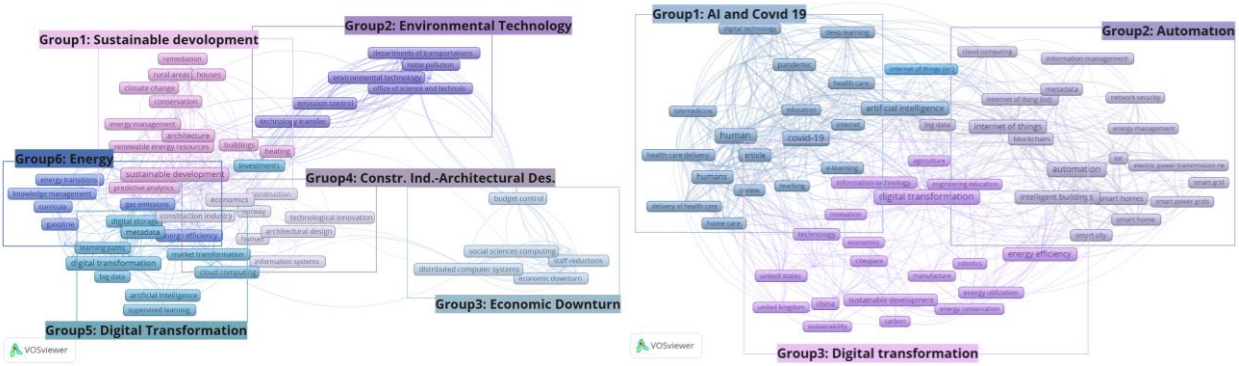

Figure 6. *(Data groups of Route 3 and Route 4, respectively, from left to right (Network maps were obtained via VOSviewer with a minimum word limit of 5 and were grouped manually by Author.)*

3.6. Comparison of R3 and R4

In this part, outputs of R3 and R4 have been compared to each other (Figure 6) and findings with the conclusion of the comparison have been asserted item by item.

• For R3, these concepts have been became prominent in groups: In G1_Sustainable Development: rurality, remediation, heating; in G2_Environmental Technology: transportation, noise; in G3_Economic Collapse: budget control; in G4_Construction Industry and Architectural Design: construction, technological innovations; in G5_Digital Transformation: marketing, cloud technology; in G6_Energy: circulation, energy efficiency.

• For R4, these concepts have become prominent in groups: In G1_Covid 19 and Artificial Intelligence: pandemic, education, e-learning, home care; G2_Automation: smart homes, buildings, cities; G3_Digital Transformation: agriculture, energy efficiency, robotic technology.

• There are groups of digital transformation in both searches. However, digital transformation is related to different sub-concepts in separate groups. For example, while R3 has been associated with topics of marketing and cloud technology, R4 is associated with agriculture, energy efficiency, and robotic technology. When other data groups are examined, while both R3 and R4 indicate physical issues like noise, agriculture, smart homes/buildings/cities, circulation, and energy, only R4 indicates the topics related to life such as pandemic, e-learning, home care, and education.

Table 3. *Concepts and groups that stand out with R3, R4*

R3 (*house+future+technology+transformation*)					
G1: Sustainable Development	**G2:** Environmental Technology	**G3:** Economic Collapse	**G4:** Const.Ind.-Arch. Design	**G5:** Digital Transform.	**G6:** Energy
Rurality, remediation, heating	Transportation, noise	Budget control	Construction, technological innovations	Marketing, cloud technology	Circulation, energy efficiency
R4 (*home+future+technology+transformation*)					
G1: Artificial Int.-Covid 19		**G2:** Automation		**G3:** Digital Transformation	
Pandemic, education, e-learning, home care		Smart homes/ cities, buildings		Agriculture, energy efficiency, robotic technology	

R: Route, G: Group

3.7. Focus Articles

In this part, there are focus articles to deepen the research. To determine them, a progressive selection methodology has been adopted (Figure 7). According to this, 64 articles attained via R3 have been listed and evaluated. Then, firstly 9 articles were excluded according to titles and sources, and remained 55 articles. Then, abstracts of 55 articles were read, and 34 of them were eliminated because they were weakly related. In parallel with this scan, 152 articles for R4 have been detected, listed, and evaluated. Firstly, 60 have been excluded according to their titles and sources. Then, the remaining abstracts (92) were read, and 42 of them were eliminated because they were weakly related. Then, the articles most related to this research have been determined. 6 articles for R3 and 9 articles for R4 have been selected and it has been seen that there are 4 same articles in both searches (Figure 7).

