DOI: https://doi.org/10.38027/iccaua2023en0341

Creating Polysemic Spaces: The Domotic Model

* Dr. **Amel Ghrab**
higher institute of arts and crafts of Grabes, University of Gabes, Tunisia
The institute of Science and Technology of design, Tunisia
E-mail [1]: ameliaghrab@gmail.com

Abstract
"Domotics" smart home technologies are beginning to spread and become more mainstream, although their deployment and implementation remains complex and spans different competing business ecosystems. Beyond the middle-class single-family home, often at the center of smart home history.
The design workshops allowed us to gather insights into the specific challenges and opportunities of deploying smart home technologies in an environment where issues of privacy, data collection and ownership, and autonomy collide for the various smart home technologies.
Keywords: Domotics , new technologies, sustainable development , green space

1. Introduction

Polysemic spaces are concerned with the size and scope of approved services to ensure functionality and ease of use. Through smart buildings that integrate communication systems, information technology, comfort and security together according to user needs and adapt to external conditions and environmental requirements, using the latest technology the buildings are automated, accommodate the surrounding environment, respond and interactive environment

we try to think tightly about product design and provide inherent readings in technological innovation by following a small design philosophy. This study constitutes a reflective approval derived from the interactive devices' experience in the development of responsible and ethical products.

The smart home is an organic combination of various subsystems linked to domestic life, thanks to advanced technologies such as composite fiber optic cable for the home. It can both share resources and communicate within the home, and we can exchange information with your home's external network via our smart gateway. Its main objective is to provide people with an efficient, comfortable, safe, practical and environmentally-friendly living environment, integrating system, service and management.

Feasibility studies are conducted to ensure that decisions made regarding a project are more efficient, effective, and accurate. They also serve to validate the successful implementation of a project, measure public interest, and assess the extent to which benefits, adoption, and performance are achieved. Despite the existence of intelligent buildings for a considerable period, they have not been widely adopted as required by many countries, especially low-income countries. This lack of widespread adoption may be attributed to a lack of clarity regarding their feasibility and the failure to demonstrate actual performance and benefits to potential users.

The purpose of this research is to enhance the feasibility of technologies used in intelligent architecture by identifying their benefits in terms of increasing energy efficiency, optimizing space utilization, and facilitating various aspects of life, particularly for disadvantaged population groups in need. As we enter the era of smart technology in phones, cars, homes, and cities, there is a risk of further widening the digital and participation divides(Amen, 2021; Aziz Amen, 2022; Amen et al., 2023; Amen & Nia, 2020). The objective is to explore how these technologies can bridge the digital divide by providing access to smart technologies within people's living spaces.

Currently, there is a significant gap between a basic understanding of smart technologies and a comprehensive comprehension of their functioning and potential applications. With energy resources depleting and demands escalating, addressing energy waste has become a critical concern. Consequently, this research will focus on allocating specific smart architectural technologies to meet the needs of corresponding population groups, thereby enhancing the feasibility and usefulness of smart architecture technologies. The key questions to address are: How can we design industrial products that prioritize energy consumption and reduction, space optimization, and user-friendliness based on ergonomic principles? How do digital and emerging technologies contribute to the creative process in the field of home automation?

In summary, this research aims to explore the introduction of product-industrial design, energy efficiency, waste reduction, and space optimization through ergonomic principles in the field of smart architecture.

2. How to assimilate technologically-assisted products

While recognizing the existing problem and opportunity in the absorption and recycling of industrial waste, it is essential to acknowledge that its viability will ultimately depend on embracing new aesthetic and involving consumers in understanding and embracing a new generation of problem-solving products rather than exacerbating the issue (R. Baheti, H.,2011).

Our focus has been on developing sustainable and effective solutions to everyday problems, which has led us to promote new concepts that address genuine concerns (M. Garetti, L. ,2015). The success of these designs relies on the communicative and emotional engagement of both specifiers and end consumers. Creative participation goes beyond selecting colors and patterns for geopolymeric1 cladding materials; it extends to the creation of models, environments, and, most importantly, new consumer arguments.

