

Considering the gender perspective for the concept of Smart Housing

ABSTRACT

In the realm of smart housing, the convergence of gender inclusivity and technological advancements demands wide-scale research work. This study examines gender-based participation in shaping indicators for smart housing targeting the Indian context. With a focus on home automation, energy efficiency, security, service management, and resource management, the research unveils distinct contributions from diverse genders. Utilizing a robust survey analysis methodology, the study indicates the gendered preferences and priorities across regions ~~and genders, and~~ shedding light on the dynamics of factors influencing attitudes towards smart housing ~~hence, by~~ comparing evidence from two cities: Agra and ~~Bhopal~~. Security and monitoring take precedence in Agra, securing 36.68% of votes, while Bhopal emphasizes energy efficiency with a leading 40%. Delving deeper into gender-specific perspectives within each city, the findings reveal the multifaceted priorities of residents. In the end, a comprehensive list of indicators for gender-inclusive smart housing is formed. Recommendations in the discussion section aim to empower policymakers and planners with practical insights. Focusing on solutions towards equitable and responsive futures, resonating with the diverse needs across genders in India.

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Keywords: Smart Housing, Home Automation, Energy Efficiency, Security, ~~Service management~~, Resource management.

Introduction

The concept of smart housing from the point of planning aspects is derived from the concept of smart city mission. Where major findings and policy implementations have been taken from the National Smart Cities Mission program. The aim of the smart city mission is the make a city technologically sound and should be able to cater for the needs of residents by smart innovations. In the long term perspective, the smart city mission aims to improve the quality of life and standard of living in the city. As we move forward in the process it is evident that the first step to making a city smart starts from home, i.e., building smart housing and that also at the neighbourhood level. As per (Gayrbekova et al., 2023; M. Li et al., 2018) a housing is called smart housing when it qualifies to have five parameters in the housing: Automation, Energy efficiency, Security, Resource and Service management. By doing so, high-rise residential complexes can reduce energy consumption, lower carbon emissions, and improve the quality of life for residents. Additionally, the application of smart systems can enhance the management and operation of the complex, leading to increased convenience and satisfaction for residents. (Lee et al., 2016).

Comment [IO4]: Recast for a clear logical flow of presentation. According to Gayrbekova et al. (2023) and M. Li et al. (2018), a house can be referred as been smart if it has the following five housing parameters of simply define what smart housing entails in a clear and simple term and then cite the relevant reference(s).

Integrating gender into spatial planning involves recognizing gender relevance and its impact on land-use planning and appropriation. Gender-sensitive planning focuses on valuing spatial realities for gendered everyday life and aims to change unequal power relations and planning concepts (Bertram, 2021). Countries like Austria, especially Vienna, have shown greater institutionalized recognition and awareness of the importance of gender in spatial planning, making it one of the most advanced cities worldwide in terms of gender sensitivity. Non-recognition of equal importance is very much prevalent in under-developed countries like India. Women who comprise half of humanity play a major role in the development of society yet basic gender-based disadvantages prevail all over the world. Therefore, it's critical to take extra steps to empower women, particularly when it comes to planning. The rest of the globe has incorporated gender planning frameworks. Gender planning aims to achieve gender equity, equality, and empowerment by addressing strategic and pragmatic gender needs. (Sophia, 2020). The major gap is that the approach towards women in India, from a planning perspective remains “Gender Aware Planning” and not “Gender Planning.”

From the concept perspective of smart housing, the main driving forces behind smart house technology are improved home-based services, effective energy management, resource management,

and a higher standard of living (W. Li et al., 2021). The tactics used to promote smart housing take into account demographic factors such as age, gender, and personal income (Doherty & Loughborough, n.d.). Over time, there have been more advances in households due to women's advancements in education and financial market outcomes, as well as an increasing standard of living (C. H. Kim & Sakamoto, 2017). Yet, Smart home visions fail to address energy efficiency or housework burdens placed on women, potentially negatively impacting women's well-being and energy-saving goals.

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This paper analyses the various parameters considered for smart housing from the gender perspective view that particular parameters should be gender profiled or not. For this study, data has been collected from a Primary Survey in various dwelling units of the same housing society in different cities: Agra and Bhopal; considering 2 cities and comparing both in terms of a capital city (Bhopal) and Non-capital city (Agra).