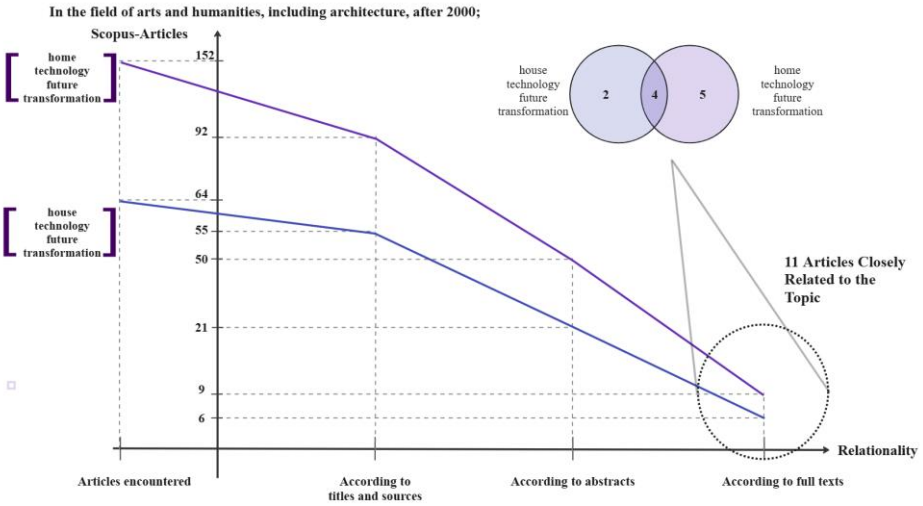

Figure 7. *Data/Article Selection Process*

Table 4. *Focus Articles*

R	*Code*	*Writer/Writers*	*Year*	*Title*
R3	**A1**	*Byounggwan LEE, Okhyun KWON, Inseong LEE, Jinwoo KIM* [22]	2017	Companionship with smart home devices: The impact of social connectedness and interaction types on perceived social support and companionship in smart homes
	A2	*Fredrik TORISSON* [23]	2023	The Digitalization of Swedish Housing
R4	**A3**	*Aykut COŞKUN, Gül KANER, İdil BOSTAN* [24]	2017	Is smart home a necessity or a fantasy for the mainstream user? A study on users' expectations of smart household appliances.
	A4	*Luis HERNAN, Carolina RAMIREZ-FIGUERROA* [25]	2023	A Home with a Future. Digital Domesticity and the Vague Fictions of Silicon Valley
	A5	*Antoine PICON* [26]	2023	Dwelling in the Digital Age: Imagination, Experience and Subjectivity
	A6	*Yvonne FÖRSTER* [27]	2021	Painting by numbers: Digital technology and the art of living
	A7	*Sotiriosa KOTSOPOULOS, Jasonb NAWYN* [28]	2023	Rethinking Autonomous and Robotic Systems in Residential Architecture
R3 + R4	**A8**	*Donghyeog CHOI, Hyunchul CHOI, Donghva SHON* [29]	2019	Future Changes to Smart Home Based on AAL Healthcare Service
	A9	*Léa-Catherine SZACKA* [30]	2021	Screen's Domesticity: from the Postmodern House to Our House
	A10	*Hamid ABDOLLAHYAN* [31]	2018	An Ethnographic Study of Communication Between Humans, Nature, and Place: In Search of a Sense of Belonging in Abarkouhi Homes, Iran
	A11	*Daniel A. BARBER* [32]	2014	Tomorrow's House: Solar Housing in 1940s America

R: Route, A: Article

*When focus articles for **R3** (A1, A2) are examined, these are detected:*

A1 emphasizes technological advancements as a response to increasing loneliness caused by changing social structures, highlighting the potential of smart devices to reduce loneliness and partially replace human interaction. The study demonstrates that as the prevalence of living alone increases, the interaction between individuals and smart devices within their homes transforms, serving as a form of social support. This shift suggests that the home itself, augmented by technology, may assume a role akin to that of a "companion". This perspective underscores how technological developments contribute to changing the meaning of the home. A2, on the other hand, differentiates between "smart houses" and "smart homes," highlighting the distinct meanings each term embodies. While smart houses are associated with structural technologies such as energy and security, smart homes are connected to household appliances like refrigerators and vacuums. By distinguishing these terms, A2 demonstrates that the home is not merely a shelter but a space shaped by technology, gaining new functions and meanings. This analysis reveals how technology not only enhances individual objects within the home but also contributes to the broader structure and purpose of the home itself.