In this project, our aim was to explore the opportunities and potential challenges associated with designing and implementing smart technologies in both public and private housing. Through our research, we identified common themes that are relevant to contemporary concerns about technology, social life, shifting boundaries, evolving expectations, and responsibilities. Additionally, we observed concerns related to accessibility and the utilization of new ergonomic products, particularly in the housing context where residents are already subject to surveillance regimes and daily ease-of-use rights and opportunities.

A broader issue arises as smart technologies are introduced into various environments. Meeting these challenges goes beyond mere interface design or transparent data agreements (E. Negri, L. Fumagalli, 2016). It requires careful consideration of agency and accountability because even the most well-designed interface that explains data usage is rendered ineffective if control over the spaces and traces of that data cannot be asserted.

This mistrust primarily stems from the fact that the "intelligence" of these new technologies relies on their ability to aggregate data from multiple systems in order to customize user experiences (Davis, T. Edgar, 2012). A home that responds to its inhabitants' needs must possess knowledge about them, acquired through recording movements and preferences. This knowledge is then used with domestic products that enable inhabitants to optimize space and act comfortably. As residents engage in this lifestyle, the reliability and usefulness of these systems become more apparent.

3. How to integrate ecology and sustainable development into home automation

These artifacts, such as floor and wall cladding modules, possess unique characteristics including acoustic, water, and thermal insulation capabilities. They also support vertical gardens, floor lighting, and visual limiters like sanitary containers, while exploring strong textures and brown tones reminiscent of natural craftsmanship and ceramics. These elements contribute to a naturalistic, ecological, and traditional expression (Roulet, C. A. (2010).

To further enhance the integration of organic elements within the home automation space, we introduce the concept of "biophilic design" (Saizmaa, T., & Kim, H.-C. (2008). This concept emphasizes the importance of a sustained and repeated engagement with nature and focuses on humanity's adaptations to the natural world, which have historically improved health, fitness, and overall well-being. In the context of home automation, we strive to encourage architectural solutions that are mutually reinforcing, interconnected, and integrated (Sanselme,2008) . This approach promotes positive interactions between individuals and nature, fostering a deeper sense of relationship and responsibility towards both human and natural communities.

[1] The organic polymer, mineral material, e.g. silica and alumina (Rieunier, S. (2009).

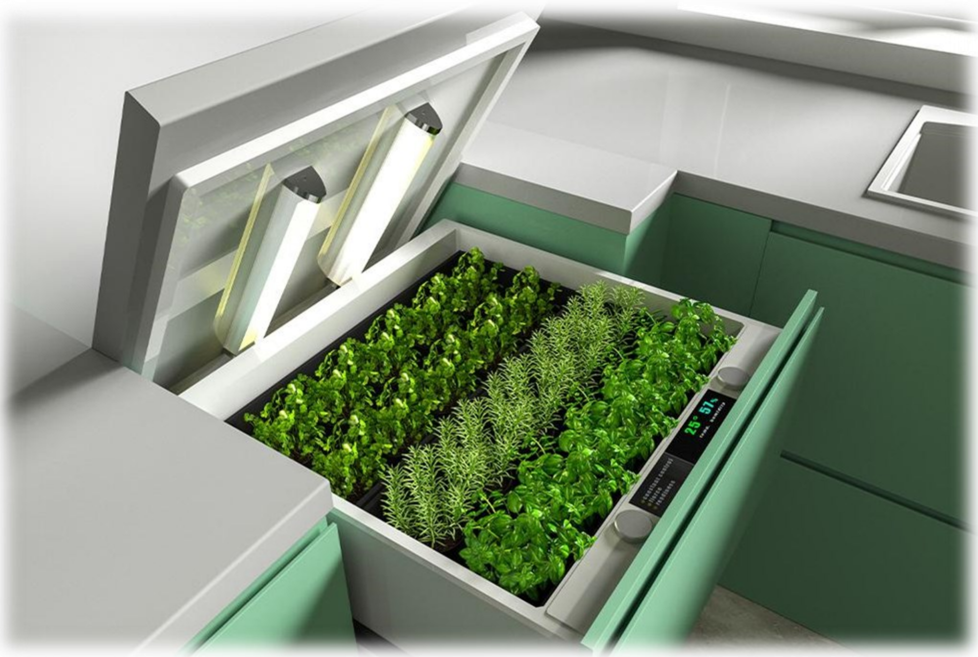

Figure 1. Yanko Herb Garden[2]