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Literature Study Review:

This section examines how each indicator takes gender into account, highlighting how Smart Housing affects various genders. This research attempts to produce more equitable and socially responsible smart living environments by methodically addressing gender and demographic dynamics. The gender Dynamics explores the various domains of Smart Housing: Automation, Energy Efficiency, Security, Resource and Service management.

It is important to consider the gendered implications of smart home technologies and design more inclusive technologies that acknowledge, regulate and design for the living experiences, gendered dynamics, and everyday practices of people (Strengers et al., 2022). Domestic automations can both support and challenge gendered norms in technology ownership and management, influenced by interpersonal relationships in emotionally laden family contexts addressing the need for Personalized Automation Profiles. Voice recognition features can enhance smart home automation systems by providing a user-friendly interface and determining performance. The implementation of demand response and demand management strategies in energy systems reflects the evolving social practices influenced by flexibility, as stakeholders adapt to the temporality of energy demand fluctuations benefiting Flexible Scheduling Options. Task Delegation Notification in Advanced automation and autonomous systems have been increasingly used to reduce pilot workload, help them better manage their tasks, and support their decision-making during both normal and non-normal operations. Also, adding human-like faces to interfaces improves subjective responses by delivering Visual Interface Representation (Burian et al., 2017; Eric et al., 2017; Lo Piano & Smith, 2022; Mosier et al., 2017).

Smart home visions need to be realigned towards a care ethic to promote gender-equitable practices and energy reduction while considering diverse household types and addressing housework burdens on women (Chambers, 2022). Real-time information significantly reduces energy consumption in residential households, with learning playing a more prominent role than constant reminders, supporting energy conservation programs targeting consumer knowledge and ensuring Equal Access to Energy Data. Dr Qian Xu has given Personalized Energy Usage Recommendations for the Household Energy-Saving Option (HESO) effectively encourages household energy-saving behaviours, with the personal norm and perceived behavioural control being key determinants, and risk preference moderating these relationships. Inclusive Smart Metering focuses on consumer-oriented implementation and addressing current regulations and technological solutions for a successful consumer-oriented smart meter network. The barriers to energy efficiency in India's household sector could be overcome by Energy Efficiency Education Programs. Equitable Incentive Programs include participatory planning (Benzi et al., 2011; Lynham et al., 2016; Reddy, 2003; Xu et al., 2021).

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G. Hoogensen citation justifies Gender identity as an integral perspective of security, articulating the security interests of 'significant groups' and allowing for a broader understanding of security as it is understood by individuals and communities. User-Specific Permissions keenly suggest 'An Active Space' which may be an individual, group supervised or collaborative mode, depending on

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the users, devices, and other context in the space. The intelligent video surveillance system using two-factor human information can prevent privacy invasion and simultaneously perform monitoring and protection functions leading to a Privacy-Centric Design. Deep learning can improve gender and age detection in images, with potential applications in monitoring, surveillance, human-computer interaction, and security managing Gender-Inclusive Threat Detection. Emergency Response Customization needs [Advances in communications and information technology can enhance real-time decision support for emergency response, improving safety and efficiency. Occupancy Privacy Measures presents a privacy-aware passive network monitoring system, focusing on access control and authorization aspects, to protect personal privacy in ICTs](#)(Moon et al., 2013; Sampemane et al., 2002; Saxena et al., 2021)

Gender issues impact property rights and natural resource use in developing countries, like India highlighting the need for effective policy interventions to address these issues (R. S. Meinzen-Dick et al., 1997). The specific roles of universities in promoting sustainable development have been highlighted in several significant declarations, including the Kyoto Declaration, Agenda 21 and Thessaloniki Declaration with the objective of Equal Access to Resource Controls. An adaptive scheduling framework for real-time control tasks in cyber-physical systems, utilizing cloud-based monitoring and prediction models to facilitate gradual period adaptation while minimizing implementation overhead provides Automated Resource Optimization. Transparent energy monitoring systems can significantly impact consumer and producer behaviour by providing more meaningful economic and environmental information for Resource Usage Monitoring. Gender influences conservation efforts, but local ecology, context, and culture also play a role in shaping incentives and the ability to adopt sustainable practices. Geospatial Applications used for Climate Adaptation Planning emphasis on Diverse User Feedback response (Alshuwaikhat & Abubakar, 2008; Dai & Burns, 2020; R. Meinzen-Dick et al., 2014).

