Article

Research on Intelligent Space Design Strategies for Women Living Alone

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Abstract: With societal development, the population of single women living alone has continued to grow, drawing increasing attention to their residential safety. This study investigates the design of intelligent living spaces and safety-oriented home products tailored for single women. Using questionnaires and in-depth interviews, the study collected 215 valid responses and analyzed key characteristics of the participants, including age, occupation, and length of independent living. Grounded in Maslow's hierarchy of needs, the research examines how smart home products influence their sense of security across physical, psychological, and social dimensions. The study further evaluates existing product design strategies and identifies current shortcomings, while exploring single women's perceptions, trust levels, usage challenges, and expectations regarding smart safety products. Finally, it proposes design strategies for intelligent living spaces—covering needs assessment, the application of smart technologies, interaction design, and privacy protection—to create safer and more comfortable home environments for single women and to provide theoretical and practical guidance for related industries.

Keywords: single women; intelligent space design; residential safety; user experience; privacy protection

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1. Introduction

1.1. Research Background

In the contemporary social landscape, with the rapid development of the economy, the continuous advancement of urbanization, and the profound transformation of cultural concepts, the family structure and lifestyle of modern society have undergone fundamental changes. Among them, the number of single women has shown a significant upward trend. This phenomenon results from multiple factors, such as improvements in women's educational levels, the expansion of employment opportunities, and greater economic independence. At the same time, the increasing acceptance of diverse individual lifestyles in society has also made living alone a more common choice among women. However, single women inevitably encounter many unique safety challenges in their living environment. In recent years, a series of safety incidents involving single women, such as illegal home break-ins, malicious harassment, and violent attacks, have been frequently reported in the news media, attracting widespread attention and concern from all sectors of society. Against this backdrop, the rapidly advancing field of technology has opened up new possibilities for addressing the safety concerns of single women. This includes areas such as security monitoring systems, smart door lock systems, and smart alarm facilities. The application of intelligent technologies in residential safety is becoming increasingly widespread. These technological applications have effectively

enhanced the effectiveness of residential safety protection to a certain extent and have also provided single women with a stronger sense of safety and psychological comfort, offering technological support and innovative security solutions for their living environment. However, there is still room for further development [1].

In this study, the overall profile was described and analyzed through the respondents' age, occupation, duration of living alone, the residential safety issues they faced, and their use of smart products. From the questionnaire data, 94 valid responses were collected. The respondents were mainly concentrated in the age group of 18–35 years old, accounting for 66%. Meanwhile, office workers (56.4%) and students (26.6%) constituted the main groups, totaling 83%. Women in this age group are mostly in a stage of personal development and have a corresponding need for independent space. As shown in Table 1, nearly 60% of women consider their living environment safe, but more than one-third believe the safety level of their living environment is average (31.9%) or unsafe ("not very safe" 8.5%, "very unsafe" 2.1%).

Table 1. Anxiety among Women Living Alone.

Option	Frequency	Percentage (%)
average	30	31.90
not very safe	38	8.50
very unsafe	2	2.10

Single women face numerous challenges in terms of living safety. At the individual level, young single individuals often have relatively weak safety awareness and insufficient social experience, making it difficult for them to effectively respond to dangers. Those who have been living alone for a short period tend to have inadequate risk awareness and lack sufficient safety precautions, such as missing safety equipment and failing to formulate emergency plans. In terms of living patterns, the work schedules of office workers and students result in their living spaces often being unattended during the day, significantly increasing safety risks. Moreover, due to the busy nature of work or studies, they have limited energy to invest in safety maintenance, making it difficult to ensure equipment upkeep and conduct routine hazard inspections. In terms of the environment, some women's negative evaluations reveal issues such as poor community security and a complex mix of surrounding residents. As the duration of living alone increases, these risks may worsen. Therefore, it is urgent to establish a long-term safeguarding mechanism, starting with improving community security and regulating the management of surrounding personnel, while also promoting the integration of intelligent safety products and comprehensive smart home systems into the living environment. Through technologies such as intelligent monitoring and alarms, real-time monitoring and early warnings can be achieved, filling safety loopholes during unattended periods and addressing the issue from multiple angles to enhance the safety and quality of life of single women and ensure their residential security [2].

1.2. Literature Review

In recent years, the phenomenon of single women living alone has attracted significant attention from the academic community. Sociological studies have shown that this group, while gaining independent living spaces, also generally faces specific safety anxieties and social pressures [3]. Most of these studies analyze the issues from macro social-structural or individual psychological perspectives, but they rarely take their living spaces as the core object of systematic design intervention.

In the field of technology, the application of smart home security has become a research hotspot. Scholars have extensively discussed the technical principles and application status of technologies such as smart door locks and monitoring systems [4,5]. However, existing research mostly adopts an engineering- and technology-centered security perspective, lacking critical examination from the user's standpoint—especially

that of the specific user group of single women [6]. In particular, studies on how technology affects their psychological sense of security remain insufficient.