Indeed, the utilization of lightweight, high-performance materials holds significant merit, as they provide an opportunity to engage all stakeholders and incorporate various products in the collaborative design and implementation of optimal solutions for spatial challenges in both built and natural environments(Talotte, C., Paradot, N., Da Costa, P., & Mzali, M. (2006).

Figure 2. Time Capsule Hotel[3]

[2]https://www.gizmodo.cz/?tag=igor abakumov&fbclid=IwAR2Az8MQrwD9MfbJVN77W1hkOaT_qsTw7_mV1PwzZh8lUM_KtgiOZ_120yk
[3]https://www.uniqhotels.com/optimiroomsbilbao?fbclid=IwAR0LM7L9T7TPpGmAlI8MKgJDW4seR8miig8xpX0SKTbN2LTxTMbGwhzyA

Geodesign4, as a discipline, advocates for the integration of large quantities of industrial waste and transforming them into geopolymers5 for application in architecture and urban planning (Tapia, E., Intille, S., Lopez, L., & Larson, K. (2006). This approach aims to enhance the territory by presenting a design that is more natural, ecological, and aligned with contemporary ideologies (Saizmaa, T., & Kim, H.-C. (2008). It exemplifies an active, engaging, participative, and creative social ethic, which, in turn, generates a new trend in taste and consumption (Roulet, C. A. (2010). The name itself represents both the chemical recycling process involved and the crucial emergence of a new design approach for the Earth(Repiquet, J., & Jeuland, F. X. (2007).

Figure 2. The Anthénea Pod[6]

The application of biophilic design is expected to yield a broad spectrum of physical, mental, and behavioral benefits. From a physical standpoint, individuals can experience improvements in fitness levels, lower blood pressure, increased comfort and satisfaction, a reduction in illness symptoms, and overall better health (Nicol F., & Humphreys, M. (2010). Mentally, the benefits encompass enhanced satisfaction, motivation, reduced stress and anxiety, as well as improved problem-solving abilities and creativity (Nourizadeh, S., Song, Y.-Q., Thomesse, J.-P., & Sepulchre, X. (2009). Additionally, positive behavioral changes can manifest, such as improved coping and mastery skills, increased attention and concentration, and enhanced social interaction.

4. Econometric modeling and data

4.1. Econometric modeling:

Some researchers on home automation, such as, Milion et al., 2005), Renaudin, 2010), Sabbah, 2010; Bievre et al., 2009 , Repiquet et al., 2007). Waldner, 2007, Coutaz et al., 2008), Coutaz et al., 2005), Shelby et al., 2011),Russell et al., 2010), Edwards et al., 2001), ,among others, Demotic, green space in their empirical models to study the impact of these factors on ergonomic green building.

They generally found that these variables are important and have a statistically significant influence on ergonomic green building.

4.2. Data source and descriptive statistic

The data used in this the study are taken from Governorate of Tunisia in numbers (2018).The variables used are:

[4]Geodesign provides a design framework and supporting technology for professionals to leverage geographic information (Repiquet, J., & Jeuland, F. X. (2007).

[5]It is a set of concepts and methods used to involve all stakeholders and different professions in collaborative design and find the optimal solution to spatial challenges in built and natural environments, using all available technologies and data in an integrated process. Originally, geodesign was mainly applied in the design and planning phase(Reignier, P. (2010).

[6]https://hypebeast.com/2022/8/yannicklittouxjeanmichelducancelleantheneafloatinghotelsuite?fbclid=IwAR1Z1SxWKpJxUfak8Qh80b7ppz1DfB6_ynRyA2y3sB6M2t4a-fyvHLPY_W8

New technology, green economic, renewable energy, density, smart tools, system application, sustainable development, inhabitant per household, economic growth, energy power.