Smart service systems, characterized by technology-mediated, continuous, and routinized interactions, are transformed by smart products that integrate resources and activities between consumers and providers (Beverungen et al., 2019). Beverungen took Accessible Service Interfaces as an indicator. Remote Management Options proposes a resource-aware smart home management system that effectively manages complex home environments, accelerating advanced features and enabling cost-effective remote maintenance. Analyzing collective behaviour in smart service systems, aiming to provide context-aware, personalized, adaptive, and anticipatory services in smart environments like airports unifying Cultural Sensitivity in Service Delivery. Validating User Education on Service Features, a framework for smart home services is needed which can adapt to users' daily needs, focusing on practicability and supporting user experience, to enhance smart home adoption and use. In transport planning, a triple access system is enhanced by incorporating scenario planning to address uncertainties and optimize the effectiveness of triple access planning collaborating Service Decision-Making (M. J. Kim et al., 2020; Paddeu & Lyons, 2024).

Smart home visions need to be realigned towards a care ethic to promote gender-equitable practices and energy reduction while considering diverse household types and addressing housework burdens on women. The consolidated list of indicators for smart housing and its relationship with the Gender perspective has been mentioned in Table 1 [below](#). Smart homes change how we live at home, blending technology with daily life. However, they can also strengthen traditional gender roles by influencing household tasks and leisure activities, emphasizing a high-end, visible lifestyle in luxury residences.

Table 1: List of gender perspective indicators for smart housing (Source: Author)

Automation	Energy Efficiency	Security	Resource Management	Service Management
Personalized Automation Profiles	Equal Access to Energy Data	User-Specific Permissions	Equal Access to Resource Controls	Accessible Service Interfaces
Voice Command Customization	Personalized Energy Usage	Privacy-Centric Design	Automated Resource Optimization	Remote Management Options

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	Recommendations			
Flexible Scheduling Options	Inclusive Smart Metering	Gender-Inclusive Threat Detection	Resource Usage Monitoring	Cultural Sensitivity in Service Delivery
Task Delegation Notification	Energy Efficiency Education Programs	Emergency Response Customization	Gender-Inclusive Sustainable Practices	User Education on Service Features
Visual Interface Representation	Equitable Incentive Programs	Occupancy Privacy Measures	Diverse User Feedback Channels	Collaborative Service Decision-Making

Method:

The primary **area-focus** of research is the gender perspective on smart city experiences for both residents and non-residents. The current study aims to investigate the following research objectives:

RO1: To investigate the gender perspective of the Bhopal and Agra citizens to have an understanding of different aspects of smart Housing – Automation, Energy Efficiency, Security, Resource and service management .

RO2: To establish the important indicators from a gender perspective for the smart housing concept.

RO3: To propose some recommendations for gender perspective for smart housing based on the findings of the performed primary research.

For this purpose, a survey research strategy is used to investigate the experience and opinion of participants and work towards gender perspective in smart housing conceptualizing smart cities and their ecosystem. Primary data was collected through a survey questionnaire which was circulated to the participants through an online link using Google Forms. The survey questionnaire was divided into six sections of demographic information and research-specific questions. The research-specific questions were further subdivided into questions related to opinions towards smart housing (with parameters of Automation, Energy Efficiency, Security, Resource and service management general opinion of a smart Housing).

A total of 30 participants were contacted for participation in the study, mostly the residents of Agra and Bhopal. To get a gender perspective from multiple locations, residents of Agra and Bhopal City were selected for the survey. Also, the survey being gender specific, the Survey has been taken from different Individuals in a household which includes the Alpha Male of the household and beta female of the household. Variations in the Survey are well noted for understanding the Awareness, Usage and Exploitation of both genders for the particular usage of a Technology, System or intervention. The data was collected from participants to understand their level of understanding regarding smart cities. The data was gathered through a survey questionnaire covering questions on the respondents' demographic characteristics, as well as research-related questions which were further subdivided into categories of opinion towards smart housing. The survey was conducted from December 2023 to January 2024. The sample size is limited, and the sample distribution does not allow for gaining research results representative of the entire population. Nevertheless, this research outlines preliminary findings that are laying the foundation needed for understanding the gender perspective for smart housing.