*When focus articles for **R4** (A3, A4, A5, A6) is examined, these are detected:*

In the A3 and A6 articles, discussions focus on smart homes. A3 presents a case study on how future homes should be designed according to the expectations of various social groups. It explores the relationship between the adoption of smart home technologies and the expectations users have from these homes. The study observes that different socio-cultural groups have varying expectations and levels of

technology adoption. Users were categorized by age and parental status, and daily living habits and the needs of different age groups regarding smart home technologies were assessed using descriptive cards. A6, taking a more speculative approach, emphasizes human-machine interaction and explores how technological advancements may transform daily life and the home. It draws projections from science fiction cinema, referring to this lifestyle as "techno-culture." A4 introduces the concept of "digital domesticity" in the context of digital devices and their integration into everyday life. It argues that through miniaturization and widespread presence, digital devices have become almost imperceptibly integrated into daily life. The placement of AI-supported devices in the home is examined in terms of their potential to transform both space and lifestyle. This new understanding of "home" is described as digital domesticity and serves as an example of the "techno-culture" lifestyle discussed in A6. A4 envisions the future home in physical terms while emphasizing changes in daily life and the meaning of home, aligning with the "techno-culture" lifestyle. A5 focuses on the pandemic, new types of dwellings, and the dreams of housing, highlighting the blurred boundaries between the physical and virtual realities of home. A5 discusses how digital technologies have reshaped home expectations, influencing its location, lifestyle, and function. It also examines how these technologies, by enabling remote work, socializing, and education, have added new meanings to the concept of home. In A7, the transformative role of artificial intelligence and autonomous technologies is discussed through three future home prototypes. A7's contribution to this study lies in its exploration of how technology impacts human life and, in addition, provides insights into how architects and residents make design and usage decisions regarding the integration of AI technologies into the home.

*When common focus articles for **R3 and R4** (A8, A9, A10, A11) is examined, these are detected.*

When these articles are examined, the concepts of "home" and "house" are interrelated, except for A10. The concept of "house" is used when describing physical features, whereas the concept of "home" is used when discussing interior space, roles, and lifestyle. Therefore, A10 contributes to this study by helping define the scope of these concepts. While A8, A9, and A10 are case studies, A9 explores domesticity through examples. A8 addresses smart home technologies for elderly people and the future of health services in homes. A9 discusses how, while screens have not altered the architectural organization, they have transformed the domestic space, including furniture arrangement, lifestyle, and roles. A11 examines the structural transformation of houses through solar technologies, focusing on domestic life in parallel with socio-cultural changes. The concepts and topics in these articles are both innovative, such as screen domesticity and digital domesticity, which define modern lifestyles, and classical, such as solar energy and smart homes, which are described in physical terms.

4. HOLISTIC EVALUATION

A systematic literature review is acknowledged as an effective research methodology for examining the current studies and systematically bringing out the outputs and findings perspicuously and reproducible by synthesizing [33]. This section includes a holistic evaluation of the article from this perspective. Routes have been determined when transformations of house and home have been examined and maps related to these routes have been created. In line with data attained via maps, the frequency of usage by years of prominent topics and concepts in maps has been demonstrated in Figure 8. In this context, it is seen that the most prominent topic is *energy* for all routes by years between 2008 and 2015. After that, *technological developments and investments followed them until 2021, but the pandemic and the topics which are related to the pandemic, such as working from home, digital transformation, and COVID-19,* became prominent in 2021. As of 2023, *artificial intelligence technologies* have become the leading actors of transformation in house and home issues, as they have been included in every area of life, such as education, training, engineering, and medicine (Figure 8).