- ✓ **Domotics:**

D12: smart tools
D13:system application
D14:new technology

- ✓ **Green Space :**

G9 : density
G16 : economic growth
G18 : renewable energy
G19 : green economic
G20 : energy power
G25 : inhabitant per household
G26 : sustainable development

To achieve the research objectives, we will use principal component analysis. The use of Principal Component Analysis (PCA) is based on four conditions that must be verified, namely[7].Generally; the Principal Component Analysis (PCA) is required to expose the appropriate items for use in research instruments. The PCA procedure on construct elements using SPSS23 software. Bartlett's Test of Sphericity[8] and the Kaiser–Meyer–Olkin (KMO)[9]sampling adequacy were also performed. MSA10 (Measure of Sampling Adequacy) was used to measure the precision of the sampling.

5. Test of the unidimensional of the measurement scale

5.1 Test of the unidimensional of the measurement scale of the variable "demotics"

The factor analysis shows that the data matrix of the sustainable development scale is factorable:
The determinant of the matrix = 8.613E-13different from 0.The KMO index of 0.571 can be called excellent or meritorious. It tells us that the correlations between the items are of good quality. Indeed, Bartlett's test of sphericity is used to test the null hypothesis (whether or not all correlations are equal to 0).However, if all the correlations are not equal to 0, and if the significance index is less than 5%, the test will be accepted. Thus, according to the results of Table 1 of Bartlett's test of sphericity is significant, the approximate chi-square is 160.461 with sig = 0.000< 5%.This said, the null hypothesis is rejected and our data come from a population for which the matrix would be an identity matrix. This indicates that the items provide a good measure of the "domotics" variable. Indeed, all MSAs are greater than 0.5. In the following, all the items in question are listed in detail in the tables.

Table 1. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0,571
Bartlett's Test of Sphericity	Approx. Chi-Square	160,461
	df	38
	Sig.	,000

Source: Authors' estimation (SPSS23).

Table 2. Factor structure: domotics

[7]A determinant equal to zero means that at least one variable is a perfect linear combination of one or more other variables. There is thus a variable which adds no new information beyond that provided by the other variables. In this case the analysis cannot proceed for mathematical reasons (it is impossible to invert the matrix). Note that we are looking for a very small determinant, which is a good indication of the existence of correlation patterns between the variables, but not equal to zero (Durand, 2003).

[8]It allows to validate the use of PCA. It tests the null hypothesis of the Sphericity of the data, i.e. that the correlation matrix is a unit matrix (a matrix in which all the terms on the diagonal are equal to 1 and all the others to 0). A result that rejects the null hypothesis at a significance level of 0.05 indicates that the correlations are different from zero and therefore the variables are correlated and their factorization is appropriate Evrard et al (2003).

[9]It is an index that indicates the extent to which the set of items selected is a coherent whole, i.e. the extent to which the items explain the construct. This index is considered excellent when it has a value of 0.9, average when the value is 0.7 and unacceptable when it is less than 0.5.

A high KMO indicates that there is a statistically acceptable factorial solution that represents the relationships between the variables (Evrard et al (2003, Hair, J.F.; Wolfinbarger, M.F.; Ortinau, D.J.; Bush, R.P.2008).

[10]The MSA values are on the diagonal of the anti-image correlation matrix in SPSS. This anti-image matrix contains the opposites of the partial correlation coefficients. In a good factorial model, most of the off-diagonal elements should be small. An MSA value of 0.5 is acceptable for research (Evrard et al. 2003).

Variables / Items	**Communalities**	**Component**	**MSA**
D12	,866	,955	,787
D13	,802	,850	,710
D14	,950	,970	,710
Eigen values	8,733		
% of Variance	87,156%		

Source: Authors' estimation (SPSS23).

The PCA of the items (D12 to D14) confirms the existence of a single factor which explains 87,156% of the total variance of the original data(Awang, Z.; Afthanorhan, A.; Mamat, M.; Aimran, 2017).