Discussion Results:

Sample Demographics:

It is observed that there is a good demographic mix in terms of the parameters of age, gender, city & occupation. However, the sample distribution is skewed towards the younger population (20-40) 83.4% of the total sample, naturally younger generation being more prone to the usage of new technology. The sample is nearly equally divided into male and female gender (55 - 45%) which resembles the equal participation of both genders in the survey. More than 15 surveys have been taken from both cities (Agra & Bhopal) for comparative analysis of two cities. The survey targeted a variety of people from different sections like Architects, Architecture & planning students, Engineers, Housewives, and Financial Advisors. Another key observation is that 27 participants (90%) are

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familiar with or keep pace with the latest innovations in the field of technology concerning Smart housing. Out of 27 participants, 52.9% are males and 47.1 are females. Out of 3 participants 2 (females) & 1 (Male) are not familiar with or keep pace with the latest innovations in the field of technology concerning Smart housing.

Table 2: Demographic Characteristics of Participants.

Demographic Characteristics	Background	Frequency	Percentage
Age	20-29	20	66.7 %
	30-39	5	16.7 %
	40-49	4	13.4 %
	50-59	1	3.3 %
Gender	Male	17	55 %
	Female	13	45 %
	Other	0	0 %
City	Agra	15	50 %
	Bhopal	15	50%
Occupation	Agriculture	1	3.3 %
	Human Resource	3	10%
	Architecture & planning	10	33.3 %
	Housewife	2	6.7 %
	Engineering	10	33.3 %
	Education	1	3.3 %
	Finance	2	6.7%
	Business	1	3.3 %

On introducing the five parameters of smart housing: Automation, Energy Efficiency, Security Resource Management, and Service Management; to the participants and understand whether they are aware of the smart interventions being used in a house as well as the surrounding (neighbourhood) in terms of smart housing. This information is depicted in Table 3.

Table 3: Demographic Characteristic survey for awareness about the following parameters of smart housing

Parameter	Response	Male	Female
Home Automation	16	11	5
Energy Efficiency	17	12	5
Service Management	12	6	6
Resource Management	17	10	7
Security & Monitoring	20	12	8

Out of 30 Responses, a maximum of participants (66.7%) are familiar with Security & Monitoring, and only 40% of people are aware of service management. Males have more user experience than females in terms of home automation & energy efficiency. For security, resource and service management the user experience is slightly inclined towards the male side. There also has been an instance where a female participant admits not to know all the parameters.

Survey Analysis

The analysis of the survey results with prevailing opinions for all the questions in this section of the survey, which is presented in the following subsection, uncovers the gender perspective of the respondents towards different parameters of smart housing.

Automation

Smart housing utilizes automation for controlling home aspects like lighting, HVAC, and appliances, offering remote monitoring through centralized systems or smartphone apps. 50% of respondents are comfortable with automation, 43.3% desire it, and 6.7% don't want it. Personalized Automation Profiles are favored by 63.3% of participants, with 69.2% of females supporting gender-

profiled systems. Task Delegation Notification and Visual Interface Representation are preferred by the male population. Survey analysis reveals visual interfaces remain a challenge for women.

City	Indicator		
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Commonly used automation systems include remote/mobile-accessed smart security cameras, smart appliances (smart TVs, refrigerators, ovens, washing machines), and remote/mobile-controlled smart lighting. Uncommon systems include smart doorbells and digital/analog community information kiosks (refer to Fig. 1 for details).

Table 4: Gendered Analysis of Participant Feedback on Automation Indicators in Dual Cities

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City	Indicator	Yes			No		
		Total	Male	Female	Total	Male	Female
Agra	Personalized Automation Profiles	9	5	4	6	4	2
	Voice Command Customization	9	7	2	6	4	2
	Flexible Scheduling Options	9	6	3	6	3	3
	Task Delegation Notification	9	6	3	6	3	3
	Visual Interface Representation	8	7	1	7	2	5
Bhopal	Personalized Automation Profiles	10	5	5	5	3	2
	Voice Command Customization	8	5	3	7	4	3
	Flexible Scheduling Options	9	5	4	6	4	2
	Task Delegation Notification	9	7	2	6	2	4
	Visual Interface Representation	10	6	4	5	2	3

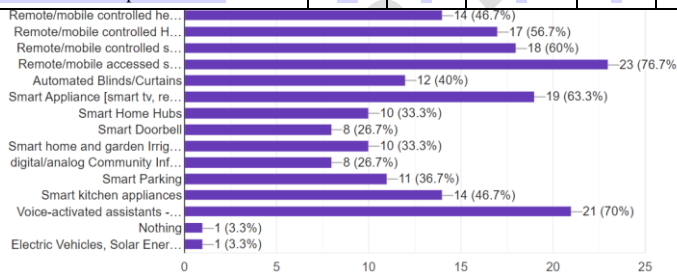


Figure 1: Survey results (frequency distribution %) – Automation indicators for smart housing.