In the field of design, scholars have begun to pay attention to the emotional needs of female users and the interaction design of intelligent products [7,8]. However, these studies either focus on a single product or remain at the theoretical level, failing to form a comprehensive design framework that integrates spatial planning, technological application, and interaction experience o systematically address the multidimensional safety needs of single women [9].

In conclusion, by integrating sociological insights with technological critique and adopting design as the methodological approach, this study focuses on "how to design intelligent spaces that not only provide physical safety protection but also nurture psychological security and respect individual privacy," thereby offering a more comprehensive and human-centered solution for the living safety of single women.

1.3. Research Purpose

Based on the above literature review, the specific objectives of this study are as follows:

Demand exploration: Conduct in-depth research on the specific safety needs of single women in Chinese cities in terms of personal, psychological, and social aspects, as well as the interrelationships among them.

Problem diagnosis: Conduct a systematic assessment of the trust crises and usage obstacles that arise when existing intelligent security products interact with elderly female users who live alone.

Strategy construction: Propose a "hidden guardianship" type of intelligent space design strategy framework that centers on user trust and integrates intelligent technology, spatial layout, and interaction design.

1.4. Research Scope and Limitations

The research scope includes exploring technical feasibility and analyzing the potential technical bottlenecks that may arise when current smart home technologies—such as intelligent monitoring and sensing devices—are applied in the living spaces of single women, including issues like system compatibility and signal stability. Additionally, under conditions of limited resources, including funding and available space, the study examines how to reasonably plan the layout and functional integration of smart devices to achieve maximum efficiency. At the same time, attention is paid to the implementation of privacy protection policies by examining how to ensure data security and prevent data leakage or improper use when collecting living data from single women through smart devices, in accordance with relevant regulations.

However, this study inevitably has limitations. The rapid pace of change in the technology field makes it difficult to accurately predict the potential disruptions that future technological innovations may pose to the current research results. Moreover, the complex and diverse technological ecosystem at present may hinder the ideal application of some intelligent technologies in practice, thereby weakening the expected technical feasibility. The design of smart homes also lacks specific standardization, and resource limitations make it impossible to account for all special circumstances and boundary conditions, which reduces the universality of the proposed design strategies. At the policy level, due to differences in privacy protection requirements across regions and the varying standards implemented by smart product suppliers, it is challenging to develop unified, complete, and widely applicable implementation guidelines. This undoubtedly restricts the broad dissemination and precise implementation of the research results in practice, leaving room for further solutions in subsequent in-depth research and applications.

2. Investigation of the Sense of Security and Needs of Single Women

2.1. Definition and Sociodemographic Characteristics of Single Women

The concept of "single women" is usually defined as a group of women who live alone. This definition varies to some extent across different disciplines and research perspectives. From a sociological perspective, single women start to lead an independent life after reaching adulthood, and there is no specific upper age limit for this. In terms of marital status, they mainly include unmarried, divorced, and widowed women within the single category. The living pattern refers to residing alone in a single house or apartment, excluding long-term cohabitation with family members or other non-relatives [10,11].

With the continuous development of society, the definition of single women has undergone significant evolution. In the early stages, single women were often regarded as outliers or individuals in special circumstances. However, as social concepts gradually changed and individual choices became increasingly diverse, the number of single women has risen, and accordingly, their definition has broadened and gradually gained widespread acceptance in society.

This reflects the social characteristics of single women in various aspects. The age distribution is wide. Due to the pursuit of independence, career development, or personal space, young single women tend to live alone, while middle-aged and elderly women often choose to live alone for reasons such as widowhood, divorce, or children's independence. Their educational qualifications are generally high, which enables them to have strong independent living abilities and supports career pursuit and goal achievement. They also tend to prefer independent thinking and self-directed choices. The types of occupations are diverse, covering white-collar workers, freelancers, and entrepreneurs who have high requirements for professional skills and autonomy. This provides women with the basis for economic independence, allowing them to choose to live alone. Income levels vary: high-income groups can enjoy a high-quality life, ensuring safety and meeting their needs, while low-income groups face greater economic pressure and place more emphasis on ensuring safety. In different regions and under different cultural backgrounds, the characteristics of single women vary significantly. In economically developed areas, they focus on personal development and improving quality of life. In regions with strong traditional concepts, single women face more social pressure and ideological constraints. For example, they may encounter critical looks or pressure from family and public opinion regarding social interactions and career development, and are more concerned about balancing family and personal life, all of which profoundly impact their living conditions and psychological wellbeing [12,13].

This study collected relevant data through the distribution of two questionnaires, with a total of 215 valid responses retrieved. Subsequently, a rigorous integration and in-depth analysis were conducted on the age information of the interviewed single women. Statistical analysis revealed that among all the interviewed single women, those aged between 18 and 35 accounted for a relatively larger proportion, at 63.7%.