The factorial contributions are positive and greater than 0.7.

These items therefore present strong positive contributions for the measurement of domotics. The Cronbach's alpha value of 0.875> 0.7 (see Table 3) is excellent. Thus, the quality of representation for each item is also satisfactory (>0.5).

Table 3. Reliability Statistics

Cronbach's Alpha	N of Items
,875	5

Source: Authors' estimation (SPSS23).

5.2. Test of the unidimensional of the measurement scale of the variable "green space"

The factor analysis shows that the data matrix of the TBP-based modern management control functioning measurement scale, is factorable:

* The determinant of the matrix is 7,870E-12 (see, Table4) different from 0

* KMO =,716 (see Table 5) is greater than 0.5.

* Bartlett's test indicates that all the variables are perfectly independent of each other (p<0.05; Chi-square = 174,087)(see Table 5).

* The MSAi are all greater than 0.5 table 5.

Similarly, this analysis reveals only one factor with an eigenvalue greater than one (i.e. 5.211). In the following, all the items in question are listed in detail in Table 6.

Table 4. Correlation Matrix[a]

		G9	G16	G18	G19	G20	G25	G26
Correlation	G9	1,000	,708	,999	,803	,999	,999	,999
	G16	,608	1,000	,703	,366	,605	,701	,701
	G18	,999	,603	1,000	,700	,998	,998	,998
	G19	,803	,477	,800	1,000	,796	,796	,796
	G20	,999	,704	,998	,796	1,000	1,000	1,000
	G25	,999	,702	,998	,796	1,000	1,000	1,000
	G26	,807	,007	,000	,001	,000	,000	,000

a. Determinant = 7,870E-12

Source: Authors' estimation (SPSS23).

Table 5. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,716
Bartlett's Test of Sphericity	Approx. Chi-Square	174,087
	df	15
	Sig.	,000

Source: Authors' estimation (SPSS23).

Table 6. Anti-image Matrices

		G9	G16	G18	G19	G20	G25	G26
Anti-image Covariance	G9	,001	-,003	-,001	-,005	-2,644E-5	1,850E-5	1,850E-5
	G16	-,003	,359	,003	,073	-,001	,001	,001
	G18	-,001	,003	,001	,004	2,799E-5	-2,563E-5	-2,563E-5
	G19	-,005	,073	,004	,288	,000	,000	,000
	G20	-2,644E-5	-,001	2,799E-5	,000	1,811E-5	-1,838E-5	-1,838E-5
	G25	1,850E-5	,001	-2,563E-5	,000	-1,838E-5	1,889E-5	1,889E-5
	G26	1,850E-5	,001	-2,563E-5	,000	-1,838E-5	1,889E-5	1,889E-5
Anti-image Correlation	G9	,720[a]	-,222	-,777	-,399	-,255	,166	,166
	G16	-,325	,835[a]	,144	,228	-,384	,409	,409
	G18	-,866	,144	,851[a]	,204	,176	-,158	-,158
	G19	-,495	,228	,204	,908[a]	,145	-,108	-,108
	G20	-,360	-,385	,177	,145	,767[a]	-,994	-,994
	G25	,188	,408	-,168	-,108	-,994	,771[a]	,771[a]
	G26	,188	,408	-,168	-,108	-,994	,771[a]	,771[a]

a. Measures of Sampling Adequacy(MSA)

Source: Authors' estimation (SPSS23).

Table 6. Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,211	86,851	86,851	5,211	86,851	86,851
2	,537	8,945	95,796			
3	,249	4,156	99,952			
4	,002	,041	99,993			
5	,000	,007	100,000			
6	9,263E-6	,000	100,000			

Extraction Method: Principal Component Analysis.

Note:, *Level 1%* , *Source*: Authors' estimation (SPSS23).

Table 7. The factor structure: environmental development

Variables Items	**Communalities**	**Component**	MSA
G9	,986	,993	,820
G16	,575	,758	,835
G18	,983	,991	,851
G19	,703	,838	,908
G20	,982	,991	,767
G25	,982	,991	,771
G26	,982	,991	,771
Eigen values	5,211		
% of Variance	86,851%		

Note:, Level 1% Source: Authors' estimation (SPSS23).