Refer to table 4 above, for a comparative analysis of indicators for automation in smart housing in both cities. Personalized Automation Profiles have been a preferred choice for both cities. Further analyzing, 60% people are comfortable with automation systems at their home out of which 65% are male and 35% are female. Also, 40% don't consider automation systems important for Smart housing out of which 52% are male and 48% are female.

Energy Efficiency:

Integrating smart technology such as meters and sensors enables monitoring and optimizing energy consumption patterns, identifying wasteful usage. 50% of respondents are comfortable with energy-efficient systems, 43.3% desire them, and 6.7% don't want them. Inclusive Smart Metering and Equitable Incentive Programs are the most preferred indicators, with 70% supporting features like potential energy gap and peak-hour optimization, including 65.4% of females. Inclusive Smart Metering is the top choice for males, and Equitable Incentive Programs for females. Smart Metering remains a challenge for women, according to survey analysis. Commonly used energy-efficient systems include energy-efficient lighting (smart LED, energy-saving LED, etc.) and 5-star rated appliances. Uncommon systems include 1-3 star rated appliances and building thermal insulations (refer to Fig. 2 for details).

Table 5: Gendered Analysis of Participant Feedback on Energy Efficiency Indicators in Dual Cities

		Total	Male	Female	Total	Male	Female
Agra	Equal Access to Energy Data	9	6	3	6	3	3
	Personalized Energy Usage Recommendations	11	8	3	4	1	3
	Inclusive Smart Metering	13	9	4	2	0	2
	Energy Efficiency Education Programs	9	7	2	6	2	4
	Equitable Incentive Programs	11	5	6	4	4	0
Bhopal	Equal Access to Energy Data	10	5	5	5	4	1
	Personalized Energy Usage Recommendations	8	5	3	7	4	3
	Inclusive Smart Metering	8	7	1	7	2	5
	Energy Efficiency Education Programs	11	7	4	4	2	2
	Equitable Incentive Programs	11	5	6	4	3	1

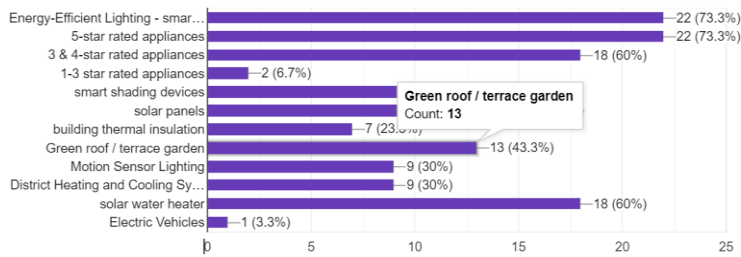


Figure 2: Survey results (frequency distribution %) – Energy Efficiency indicators for smart housing.

Refer to Table 5 above, for a comparative analysis of indicators for energy efficiency in smart housing in both the cities. Equitable Incentive Programs have been the preferred choice for both cities. Further analyzing, 67.3% people are comfortable with energy-efficiency systems at their home out of which 63% are male and 37% are female. Also, 32.6% don't consider energy-efficient systems important for Smart housing out of which 51.1% are male and 48.9% are female.

Security:

Smart housing incorporates advanced security features like smart locks, cameras, and motion sensors to enhance resident safety and reduce the risk of theft or break-ins. 46.7% of respondents are comfortable with security systems, 50% desire them, and 3.3% don't want them. User-Specific Permissions and Occupancy Privacy Measures are the most preferred indicators, with 60% supporting security systems with customizable user permissions and activity parameters, including 53.8% of females. Gender-Inclusive Threat Detection is the top choice for males, and Occupancy Privacy Measures for females. Survey analysis indicates Privacy-Centric Design is lacking in India, and many women feel there is room for improvement in this area. Commonly used smart security systems include surveillance cameras, vehicle monitoring systems, biometric access, and firewalls/anti-virus scanning devices. Uncommon systems include smart locks hybrid version - Godrej locks, automated entry gate boom barrier, and data loss prevention (refer to Fig. 3 for details)