Based on the empirical analysis results (Table 2) and taking various factors into account, this paper defines the concept of urban single women as follows: Urban single women specifically refer to women aged between 18 and 35 who primarily live alone in urban environments. In the subsequent discussion of this article, the focus will be on this specific age group of female users living alone. Further comprehensive and in-depth analysis and research will be carried out, aiming to reveal the characteristics and patterns of this group in multiple aspects and to provide strong support for theoretical development and practical applications in related fields.

Table 2. Age Distribution of Women Living Alone.

Option	Frequency	Percentage (%)
18-25 years	80	37.20
26-35 years	57	26.51
36-45 years	46	21.39

Over 45years	32	14.88

2.2. Analysis of the Security Needs of Solo-Living Women in Smart Home Products Based on Maslow's Hierarchy of Needs

In the current social living context, the need for security among single women has become a highly significant research topic. According to Maslow's hierarchy of needs theory, security is listed as the second-level need, ranking only after physiological needs [14]. Security refers to the psychological and physiological need and feeling of individuals for a stable, safe, and predictable environment. From different theoretical perspectives, the essence of security is the individual's cognition of the certainty, controllability, and stability of their own living environment. Maslow's demand hierarchy theory divides human needs from low to high into several levels: physiological needs, safety needs, love and belongingness needs, esteem needs, and self-actualization needs. For single women, smart home products play an extremely crucial role in meeting their security needs [15].

For enhancing the stability of women's solitary life, after gradually progressing from physiological needs to higher-level needs, the need for safety remains an indispensable foundation. Further exploring the functions of intelligent home products from this hierarchical perspective cannot be ignored. The solitary living model, to a certain extent, can effectively alleviate psychological pressure, but it often causes women to feel lonely and experience inner unease. The living environment created by a smart home system can play a significant role in alleviating this sense of loneliness and inner unease [7]. For example, considering the emotional states of solitary women at different times, intelligent lighting systems can flexibly set various lighting scene modes. At night, soft and gentle lights can create a comfortable, soothing, and pleasant living atmosphere for solitary women, or devices such as smart speakers with voice interaction functions can provide a unique sense of companionship by playing soothing music, communicating, and interacting with solitary women. In this way, the purpose of enhancing the sense of companionship is achieved. This sense of companionship can greatly reduce the psychological anxiety of solitary women during lonely moments, thereby significantly strengthening their sense of psychological security.

From the perspective of social security, intelligent safety home products can effectively enhance communication and interaction between single women and the outside world. Intelligent doorbells, combined with visual intercom functions, enable single women to clearly know the identity information of the other party in advance and communicate with them smoothly. This function not only ensures the safety of single women but also greatly facilitates friendly communication and interaction with delivery personnel, neighbors, and other people, helping maintain good community relationships and playing an extremely important role in promoting a harmonious social environment. In addition, some smart home systems also support seamless connection with various social software or family-sharing platforms. Through these connection methods, single women can quickly send out a distress signal in case of emergencies, which undoubtedly strengthens the social support network available to them, thereby effectively enhancing their sense of social security [16,17].

Based on Maslow's hierarchy of needs theory, an in-depth analysis was conducted, revealing that intelligent security home systems should comprehensively and effectively meet the safety needs of single women from multiple important aspects, including personal safety, psychological safety, and social safety. In this direction, a more complete, intelligent, and highly humanized security guarantee system has been meticulously designed for the solitary life of single women, ensuring both physical protection and psychological reassurance.

2.3. The Impact of Intelligent Security Homes on the Sense of Security of Solo-Dwelling Women

Intelligent security home products come in a wide variety of types and offer diverse functions. There are numerous types of intelligent security protection products. For instance, users can check the situation at home at any time through a mobile app. Intelligent monitoring systems with features such as motion detection and video playback can conduct real-time monitoring of the home environment. Smart door locks enhance home security by allowing remote unlocking through fingerprint recognition, passwords, or the mobile app. Intelligent alarm devices promptly issue alerts in case of intrusions, fires, or other abnormal situations. Meanwhile, the technical principles of intelligent security home products include sensor technology and network communication technology. One key technique involves collecting images and data through cameras and sensors, which are then transmitted to the user's mobile phone or other devices via the network. Classification methods can be divided into indoor monitoring and outdoor monitoring, wired and wireless connections, or other combinations such as indoor surveillance and outdoor surveillance [18].

Intelligent security home products offer obvious advantages in ensuring home safety, such as high convenience, strong real-time performance, and a high level of intelligence. Users can remotely control the devices in their homes via mobile phones and monitor the home situation at any time. In case of abnormal situations, they can respond promptly. Intelligent security home products also provide specific mechanisms to meet the security needs of single-person households. Smart door locks and monitoring systems can effectively prevent the intrusion of strangers in terms of personal safety. In terms of property safety, theft and other incidents can be detected promptly by intelligent alarm devices. Regarding psychological security, real-time monitoring and risk alerts can help single-person women feel more at ease [19].