Tableau 8. Reliability Statistics

Cronbach's Alpha	N of Items
,975	5

Source: Authors' estimation (SPSS23).

The PCA of the items (EN5 to EN20) confirms the existence of a single factor which explains 86.851% of the total variance of the original data. The factorial contributions are positive and higher than 0.7, except for items G10, G11, G12, G13, G14, G15, G17, G21, G22, G23, G24,they confirm the unidimensional of this construct so these items present strong positive contributions for the measure of green space on the other hand the G10, G11, G12, G13, G14, G15, G17, G21, G22, G23, G24represent a negative contribution what leads us to eliminate it. The Cronbach's alpha value of 0.975 is excellent (see Table 8)(Sekaran, U.; Bougie, R.2010). Thus, the quality of representation for each item is also satisfactory (>0.5).

6. Analysis and Interpretation of the Linear Regression Results

6.1 The results of the multiple linear regressions

We have chosen, in this work, the descriptive method because we are trying to describe the relationship between domotics and green space in terms of density, system application, new technology, smart tools, economic growth, renewable energy, green economic ,energy power, inhabitant per household, soustainable development.

Among the techniques of this method, we have chosen the linear regression (OLS), showing the impact of the exogenous quantitative variables (system application, new technology, smart tools) on the endogenous quantitative variable (economic growth, renewable energy, green economic ,energy power, inhabitant per household, soustainable development). B is the non-standardized coefficient of the linear regression that will be taken into account in the analysis of the results.

Tableau 14. model regression

Variables		Etape 1 : Modèle 9 Performance de la firme (PR)	
		β	T
	DEM	,761	4,385***
	GS	,428	3,320***
R^2 Ajusted		,766	
F (Fischer)		25,652***	

*** : significatif au seuil de 1% ; ** : significatif au seuil de 5% ; * : significatif au seuil de 10% ; n.s : non significatif

Note:,

Level 1%

Source: Authors' estimation (SPSS23).

Indeed, this estimation shows that the model is globally significant with an adjusted R2 (.766) and Fischer (25.652<1%) . The table shows that the variable DEM has a significant effect at the 1% threshold which verifies the approach of Baron and Kenny (1986). Our results show that green space has a positive and significant effect at the 1% level on home automation. This explains that Smart home automation can make your home greener by significantly minimizing its energy consumption. The paper notes that every region of the world has made progress towards achieving high levels of technological development; however, each region also faces unique challenges that affect the achievement of goals in the Tunisia region. These challenges have social, political, structural, institutional and economic dimensions. Moreover, demotics is a widely recognized concept following the emergence of energy issues due to the oil crises that affected building construction. This document notes that The intelligent home is capable of acquiring and applying knowledge about its inhabitants and their environment (V. Ricquebourg,2006).

The overall results are presented in Table 14. We find that the value of domotics, green space in the region Tunisi has positive and statistically significant effects at the level of 1% on sustainable development in the government Tunisia. The coefficient of domotics is 4.385, which implies that a 1% increase in the domotics rate increases