Table 6: Gendered Analysis of Participant Feedback on Security & Monitoring Indicators in Dual Cities

City		Yes			No		
		Total	Male	Female	Total	Male	Female
Agra	User-Specific Permissions	8	6	2	7	3	4
	Privacy-Centric Design	7	4	3	8	4	4
	Gender-Inclusive Threat Detection	9	7	2	6	2	4
	Emergency Response Customization	7	5	2	8	4	4
	Occupancy Privacy Measures	10	5	5	5	4	1
Bhopal	User-Specific Permissions	10	6	4	5	2	3
	Privacy-Centric Design	8	7	1	7	1	6
	Gender-Inclusive Threat Detection	8	6	2	7	2	5
	Emergency Response Customization	9	7	2	6	2	4
	Occupancy Privacy Measures	8	6	2	7	3	4

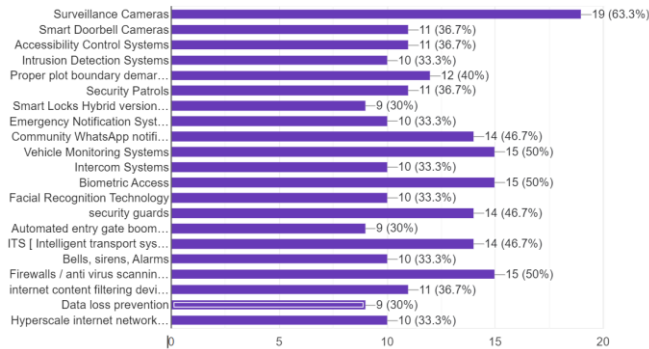


Figure 3: Survey results (frequency distribution %) – Security indicators for smart housing

Refer to Table 6 above, for a comparative analysis of indicators for security in smart housing in both cities. User-Specific Permissions and Occupancy Privacy Measures have been preferred choice for both cities. Further analyzing, 56% people are comfortable with security systems in their home out of which 70% are male and 30% are only female. Also, 44% don't consider Security systems important for Smart housing out of which 41% are male and 59% are female.

Resource management:

Smart housing places emphasis on efficient resource management using technologies like smart lighting, HVAC systems, and water-saving fixtures, promoting sustainability. 50% of respondents are comfortable with resource management systems, 43.3% desire them, and 6.7% don't want them. Gender-Inclusive Sustainable Practices are the most preferred indicators, with 60% supporting resource management systems, including 61.5% of females. Diverse User Feedback is the top choice for males, and Gender-Inclusive Sustainable Practices for females. Survey analysis indicates Diverse User Feedback is not well-developed in India, with many female participants unaware of this parameter. Commonly used resource management systems include leakage detection systems, low-flow plumbing fixtures, rainwater harvesting systems, and solar-powered street charging stations. Uncommon systems include grey-water recycling systems, community composting and bio waste disposal, and green building materials (refer to Fig. 4 for details).

Table 7: Gendered Analysis of Participant Feedback on Resource Management Indicators in Dual Cities

City	Indicator	Yes			No		
		Total	Male	Female	Total	Male	Female
Agra	Equal Access to Resource Controls	8	5	3	7	3	4
	Automated Resource Optimization	7	5	2	8	4	4
	Resource Usage Monitoring	9	7	2	6	2	4
	Gender-Inclusive Sustainable Practices	10	6	4	5	3	2
	Diverse User Feedback Channels	8	8	0	7	1	6
Bhopal	Equal Access to Resource Controls	9	7	2	6	1	5
	Automated Resource Optimization	7	5	2	8	3	5
	Resource Usage Monitoring	8	7	1	7	2	5
	Gender-Inclusive Sustainable Practices	8	4	4	7	4	3
	Diverse User Feedback Channels	8	7	1	7	2	5

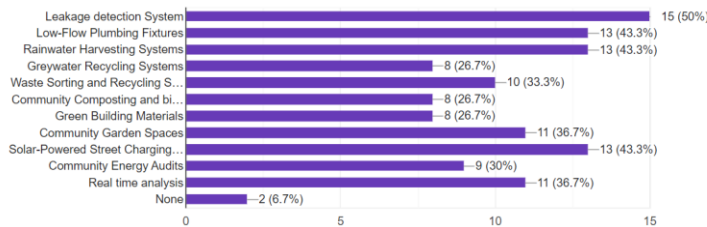


Figure 4: Survey results (frequency distribution %) – Resource management indicators for smart housing

Refer to Table 7 above, for a comparative analysis of indicators for resource management in smart housing in both cities. Gender-inclusive sustainable Practices have been the preferred choice for both cities. Further analysing, 54.6% people are comfortable with Resource management systems at their home out of which 74% are male and 26% are only female. Also, 45.3% people don't consider Resource management systems important for Smart housing out of which 37% are male and 63% are female.