The psychological cognition and behavioral habits of single women interact closely with intelligent home appliances. The safety needs of single women prompt them to select home appliances suitable for living alone, and the use of these products, in turn, influences their psychological cognition and behavioral habits. For example, after using an intelligent monitoring system, single women may become more attentive to safety issues in their home environment, thereby developing good safety habits. At the same time, by providing convenient operation and a comfortable user experience, intelligent security home appliances can also meet the living needs of single women, enabling them to maintain a more peaceful psychological state during their long-term solitary living [20].

2.4. Design Strategies and Solutions in Existing Studies

The intelligent security function is integrated into the spatial layout, taking into account both aesthetics and practicality. The design is carried out from the following aspects. First, in interior design, intelligent security home products are integrated with furniture and decorative items for a unified design, so that the security function can be fully exerted without being visually obtrusive. For example, intelligent surveillance cameras can be concealed within lamps or decorative objects, and smart door locks can be combined with the design of doors. Second, in terms of spatial layout, the positions of intelligent security home products can be reasonably arranged. For instance, based on the living habits of single women and their safety needs, the space layout can be designed to optimize security. Important areas such as bedrooms and living rooms can be equipped with smart door locks, surveillance cameras at entrances, and intelligent alarm devices [21].

Through several approaches, a fully integrated intelligent security home system can be realized both online and offline. On the one hand, various intelligent security home products can be integrated using the Internet of Things as a carrier and connected to a unified platform, enabling remote control and intelligent management. Single women can monitor and control the equipment at home through a mobile app at any time, and have

a clear understanding of home conditions and alarm information. On the other hand, to ensure the stable operation of the intelligent security home system, an online-offline service system can be established, including installation, maintenance, and after-sales services, providing reliable guarantees [22].

2.5. Limitations of Current Research and Possibilities for Future Development

At present, policies and regulations concerning personal privacy and safety protection provide certain safeguards for single women. However, there is still room for improvement. For instance, regarding personal privacy protection, the popularization of smart security home products increases the risk of personal information leakage. It is necessary to further strengthen data security management of smart security home products, clarify the responsibilities and obligations of enterprises, and ensure the personal privacy of users.

In cases where individuals' lives are affected by strangers following them or even suffer personal harm, it is worth discussing whether existing legal punishments are sufficient. Current legal measures for such behaviors may be inadequate, and it is necessary to further improve relevant laws and regulations and intensify enforcement against acts that violate the personal safety of single women [23].

Considering current policies on personal privacy protection, there is potential for collaboration with smart home brands, such as Xiaomi, for design purposes. By employing encryption technology and authorization management, product design can fully address the needs for personal privacy protection, ensuring the security of users' personal information. At the same time, cooperation with smart home brands allows various smart home products to be integrated, providing a more comprehensive and convenient security protection solution.

3. Characteristics and Needs of Single Women for Smart Security Products

3.1. Questionnaire Design and Analysis of Smart Security Product Impact

In this study, the research objectives and questions were determined, with a clear focus on issues related to the living safety of solo-dwelling women, including understanding their perceptions of the safety of their living environment, the safety challenges they face, and their cognition of and demand for smart home products. This focus guided the targeted design of the questionnaire content. At the same time, the questionnaire structure was carefully designed and divided into four parts: the personal information section, the living safety cognition section, the smart home product-related section, and the safety needs and expectations section. This structure aimed to capture the current safety situation of solo-dwelling women and the safety measures they expect, thereby providing a solid basis for proposing targeted design strategies.

Table 3 presents the descriptive statistics of the users' features, including age, profession, length of living alone, and type of living alone. The age distribution shows that 18–25 years old accounted for 35%, 26–35 years old for 27%, 36–45 years old for 18%, and over 45 years old for 20%. Regarding profession, enterprise employees made up 60%, civil servants or personnel of public institutions 11%, and freelancers 29%. In terms of the length of living alone, less than a year accounted for 16%, 1–3 years 22%, 3–5 years 34%, and over 5 years 28%. Concerning the type of living alone, property owners accounted for 66% and renters 34%, making a total of 100% across all categories.

Table 3. Descriptive Statistics of User Characteristics.