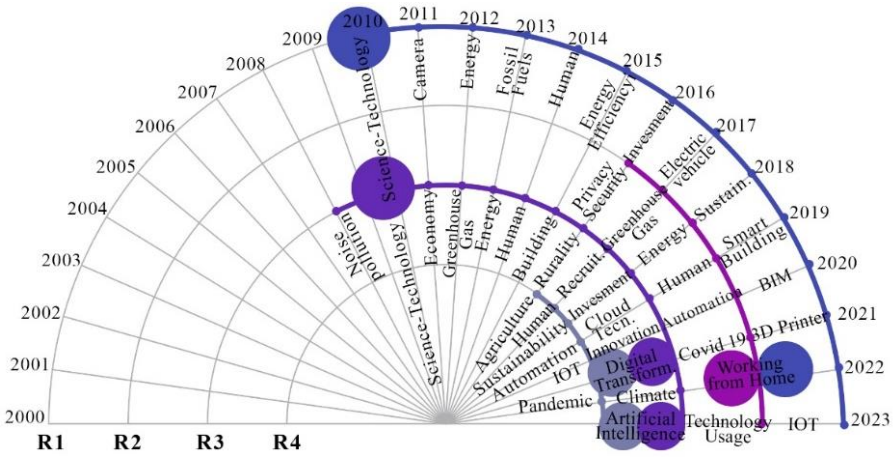

Figure 8. *Concepts according to years in routes*

When the related publications examined in detail to deepen research, the transformation of home has been associated with *artificial intelligence, automation, and digital transformation*; the concept of home has been used for explaining life, human and physical home. For example, While Hernan and Ramirez-Figuerrova [25] discussed the mixing of these technologies into life with the concept of *"digital domesticity"*, Picon [26] emphasized the change in both the dream and meaning of home with *digitalization*.

The concept of digital domesticity first emerged in Spigel's [34] article *"Media Homes: Then and Now,"* where she discusses smart homes as the modern representation of digital domesticity. Domesticity refers to how families and housemates live within their homes, highlighting how daily life is experienced in domestic spaces. Historically, domestic life has always been shaped by various items such as furniture, appliances, fixtures, decorations, and utilities. In contemporary times, however, this mediation has expanded to include an incrasing presence of media technologies, communication infrastructures, and software applications that shape and organize life within modern households [35]. Digital domesticity, the concept of integrating digital technologies into the home environment, represents a shift from traditional living to one centered around continuous technological engagement. It signifies a transformation of the home into a space where digital tools mediate both daily routines and social interactions, affecting both the physical structure of the home and the way people live within it. These technologies are reshaping the meaning of home, making it more than just a shelter but an active, dynamic environment influenced by technological advancements. While the physical transformation of the house expresses the structural integration of digital technologies and smart home technologies, the semantic transformation changes the bonds people establish with the house and their perception of life. With this process, the house ceases to be just a shelter and turns into a dynamic living space shaped by technological developments. The house, on the other hand, is related to physical and structural change, and digitalization and smart home technologies transform the static structure of the house into a more interactive and constantly changing space.

The integration of smart home technologies within digital domesticity redefines *communication* and *interaction* boundaries, significantly transforming how individuals engage with their environment and each other. Picon [26] posits that the concepts of "house" and "home" are inseparable, involving both spatial and experiential dimensions that mutually influence each other. Thus, the home evolves beyond a physical structure, fostering a sense of belonging and leaving lasting impressions and meanings shaped through its interactions with its environment and inhabitants. However, digital technologies bring new complexities to traditional concepts like privacy and security. On one hand, *smart home* technologies enhance physical *security* (e.g., protection against theft) by providing greater security; on the other hand, these expanding communication networks increase the home's *traceability* and potential for *surveillance*, challenging conventional notions of *privacy*. This dual impact creates an ecosystem where *privacy* and *security* are interwoven, transforming the concept of privacy in the smart home. Supporting this perspective, Coşkun, Kemer, and Bostan [24] highlight how *smart home appliances* shape daily routines,

while Förster [27] emphasizes the evolving *human-machine relationship* within these settings. Hernan and Ramirez-Figuerrova [25] also envision the future home as a transformed daily environment, though they primarily address physical changes such as architectural plans. Additionally, Kotsopoulos and Nawyn [28] argue that homes can be studied from both structural and spatial perspectives, with human behaviors examined through interdisciplinary frameworks to better understand these transformations. In summary, the integration of smart home technologies does more than alter lifestyle; it compels a reconfiguration of the home's spatial and structural dimensions, especially in relation to *privacy, security, and interaction.* Concepts like *digital domesticity, ubiquity, and smart appliances -related to smart home technologies-* are reshaping the modern home into a *dynamic, responsive* space, adapting to its inhabitants' needs and redefining the traditional notion of what it means to live in a "home."