sustainable development by 3.320% for the Tunisia government. To promote the development of the smart home, it is important that suppliers and users of smart home technologies share their knowledge.
The results of results are consistent with those of a recent study on this topic. Today, climate change has become an increasingly serious global challenge (F. Feng and J. Wang, 2013). A number of studies highlight the importance of sustainable development in climate change. Sustainable development aims to achieve environmental protection and economic and social development. Smart home technology helps to achieve the goal of sustainable development (A. N. A. Anuar,2013,R. Y. M. Li,2009,R. Y. M. Li,2011, R. Y. M. Li and D. H. Ah Pak,2010).
Furthermore, integration of water and energy management technology the integration of water and energy management technology into a system is more sustainable and saves more energy (Smart Home Solutions, 2013). That said, energy efficiency increases the value of a home (Smart Home Solutions, 2013). Furthermore, the smart home reduces planning, installation and wiring costs (Eco Centric Energy, 2013). It integrates new functions and provides intelligent automation, i.e. control of lighting and heating in case of absence. This reduces the
and protects the environment. Furthermore, it reduces operating costs, provides efficient and ensures optimum building maintenance. That said , the smart home increases home value and security. Furthermore, intelligent building technology economies of scale and improve the usability of the smart home (F. Feng and J. Wang, 2012).
In Tunisia, environmental protection is one of the main objectives (Smart Home Product,
Smart Home Solutions, , improving quality of life , comfort). Typically, smart home system components include water management (Smart Home Solution), energy management.
Compared to other regions, the Tunisia region considers the smart home to be an important factor in improving quality of life. Nevertheless, the importance of smart home automation lies in sustainable development. Furthermore, the benefits of the smart home can be categorized socially (convenience, comfort, quality of life, etc.); economically (cost reduction, efficiency) and environmentally (water saving, energy saving, environmental protection, green energy).
To sum up, global climate change is forcing us to reconsider the important elements inside our homes. Recent technological advances are driving the rapid development of automation devices for smart home users (T. Perumal, 2013).

7. Conclusions

The central objective is to study the devices likely to contribute to the development of new "Home Automation" technologies, which are starting to become more widespread and efficient in terms of deployment and innovative implementation. They span different competing commercial ecosystems, and create a significant advantage in terms of the basic conceptualization of smart technologies and a solid understanding of how they work and how they can be used.
Smart home technologies are gaining popularity and becoming more mainstream, although their deployment and implementation remain complex and involve different competing business ecosystems. It goes beyond the traditional single-family homes, which have been the focal point of the smart home narrative.
The design workshops have provided valuable insights into the specific challenges and opportunities associated with deploying smart home technologies in an environment where privacy, data collection, ownership, and the independence of various smart home technologies often collide. This has opened up new avenues for adopting and working on innovative concepts in domotic design.
As a crucial component of the smart grid, smart home services play a significant role in achieving real-time interactive communication between the grid and users. This improves the overall service capacity of the grid, meets the demand for interactive marketing, enhances service levels, and fosters information exchange between users and the grid. The integration of green spaces into smart homes promotes consumer well-being and incorporates principles of ecology and sustainable development into home automation.
The conclusion sheds light on the challenges and opportunities inherent in the realm of smart homes, particularly in an environment where concerns related to privacy, data collection, ownership, and the autonomy of various home technologies prevail. Embracing and exploring innovative design concepts for domotic systems situated within green spaces can pave the way for a more sustainable and interconnected future.

References

Alkar, A. Z., & Buhur, U. An Internet Based Wireless Home Automation System for Multifunctional Devices. IEEE Consumer Electronics, 51(4), 1169-1174 (2005).

Amen, M. A. (2021). The Assessment of Cities Physical Complexity through Urban Energy Consumption. Civil Engineering and Architecture, 9(7), 2517–2527. https://doi.org/10.13189/cea.2021.090735

Aziz Amen, M. (2022). The effects of buildings' physical characteristics on urban network centrality. Ain Shams Engineering Journal, 13(6), 101765. https://doi.org/10.1016/j.asej.2022.101765

Amen, M. A., Afara, A., & Nia, H. A. (2023). Exploring the Link between Street Layout Centrality and Walkability for Sustainable Tourism in Historical Urban Areas. Urban Science, 7(2), 67. https://doi.org/10.3390/urbansci7020067

Amen, M. A., & Nia, H. A. (2020). The Effect of Centrality Values in Urban Gentrification Development: A Case Study of Erbil City. Civil Engineering and Architecture, 8(5), 916–928. https://doi.org/10.13189/cea.2020.080519

A. D. Basiago, "Economic, Social and Environmental Sustainability in Development Theory and Urban Planning Practice", The Environmentalist, vol. 19, no. 2, (1999), pp. 145-160.

A. N. A. Anuar, "Policy and Tourism Development Strategy towards Tourist Friendly Destination in Kuala Lumpur. Asian Social Science", vol. 9, no. 2, (2013), pp. 180-190.