Question	Option	Frequency Percentage	(%)	Cumulative Percentage (%)
Age：	18~25	35	35.00	35.00
	26~35	27	27.00	62.00
	36~45	18	18.00	80.00
	Over 45 years	20	20.00	100.00
Profession：	employees of the enterprises	60	60.00	60.00
	Civil servants/personnel of public institutions	11	11.00	71.00
	freelancer	29	29.00	100.00
Length of living alone：	Less than a year	16	16.00	16.00
	1-3 years	22	22.00	38.00
	3-5 years	34	34.00	72.00
	Over 5 years	28	28.00	100.00
Type of living alone：	property	66	66.00	66.00
	renting	34	34.00	100.00
Total		100	100.0	100.0

Based on the questionnaire survey research method, in-depth interviews were conducted with 10 women who had experienced safety threats in their solitary living situations. The interview outline was revised and improved as follows: 1. Please briefly introduce your age, occupation, and duration of living alone. 2. What prompted you to choose a solitary lifestyle? 3. Are there any factors in the community or surrounding environment that make you feel unsafe (such as security conditions, lighting, personnel flow, etc.)? How do these factors affect your daily life? 4. What kind of living environment would make you feel safe? (Describe from aspects such as physical environment, community atmosphere, safety facilities, etc.) 5. In your opinion, how important is security for solitary women? How does it affect your life (such as emotions, social life, daily activities, etc.)? 6. During your solitary living, did you often worry about your safety? What aspects did you mainly worry about? 7. Could you please share an event that left a strong impression on you during your solitary living? 8. Regarding the intelligent security products you know, which functions are the most important to you (such as remote monitoring, real-time alarms, automatic protection, etc.)? What aspects would you like these products to improve (such as price, appearance design, functional integration, etc.)? 9. What do you think an intelligent security home system can provide for solitary women? Can it truly enhance living security?

During the interviews, the order of questions and methods was flexibly adjusted according to the situation. Valuable topics were pursued, and interviewees were encouraged to describe the reasons behind their safety threats in solitary living (such as theft, personal assault, fire, etc.). Details such as the time, location, process, involved personnel, feelings at the time, and response measures were inquired. The potential role of smart home products in mitigating or changing the development of these incidents was also explored. Each interview lasted 10 to 15 minutes, and the entire process was recorded by the researcher.

The key safety threats encountered by the interviewed women and their preferred intelligent security products, along with the suggested product improvements, are summarized in Table 4.

Table 4. Key Safety Threats and Selection of Intelligent Products by Solo-Dwelling Women.

Respondent	Type of Safety Threat Encountered	Intelligent Products Providing Higher Sense of Security	Product Design Points for Improvement
1	Poor sound insulation; unease caused by maintenance personnel	Monitoring system, alarm system	Facial recognition function
2	Intrusion or harassment by others	Smart doorbell, monitoring system	Reduce false alarm rate
3	Community security risks	Smart doorbell, alarm system	Intelligent recognition; clear image quality
4	Poor sound insulation; community security risks	Monitoring system	Voice recognition function
5	Concern about harassment by men	Monitoring system, alarm system	Facial or identity recognition
6	Poor sound insulation	Alarm system	Compact, concealed, integrated with whole-home smart system
7	Community security risks	Monitoring system, smart doorbell, alarm system	Multi-function integration for monitoring, alarm, and communication functions
8	Unease or harassment by maintenance personnel	Monitoring system, smart doorbell, alarm system	Multi-function integration for monitoring, alarm, and communication functions
9	Intrusion or harassment by others	Smart doorbell, alarm system	Whole-home linkage; voice control
10	Harassment or stalking by men	Smart doorbell, alarm system	Concealed buttons; facial or identity recognition

In terms of cognition and demand for smart security products, single women attach great importance to monitoring functions (e.g., real-time monitoring, face recording), alarm protection functions (e.g., emergency alarms), and smart door lock functions (e.g., multiple unlocking methods). They expect improvements in monitoring accuracy, optimization of alarm functions, perfection of smart door lock features, and consideration of special needs (e.g., concealed alarm buttons). The intelligent security home system has been shown to enhance the sense of security for single women. Most respondents agree that it can strengthen psychological security and even improve actual living safety (e.g., real-time monitoring and identity tracking); however, it must be considered comprehensively, as it cannot completely eliminate security issues and should be combined with other protective measures. Moreover, society should pay more attention to and ensure the safety of single women.

3.2. Analysis of Survey and Interview Results

3.2.1. The Divergence of Trust and Challenges in Building It

The questionnaire survey indicates that the effectiveness of the intelligent alarm system has been questioned. Respondents who consider it "relatively effective" and those who rate it as "average/basic ineffective" are almost evenly split (43.24% vs. 32.43%). This data not only highlights shortcomings in product reliability but also reflects a widespread trust crisis among single women regarding automated systems. They rely on technology for protection but cannot fully trust its judgment and response. This contradictory mentality represents the core issue that design must address.

3.2.2. From Functional Requirements to Emotional Needs: Interview Analysis

Topic 1: "The Illusion of Control" – Respondents generally yearned for a sense of control, but the "black box" operation of smart products (e.g., unexpected false alarms) and the complexity of settings deprived them of this feeling. For instance, Respondent 2 and Respondent 10 both mentioned the need to "reduce the probability of false alarms," which essentially reflects their desire to regain control over the interpretation of home security.