The concepts of *Internet of Things, security, integration, 5G communication systems, smart homes, wellness, COVID-19, child algorithms, tele-health, health risk, zero-energy buildings,* and *Building Information Modeling (BIM)* are becoming more important in research on homes, technology, and the future. Similarly, concepts like *artificial intelligence (AI), machine learning, virtual reality, sustainability, climate change, energy efficiency, flexibility, health, fragility, working from home, technology use, daily activities, mobile apps, and wearable sensors* are key topics in research about homes, technology, and the future.

Smart home technology is driven by artificial intelligence (AI), which functions through three primary tools: sensor data, speech recognition, and automatic actions. These technologies enable the home to *monitor, analyze, and adapt* itself with minimal need for input from residents. This is also related to the idea that homes will evolve to become more integrated with our daily lives, functioning almost as companions. AI is the key factor that makes a home "smart" by learning the routines of its residents and automatically adjusting devices and systems based on their needs. This structure provides residents with greater independence, a safer living environment, improved quality of life, and enhanced energy efficiency [36]. Therefore, smart homes and artificial intelligence bring together all the technologies mentioned above and play an important role in *sustainability, adaptation, flexibility, and enhancing overall quality of life.*

Abdollahyan [31] clarifies the distinction between house and home, suggesting that the house relates to structural and physical aspects, while home embodies social and emotional connections. Picon [26], emphasizes the transformative relationship between "house" and "home," noting how each influences the other. As smart technologies continue to blur the boundaries between the *physical and experiential,* future homes are expected to integrate digital functionality seamlessly with physical space. This transformation will shift the home from a passive shelter into an active, adaptive space, responding to the inhabitants' needs and behaviours. Torisson [23] differentiates between *"smart house"* and *"smart home"* technologies. Smart house technologies focus on structural improvements, such as *energy efficiency, security, and sustainability.* Examples include smart lighting, HVAC (heating, ventilation, and air conditioning) systems, and advanced security solutions, all designed to enhance physical security and optimize energy use, contributing to sustainability. On the other hand, smart home technologies prioritize user experience and convenience, involving devices that interact with daily routines. These technologies use *machine learning* and the *Internet of Things (IoT)* to adapt to users' behaviors, predict needs, and adjust settings autonomously thanks to artificial intelligence. For example, smart systems may monitor sleep patterns to adjust bedroom lighting or integrate voice-activated assistants to manage tasks, improving privacy by restricting unauthorized access and enhancing sustainability through energy efficiency.

Researchers such as Torisson [23] and Szacka [30] envision future homes as integrated spaces where structural resilience and experiential adaptability converge. Hernan and Ramirez-Figuerrova [25] describe these spaces as designed to accommodate flexible lifestyles, transforming homes from mere physical structures into dynamic, intelligent environments that anticipate and meet the evolving needs of their inhabitants.The prominent topics and concepts in search with the concepts of house, future, technology and transformation, *smart houses, interaction, and smart technologies, show similarities with house,*

technology, and future, but digital transformation differs in this search. The prominent topics and concepts in search with the concepts of home, future, technology and transformation, smart *homes, and pandemic show similarities with home, technology, and future*, but concepts of *smart home appliances, ambiguity, digital domesticity, ubiquity, physical mobility, digitalization, and digital experience* is seen here for the first time. The common topics and concepts are smart homes, the Internet of things, attachment, and energy houses for all searches. When the research has been deepened through selected articles, concepts of ubiquity, screen domesticity, telematic house, media house, VR house, and small home are seen (Figure 9). It can be said that these concepts are the sub-concepts of the concepts at the center of this discussion. As Grübler [20] puts it, these concepts that come to the fore at the intersection of technology and the home, distinguished from other events by their continuity and characterized change when it intersects with them, **are important in imagining the home of the future.** On the relationality of technology and the future, the topics transforming both house and home are the Internet of Things, digital technologies, artificial intelligence, smart homes, and *smart buildings.*

They are also about smart homes and artificial intelligence technologies. The development and adoption of artificial intelligence-based solutions are crucial for advancing smart home technologies. To fully realize the vision of a proactive, ubiquitous smart home, intelligent software solutions are needed [37]. While smart homes are gaining popularity, many people still hesitate to adopt the technology due to concerns about security, privacy, and potential physical risks [36]. In addition to these concerns, concepts such as digital domesticity, ubiquity, smart appliances, and physical mobility, discussed in various research, are key indicators of future trends in housing. These concepts have the potential to not only transform the physical aspects of homes but also reshape how we perceive and use space. As a result, they could significantly alter the meaning of "house" and "home," marking a shift towards more dynamic, adaptive, and interconnected living environments.