Davidoff, S., Lee, M., Yiu, C., Zimmerman, J., Dey, A. Principles of Smart Home Control. Proc. UbiComp 2006, 19-34.

E. H. W. Chan and E. H. K. Yung, "Is the Development Control Legal Framework Conducive to a Sustainable Dense Development in Hong Kong?", Habitat International, vol. 28, (2004), pp. 409-426.

E. Negri, L. Fumagalli, M. Macchi, A review of the roles of digital twin in cps-based production systems. Procedia Manufacturing 11, 939–948 (2017). 27th International Conference on Flexible Automation and Intelligent Manufacturing, FAIM2017, 27-30 June 2017, Modena

F. Feng and J. Wang, "The Efficiency for the Three Industries of Provinces in China, Considering the Effects of Carbon Emission: An Application of the Parallel DEA Model", Asian Social Science, vol. 8, no. 12, (2012), pp. 29-35.

J. C. Nunes and J. C. M. Delgado, “An Internet application for home automation,” Electrotechnical Conference, 2000. MELECON 10th Mediterranean, Vol. 1, pp. 298 -301, 2000.

J. M. Conejero, "A Model-driven Approach for Reusing Tests in Smart Home Systems", Pers ubiquit Comput, vol. 15, (2011), pp. 317-327.

Jia-Ching Wang; Hsiao-Ping Lee; Jhing-Fa Wang; Cai-Bei Lin; , "Robust Environmental Sound Recognition for Home Automation," Automation Science and Engineering, IEEE Transactions on , vol.5, no.1, pp.25-31, Jan. 2008.

K. Chapman and K. McCartney, "Smart Homes for People with Restricted Mobility", Property Management, vol. 20, no. 2, (2002), pp. 153-166.

Neng-Shiang Liang; Li-Chen Fu; Chao-Lin Wu; “An integrated, flexible, and Internet-based control architecture for home automation System in the Internet era,” Proceedings ICRA 2002. IEEE International Conference on Robotics and Automation, Vol. 2, pp. 1101 – 1106, 2002.

N. Sriskanthan and Tan Karande, “Bluetooth Based Home Automation Systems,” Journal of Microprocessors and Microsystems, Vol. 26, pp. 281-289, 2002.

Rifat Shahriyar, Enamul Hoque, S.M. Sohan, Iftekhar Naim; Remote Controlling of Home Appliances using Mobile Telephony, International Journal of Smart Home,Vol. 2, No. 3, July, 2008.

Saizmaa, T., & Kim, H.-C. (2008). « Smart Home Design: Home or House? ».

Proceedings of the 2008 Third International Conference on Convergence and

Hybrid Information Technology - Volume 01 (pp. 143-148). Washington, DC, USA

Russell, S. J., & Norvig, P. (2010). Artificial intelligence: a modern approach. Prentice Hall. ISBN:9780136042594.

S.N. Bairampalli, F. Ustolin, D. Ciuonzo, P.S. Rossi, Digital moka: Small-scale condition monitoring in process engineering. IEEE Sensors Letters 5(3)(2021).https://doi.org/10.1109/LSENS.2021.3059850.

Tolmie, P., Crabtree, A., Egglestone, S., Humble, J., Greenhalgh, C., Rodden, T. Digital plumbing: the mundane work of deploying UbiComp in the home. PUC 14, 3 (2010), 181-196.

Wacks, K. (2002). « Home systems standards: achievements and challenges ».

Communications Magazine, IEEE, 40(4), 152-159. doi:10.1109/35.995865.

Y. Cao and Y. Xiang, "The Impact of Knowledge Governance on Knowledge Sharing", Management Decision, vol. 50, no. 4, (2012), pp. 591-610.

Yuksekkaya, B.; Kayalar, A.A.; Tosun, M.B.; Ozcan, M.K.; Alkar, A.Z.; , "A GSM, internet and speech controlled wireless interactive home automation system," Consumer Electronics, IEEE Transactions on , vol.52,no.3,pp.837-843,Aug.2006