Topic 2: "The Fear of Surveillance" – Almost all respondents expressed concerns about privacy leakage (see Table 4, demands for optimization of facial image and voice collection functions). This creates a paradox: the devices introduced to prevent external threats have themselves become potential internal threats. Design must confront this paradox.

Topic 3: "The Duality of Accompaniment and Warning" – Smart speakers and other devices are expected to provide companionship (e.g., playing music), but their security functions (e.g., alarms) constantly remind users that they are in a "dangerous" environment. This functional schizophrenia requires that, when designing such products, the emotional tone in different modes must be clearly defined and seamless transitions ensured.

4. Design Strategies for Smart and Secure Homes for Single Women

4.1. Analysis of Living Needs of Single Women

Single women face risks in terms of personal safety, such as intrusion by strangers, violent attacks, and unlawful infringements in the surrounding area of their residence. In terms of property safety, they need to guard against threats such as theft and fraud. Both household belongings and online financial assets require proper protection. Psychological safety is also essential. Living alone can easily lead to feelings of loneliness and anxiety. The living environment should help alleviate these negative emotions and provide psychological comfort and security. For instance, a secure community environment and a safe layout of the living space can, to some extent, reduce the psychological pressure on single women [24].

Single women also have specific demands regarding spatial comfort. They expect their living environment to be designed according to their habits and aesthetic preferences. For example, the interior decoration style should be warm, indoor temperature and humidity should be appropriately adjusted, and personalized design should be reflected in the flexibility of space utilization across work, leisure, socializing, and other living scenarios. Furniture layout can be flexibly arranged to meet daily rest needs while quickly transforming into a social space when friends visit [25].

The practicality of the intelligent home system in terms of functionality is a key consideration during the design process. For instance, the intelligent lighting system should not only provide sufficient light but also automatically adjust light intensity based on different scenarios and switch between modes as needed. Intelligent kitchen appliances should allow remote control of parameters such as cooking time and

temperature, enabling women living alone to efficiently manage their meals. Additionally, the intelligent lighting system should have self-diagnosis and maintenance functions, detecting device faults promptly and providing usage prompts to minimize inconvenience [26].

The foundation for building an intelligent and secure home system lies in conducting a comprehensive safety risk assessment of the living environment of single women. This assessment covers aspects such as the security situation in the residential area, the safety of the house structure (e.g., anti-theft performance of doors and windows, smoothness of fire escape routes), and potential hazards in the surrounding environment (e.g., proximity to major traffic routes or areas with complex security conditions). Based on the quantified risk assessment results, the intelligent security home system can ensure effectiveness in preventing and responding to security incidents, thereby determining functional priorities and protection levels.

4.2. Application of Smart Security Technologies

4.2.1. Intelligent Door Lock System

Smart door locks are core devices of access control systems. They support various unlocking methods such as fingerprint recognition, password entry, Bluetooth connection, and remote mobile unlocking, allowing single women to choose the appropriate method and operate according to different scenarios. For authorized visitors, to avoid the inconvenience of traditional key handovers, temporary passwords can be sent via mobile phone or remote unlocking instructions can be issued. Moreover, the access control system can be linked with the monitoring system. When someone attempts unauthorized unlocking, the alarm is immediately triggered, and relevant information is recorded [27].

Research on the impact of intelligent door lock systems on the sense of security of single women revealed that multiple unlocking methods were the primary factor, with a selection rate of 54.05%, indicating their emphasis on avoiding key-related security risks. The automatic alarm and linkage functions accounted for 27.03%, showing a high expectation for real-time alerts and system interaction. The remote viewing function was preferred by 21.62% of users, reflecting the demand for monitoring the status of the door lock, while only 16.22% of users selected the temporary password function, suggesting lower perceived importance of temporary access (see Table 5).

Table 5. Statistics of the Impact of Smart Door Lock System Functions on Security.

Option	Frequency	Percentage (%)
Multiple unlocking methods	20	54.50
Automatic alarm function	10	27.03
Remotely view the status of the door lock and the unlocking record	8	21.62
Interact with other smart home devices	10	27.03
The temporary password function makes it convenient for others to enter temporarily	6	16.22

To enhance the applicability and security of intelligent door lock systems for single women, multiple improvements are necessary. Promotion of various unlocking methods should be strengthened, with explanations of their technical principles, safety advantages, and convenience, alongside optimization and upgrades to consolidate their core position. The sensitivity and diversity of the automatic alarm function should be enhanced, exploring more scenarios, granting users custom permissions, and ensuring accurate and prompt responses. The remote viewing function should be improved with an intuitive interface and real-time notification system, enhancing user convenience and sense of control in monitoring and managing the door lock status. For the temporary password

function, market research should be conducted to understand demand characteristics and expectations, optimize the design, adjust validity periods or expand usage scenarios, and enhance its attractiveness and effectiveness to meet diverse security needs [28].