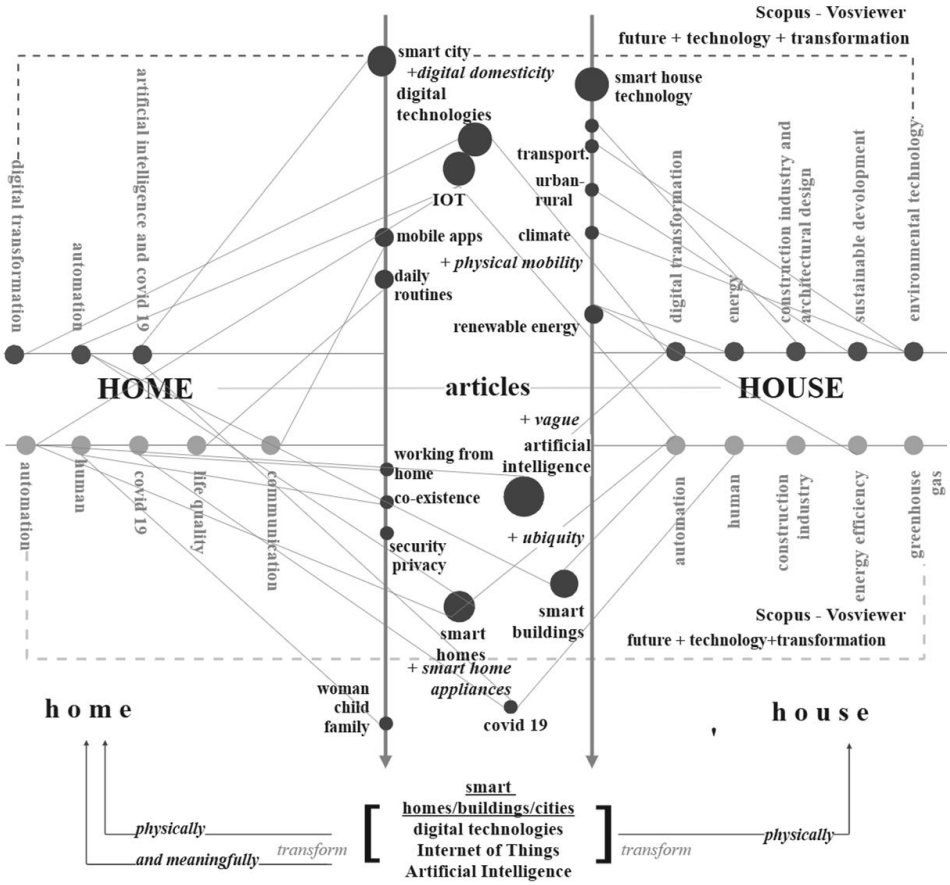

Figure 9. *Home and House: future, technology and transformation*

Within the scope of the research, when the concepts of house and home are examined, it is seen that they are used together instead of featured by researchers. But, in line with data attained via maps, the home concept is more inclusive because it is associated with physical and life issues. For instance, Szacka [30], investigated change of home through media technologies both physically and in terms of life activities. Barber [32] discussed the change of topic of home ownership both in terms of new building types and new ways of living. In contrast, concepts used for indicating living spaces such as home, house, dwelling, motherland, and something like this, change according to the dynamics of the period in which the publication was produced. For example, Işıkkaya [11] pointed out that homes had too many functions, such as sheltering, working, and socializing previously, but with the changing process that started modernization, homes obtained only sheltering function and transformed into houses. Also, he discussed gaining functions of home again during pandemic through the digital technologies. This research focuses on technology, changes in new ways of living, lifestyles, usage, and perception of space have been revealed.

5. CONCLUSION

This research examines the interaction between housing, technology, future, and transformation in existing literature. Prominent topics and concepts were identified, categorized, and analyzed through thematic analysis. Subsequently, focus articles have been detected and examined in detail, and how current issues in the relationship between housing, future, and technology are addressed are examined. Within the scope of the article, alternative routes were detected to research the effects of technology on the house; the literature review improved through these routes. According to this, the first route includes physical imagination, which can progress the house's conceptual framework. The second route points out social, cultural, and psychological aspects, and in this way, it is convenient for the researcher who aims to make a prediction/future estimation through meaning. At this point, the concept of home can be chosen to instrumentalize. However, based on studies on both architecture and human behavior, it can be said that both transformations undeniably affect each other.