Service management:

Smart housing revolutionizes the resident experience with innovative service management solutions, incorporating advanced security, automated maintenance, and centralized platforms for enhanced communication. 48.7% of respondents are comfortable with service management systems, 46.7% desire them, and 6.7% don't want them. Collaborative Service Decision-Making is the most preferred indicator, with 66.7% supporting resource management systems with optimal service usage schedules, including 69.2% of females. Remote Management Options and User Education on Service Features are the top choices for males, and Collaborative Service for females. Survey analysis indicates service management is less familiar among females. Commonly used service management systems include segregated waste collection at source, cleaning of common areas/service areas/maintenance room, and periodic repair/change/maintenance of service systems. Uncommon systems include maintenance management software, community bulletin boards, energy and utility monitoring systems, and information and communications technology (ICT) networks (refer to Fig. 5 for details).

Table 8: Gendered Analysis of Participant Feedback on Resource Management Indicators in Dual Cities

City	Indicator	Yes			No		
		Total	Male	Female	Total	Male	Female
Agra	Accessible Service Interfaces	9	7	2	6	2	4
	Remote Management Options	10	7	3	5	2	3
	Cultural Sensitivity in Service Delivery	9	7	2	6	2	4
	User Education on Service Features	10	7	3	5	2	3
	Collaborative Service Decision-Making	10	5	5	5	4	1
Bhopal	Accessible Service Interfaces	9	6	3	6	3	3
	Remote Management Options	8	7	1	7	2	5
	Cultural Sensitivity in Service Delivery	8	5	3	7	4	3
	User Education on Service Features	8	7	1	7	2	5
	Collaborative Service Decision-Making	10	6	4	5	3	2

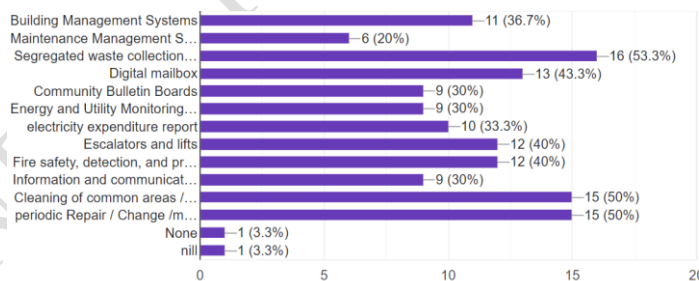


Figure 5: Survey results (frequency distribution %) – Resource management indicators for smart housing

Refer to Table 8 above, for a comparative analysis of indicators for resource management in smart housing in both the cities. Collaborative Service Decision-Making has been preferred choice for both cities. Further analysing, 60.7% people are comfortable with Service management systems at their home out of which 70% are male and 30% are only female. Also, 39.3% people don't consider service management systems important for Smart housing out of which 44% are male and 56% are female.

Results Discussions:

This study provides fresh insights into the gendered perspectives of Bhopal and Agra citizens on Smart Housing, relying on quantitative primary research through a survey questionnaire. The key

findings reveal a positive reception among respondents towards smart housing, emphasizing automation, energy efficiency, security, resource, and service management.

The literature underscores the importance of considering gender implications in smart home technology development for inclusive design. It advocates for personalized automation profiles, equal access to energy data, and gender-equitable practices. [Studies](#) suggest that real-time information reduces energy consumption, personalized energy recommendations encourage saving behaviors, and education programs can overcome barriers in India's household sector. Gender identity is seen as integral to security, with user-specific permissions proposed for creating active [spaces](#). The literature also discusses the role of universities in sustainable development, the impact of gender on conservation efforts, and the transformation of smart service systems through accessible interfaces and remote management options.