4.2.2. Intelligent Monitoring System

The intelligent monitoring system is an essential part of the intelligent safety home for single women. High-definition cameras can be installed at key locations such as the entrance, living room, and balcony to achieve 24-hour monitoring. Using advanced image recognition technology, the system can automatically identify unfamiliar faces and promptly send warning notifications to the resident's mobile device. Monitoring videos can be stored in the cloud or on local storage devices for viewing and replaying, providing evidence for investigating security incidents [29].

According to the data, when it comes to the impact of smart surveillance camera functions on the sense of security of single women, high-definition image quality accounts for 43.24%. This shows, from both safety and psychological perspectives, that consumers highly value this function, as clear images can accurately and comprehensively provide monitoring information to enhance security. The mobile detection alarm and biometric recognition functions each account for 21.62%, indicating that users attach importance to real-time monitoring and security identification, both of which align with the core demands of security protection. However, night vision and irregular cruise functions each account for 10.81%, reflecting that their demand is weaker than image quality and alarm functions in daily use. This may be due to differences in environment, habits, and cognition. The cloud storage and two-way voice communication functions also show relatively low proportions, as these features focus more on data storage management and communication interaction, which are secondary compared to core functions such as image quality and alarm (see Table 6).

Table 6. Impact of Intelligent Monitoring System Functions on Security.

Option	Frequency	Percentage (%)
High definition display	16	43.24
Night Vision Function	4	10.81
Motion detection alarm	8	21.62
Cloud storage function	6	16.22
Two-way voice call function	5	13.51
Unscheduled cruise function	4	10.81
Biometric function	8	21.62

To enhance the performance of intelligent surveillance cameras to meet user needs and improve security protection, a multi-faceted approach is required. In terms of image quality, manufacturers should continue investing in advanced optical lenses and related technologies to optimize key indicators such as resolution. For improving the alarm function, R&D teams should increase efforts by using precise sensors and other technologies to enhance accuracy, response speed, and signal transmission, thereby strengthening user trust. For night vision and irregular cruise functions that receive relatively low attention, targeted market education can be conducted through professional channels to explain their advantages and guide users to recognize their potential value. It is also necessary to establish a sound user feedback mechanism—using channels such as online questionnaires—to collect information, identify user pain points and preference trends, and further optimize existing functions or develop new ones. This helps products adapt to market changes, improve recognition, satisfaction, competitiveness, and security protection capabilities [30].

4.2.3. Intelligent Alarm System

The emergency response system for unexpected incidents is designed to provide timely rescue assistance to women living alone when sudden safety incidents occur. Emergency buttons should be installed at easily accessible locations such as bedrooms and bathrooms. Once pressed, the system will simultaneously alert the local police and automatically send a distress signal to pre-designated emergency contacts (such as family members, friends, or community security personnel). Some intelligent security home systems are also equipped with environmental monitoring devices, such as smoke alarms and gas leakage alarms, which can quickly activate the emergency response mechanism to safeguard the life and property of women living alone when abnormal situations are detected [31].

Through the analysis of survey data on the effectiveness of the intelligent alarm system, most participants held a positive attitude. 43.24% believed it was "relatively effective," although issues such as false alarms and delayed responses remained, demonstrating a certain level of acceptance. 24.32% rated it as "very effective," reflecting that it can meet security needs. However, 10.81% felt it was "basically ineffective," indicating that some users were dissatisfied, and 21.62% stated that the "effect was average," suggesting doubts and revealing a gap between the system's functions and users' expectations (see Table 7).

Table 7. Users' Evaluation of the Effectiveness of Intelligent Alarm Systems.

Option	Frequency	Percentage (%)
Highly effective	9	24.32
Moderately effective	16	43.24
Slightly effective	8	21.62
Minimally effective	4	10.81

In the application of the whole-house intelligent security system, various approaches can be adopted to enhance the performance of the intelligent alarm system: firstly, improve the system's accuracy by optimizing algorithms to reduce the false alarm rate, accurately identify emergencies, and enhance user trust; secondly, accelerate response time and strengthen linkage with emergency services to ensure rapid transmission and timely response of alarm information; thirdly, establish a user training and feedback mechanism to inform users about the system's usage and limitations and collect opinions for continuous improvement; fourthly, conduct regular evaluations and updates of the system to maintain technological advancement and adaptability, enabling it to cope with changing emergency situations [32].

4.3. Interaction Design Strategy: Establishing "Implicit Protection" and "Emotional Comfort"

Based on the themes of "fear of surveillance" and "duality of companionship and warning" extracted from the interviews, the goal of interaction design should be to make the security system an "invisible guardian" rather than an "obvious monitor."

Transform spatial interaction into "environmental" rather than "interface" interaction: Reduce the necessity for frequent user interaction with mobile apps and make greater use of the environment itself as the interaction medium. For example, when the system is on alert, a gentle light band can slowly illuminate along the baseboard, indicating that the security barrier has been activated; when the system detects an anomaly, this light band can change to a slowly flashing amber color instead of an ear-piercing alarm sound. This environmental suggestion can convey information while avoiding panic, thereby meeting psychological safety needs. For scenarios where people get up late at night, through human body sensing, a gradual and soft lighting from the bedroom to the bathroom can be triggered. This is not only safety lighting but also a silent form of care and companionship, effectively alleviating loneliness.