Beyond the scientific contributions, the individual and social impacts, especially those highlighted in the comparison of the concepts of house and home, must also be considered. These impacts reflect how personal experiences with one's living space and broader social contexts shape our perceptions of home. The concept of home is deeply connected with an individual’s sense of identity, belonging, and the emotional bond they have with physical space. Individual experiences, memories, and cultural factors shape how people interact with and relate to their homes. In social context, these relationships are not only personal but also influenced by collective social norms and cultural values. The transformation of the concepts of house and home can be viewed as both an individual and collective journey, where personal identities and cultural practices evolve to adapt to new realities.

Collen and Meesters [38] expressed the house as a physical structure and the home as the relationships we live with it and argued that the two are intertwined and inseparable parts. Tanyeli [10] and Işıkkaya [11] emphasized that the concepts of house and home transform into each other with crises (pandemic, industrial revolution, renaissance, etc.). With this perspective, it can be said that the conditions of the period in which the publications were produced are decisive in evaluating these phenomena. This determination can also be interpreted as an indicator of the necessity of researching/understanding the transformation of the home/house together -in the context of the future and technology-. Evaluating the concepts of home and house with a holistic perspective will enable researchers who aim to create a future foresight to develop a more comprehensive perspective since one will be incomplete without the other. In addition, examining the processes of how these concepts transform and transform each other can reveal new possibilities regarding both semantic and physical transformation.

An important area for future research could focus on privacy, security, and socio-cultural relationships within the context of smart homes. These aspects are increasingly relevant as technology transforms domestic environments. The privacy and security challenges posed by connected devices in smart homes, as well as the effects on social relationships within these digitally mediated spaces, offer a rich avenue for further exploration. Further studies could explore how smart homes influence emotional well-being,

cultural dynamics, and user adaptability across different contexts. In particular, the integration of personal data and surveillance systems into the home environment requires further investigation regarding its implications for individual autonomy and social cohesion. Moreover, examining the impacts of smart homes on social interactions, community participation, and individuals' sense of belonging can provide crucial insights into the social fabric of future homes. Additionally, analyzing the implications of surveillance and data privacy on social interactions will provide essential insights into the evolving role of smart homes.

As we look to the future of housing, the evolution of the house will increasingly integrate innovative technologies such as artificial intelligence and the Internet of Things. This convergence of technology and architecture will reshape how space is utilized, influencing not only the functionality of homes but also how they contribute to the emotional and social well-being of their inhabitants. The future house is likely to be a dynamic, adaptable environment, responding to the needs and desires of its inhabitants in real time. These developments promise to transform the very essence of what it means to live in a home, altering both its physical form and its role within society. In addition, concepts like digital domesticity, ubiquity, and mobility will increasingly define how individuals interact with their homes, offering new opportunities for flexibility and connectivity that will influence the design and usage of homes in the future.

This literature review summarizes scientific research on the relationship between home, house, technology, and the future. The research has determined that the relationship between the future of houses and technology is established through digital technologies, artificial intelligence, smart homes/houses, and the Internet of Things, indicating a semantic and physical transformation. Discussions on the future of the house can be based on a combined evaluation of technology and current dynamics. The future of the house and its interaction with technology offer a rich research potential with its various contexts. Investigating the implications of smart homes on privacy, security, and socio-cultural interactions can open new research directions, especially considering the increasing integration of personal data and surveillance systems in the home environment. These challenges, including balancing comfort with privacy, the impact of surveillance on social relationships, and technology’s role in either fostering or inhibiting social interaction, are crucial areas for future research.

The literature research presented within this article’s scope can be considered a step for future studies. Further research can explore the psychological effects of living in fully automated homes, focusing on user autonomy, trust in technology, and impacts on family dynamics and well-being. Long-term studies on the environmental sustainability of smart homes are also needed, particularly regarding energy efficiency, carbon footprint reduction, and material sustainability. Additionally, examining how different cultures adapt to technological changes in housing will provide valuable insights into the transformation of the concept of “home” in specific context. The topics and concepts identified through this research can pave the way for new fields of study and innovative research with the perspectives of different researchers.

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