Table 9: City-wise Demographic Breakdown - A Gendered Perspective Study in Agra and Bhopal

City	Parameter	% of people voted for the Parameter	No. of people comfortable with using the parameter		No. of people who want the parameter's innervations		No. of people who don't want the parameter	
			Male	Female	Male	Female	Male	Female
Agra	Automation	33.33%	3	3	7	3	1	0
	Energy Efficiency	23.33%	2	5	8	1	0	0
	Security	36.68%	4	4	4	3	0	0
	Resource Meg.	30.00%	1	4	7	2	2	0
	Service management	26.68%	3	4	5	3	1	0
Bhopal	Automation	26.68%	5	5	1	2	1	1
	Energy Efficiency	40.00%	5	4	2	3	1	0
	Security	36.68%	3	2	4	4	1	0
	Resource Meg.	36.68%	5	5	2	2	1	0
	Service management	20.00%	5	3	3	3	0	1

Table 9 displays survey analysis, indicating security and monitoring as primary indicators for Agra citizens (36.68%), while energy efficiency receives the lowest rating. Conversely, energy efficiency is the highest-rated parameter for Bhopal citizens (40%), with service management as the least rated. The arithmetic mean average method confirms security and monitoring as preferred gender-based parameters for both cities.

From a gender perspective in Agra, 28.57% of males and 62.5% of females report having smart housing interventions at home, with security and energy efficiency being important, respectively. In terms of desire for smart housing, 60% of males and 35.5% of females express interest, with energy efficiency being a priority. Additionally, 11.43% of males in Agra do not want smart housing interventions, particularly in resource management. In Bhopal, 58.97% of males and 54.25% of females report having smart housing interventions at home, emphasizing energy efficiency and automation. Regarding the desire for smart housing, 30.76% of males and 40% of females express interest, with security and monitoring being crucial. Moreover, 10.25% of males and 5.71% of females in Bhopal do not want smart housing interventions, particularly in resource and service management.

Conclusion

This study provides e-data analysis yields valuable insights into the gendered perspective on Smart Housing, covering components such as Automation, energy efficiency, Security, resource, and service management. The success of smart housing hinges on integrating both genders in formulating indicators for the smart housing index. Survey findings reveal notable differences between Bhopal and Agra, where Bhopal households are introduced to more indicators, while Agra residents express a greater willingness to adopt them. From a gender perspective, 43.77% of males and 58.38% of females favor smart housing interventions. Men predominantly prioritize Energy Efficiency and Automation, while women focus on Security. Specifically, 56% of women express comfort with security systems, highlighting preferences for User-specific permissions and Occupancy Privacy Measures. On the other

Comment [IO21]: Kindly mention those studies by citing the references

Comment [IO22]: Provide references in parenthesis before the full stop. Note that it is good to always situate your findings or study in literature by comparing it with other similarly studies or discuss it alongside other previous studies.

Comment [IO23]: See previous comments. Always make reference to what others have done that is similar/support or contradict your study. This will make your discussion quite interesting.

hand, men emphasize considerations such as Privacy-Centric Design and Accessible Service Interfaces. Notably, 10.84% of male participants and 2.56% of female participants don't desire the concept of smart housing, mainly targeting Resource management from a men's perspective and service management from a woman's perspective.

Participants, particularly men, suggest further research in areas such as Resource Usage Monitoring, Grey-water Recycling Systems, Community Composting, and bio waste disposal. Some indicators, like Green Building Materials, are rated lower due to a lack of general awareness among males. Similarly, female participants suggest more research in fields like Cultural Sensitivity in Service Delivery, Maintenance Management Software, Community Bulletin Boards, Energy, and Utility Monitoring Systems, and Information and Communications Technology (ICT) networks. Some indicators, like Green Building Materials, receive lower ratings due to a lack of awareness among females. The concept of smart housing and its relation to the gender perspective is a vast research field. Initial investigations can explore how gender influences residents of Agra and Bhopal, finding ways to involve citizens in decision-making about smart housing. Additionally, the study can delve into how privacy and security concerns impact the adoption of smart city housing. Using quantitative methods like the Arithmetic mean propagation method, this investigation provides objective findings applicable to a larger population. Future research can delve into the challenges and possibilities of implementing Automation and Energy efficiency strategies in smart housing, evaluating citizen satisfaction with the services in a smart housing ecosystem. These research areas offer valuable insights to enhance the overall smart housing environment and improve residents' quality of life.

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