Hierarchical and customizable alert mechanism: Incessant and harsh alerts are a main cause of anxiety. The system should allow users to customize alerts according to the situation: Level 1 alert: Someone stays at the door for a long time, the phone vibrates slightly, and an app sends a silent notification; Level 2 warning: A forced entry attempt is detected, indoor lights flash twice rapidly as a warning, and a specific ringtone sounds on the phone; Level 3 emergency: Safety is directly threatened, a high-decibel alarm is triggered, and the emergency contact person is automatically notified. This hierarchical system returns control to the user, allowing her to become a co-developer of the security strategy, thereby greatly enhancing trust.

4.4. Privacy Protection in Smart Homes

The key technology for protecting the privacy of single women is data encryption in the intelligent security home system. To prevent data from being stolen or tampered with, all transmitted and stored data must use high-strength encryption algorithms [33]. Users should have full control over their personal information and be able to independently decide the scope of data collection, retention period, and sharing targets. For example, users can choose to store surveillance video data only locally or set up automatic deletion for data after a specific period to maximize privacy protection.

When designing the architecture of a smart home system, it is essential to fully consider data security and privacy protection. By adopting a layered architecture, the stages of data collection, transmission, storage, and processing are separated to reduce the risk of data leakage. Secure and reliable storage devices and cloud providers should be selected, and regular backups and security audits performed. The system should comply with relevant privacy regulations and standards such as the EU General Data Protection Regulation (GDPR) to ensure legal and compliant protection of user privacy [34]. When building a smart security home system for women living alone, a balance must be sought between privacy protection and security: the system must have sufficient security functions to prevent and respond to threats while fully respecting users' privacy rights to avoid excessive data collection and misuse. Through reasonable technical design and user permission management mechanisms, an organic unity of privacy and security can be achieved, providing a safe and comfortable living environment for women living alone [35].

5. Conclusion and Recommendations

5.1. Research Summary and Findings

This study focuses on intelligent space design and smart home products for single women. Using a combination of questionnaire surveys and in-depth interviews, it analyzes the characteristics of this group, their safety needs, the impact of intelligent security home products, their cognitive and functional demands, and design strategies for intelligent living spaces.

The findings indicate that most single women are young adults facing multiple safety challenges. Their security needs encompass three dimensions: personal safety, psychological security, and social safety. Intelligent security home products provide positive effects in addressing these needs, yet issues related to trust and usability persist. Single women place great importance on product functions and have clear expectations for their improvement.

Based on these insights, the proposed design strategies for intelligent safety home spaces include the rational application of smart technology, optimization of interaction design, and enhancement of privacy protection. These strategies aim to comprehensively address the diverse living needs of single women while improving their sense of security and overall quality of life.

5.2. Suggestions and Strategies for Intelligent Space Design

To enhance the living experience of single women, the design of a smart and secure home environment should be carried out from multiple aspects. The first step is to design based on the needs of the residents. According to the individualized needs of single women in terms of personal safety, property security, psychological safety, and comfort, a comprehensive assessment of the risks in the living environment should be conducted, and an intelligent safety home system, including intelligent lighting and kitchen appliances, should be customized to enhance both safety and comfort.

In terms of the application of intelligent technology, the smart door lock system needs improvement, including promoting various unlocking methods, optimizing and enhancing the automatic alarm function, improving the remote viewing function, and researching and optimizing the temporary password function, thereby enhancing applicability and security. Manufacturers should invest in improving the image quality of the intelligent monitoring system, enhance alarm functions through R&D, conduct market education to raise awareness of night vision and cruise functions, improve feedback mechanisms to optimize existing functions, and ensure effective emergency response. Additionally, interaction design should be optimized using graphical interfaces and voice control, providing timely feedback on system status and alarms, and setting multiple levels of reminders to facilitate convenient operation and real-time monitoring for single women. Finally, privacy protection should be strengthened. Measures such as data encryption, user control over personal data, hierarchical architecture design, secure storage and auditing, and compliance with privacy regulations should be implemented to achieve a balance between privacy protection and security assurance.

5.3. Research Limitations and Future Research Directions

This study has certain limitations. The rapid technological changes affect the prediction of technical feasibility. The design of smart homes lacks standardization. The privacy protection policies are difficult to be unified. The resource constraints limit the universality of the design strategies. Future research can focus on the impact of technological innovation on the design of intelligent spaces for single women, explore standardized design guidelines, strengthen the research and coordination of privacy protection policies, deepen the study of the psychological and behavioral needs of single women, provide more accurate basis for intelligent space design, and enhance the living security and quality of life of these individuals.

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