Original Article

Innovative solutions for elderly care with smart technology and robotics

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ABSTRACT

The integration of smart technology with robotics is playing an increasingly significant role in elderly care, driven by rapid technological advancements and an aging global population. As countries experience demographic shifts towards older populations, the need for innovative solutions to improve the quality of life for the elderly becomes more critical. Smart robots are essential in healthcare, providing continuous health monitoring, medication reminders, and telemedicine consultations for better health management and timely medical interventions. Robots designed for social interaction help reduce loneliness and social isolation by engaging in conversations, playing games, and connecting with family and friends. In daily household tasks, smart robots assist with cleaning, cooking, and home security, allowing elderly individuals to maintain their independence and live comfortably. Despite challenges such as cost, privacy, and technology acceptance, the benefits of integrating smart technology and robotics in elderly care are significant. This paper highlights the potential of smart technology and robotics to significantly enhance the quality of life for the elderly in the future.

This study employed a descriptive and correlational method of structural equations. A total of 409 elderly individuals over the age of 60 were selected through convenience sampling based on entry criteria in Tehran. Data were collected using the Successful Aging Scale (SAS), Cognitive Flexibility Inventory (CFI), Social Participation, Purpose in Life, and Information Technology questionnaires. The data were analyzed using path analysis with correlation tests, applying the bootstrapping method with AMOS 26 software.

Keywords: Smart technology, Aging population, Robots, Healthcare, Social interaction, Psychological

Introduction

The intersection of rapid advancements in smart technology and a globally aging population has highlighted the growing importance of robots in the lives of the elderly. As many countries face a significant demographic shift towards older populations, the need for innovative solutions to enhance the quality of life for the elderly is becoming critical. Robots integrated with smart technology provide a promising solution to address various challenges faced by the elderly, including healthcare needs, social interaction, psychological well-being, and daily household tasks. As the elderly population grows, traditional methods of care are often insufficient. Smart technology and robotics can bridge this gap by offering continuous health monitoring, medication reminders, and facilitating telemedicine consultation. This real-time support can prevent medical emergencies and promote better health management. Social isolation and loneliness are prevalent issues among the elderly, leading to mental health decline. Robots designed for companionship can engage in conversations, play games, and connect the elderly with family and friends through video calls, thereby enhancing their psychological well-being. Moreover, daily household tasks can become burdensome for the elderly. Smart robots can assist with cleaning, cooking, and home maintenance, allowing the elderly to live independently in their homes. These robots also enhance home security by monitoring the environment and alerting caregivers or emergency services when needed. While challenges such as cost, privacy, and technology acceptance persist, the benefits of integrating smart technology and robotics in elderly care are substantial. Embracing these advancements can significantly improve the quality of life for the elderly, ensuring they can live with dignity and independence.

Research literature

Smart technology and robots in healthcare

Smart technology and robots can significantly impact the delivery of healthcare services to the elderly, addressing issues such as monitoring health status, providing medical services, and assisting with daily tasks. Here are some specific ways they can contribute to healthcare:

- **Health Monitoring:** Smart robots equipped with advanced sensors can continuously monitor the health status of elderly individuals, tracking vital signs such as blood pressure, glucose levels, and heart rate. This real-time data can be transmitted to healthcare providers through secure smart systems, enabling timely interventions and reducing the risk of medical emergencies.
- **Medication Management:** One of the common challenges for the elderly is remembering to take medications on time. Smart robots can assist by reminding individuals when to take their medications and ensuring that they follow the correct dosage instructions. This integration of robotics with smart technology can help prevent medication errors and improve overall health outcomes.
- **Telemedicine:** For elderly individuals who may have difficulty traveling to medical facilities, smart robots can facilitate telemedicine consultations. These robots can connect patients with healthcare professionals remotely through smart interfaces, allowing for medical advice, diagnosis, and treatment without the need for physical visits. (Chen, T. L, 2014)

Smart technology and robots in social and psychological support

Smart technology and robots can also play a vital role in enhancing the social and psychological well-being of the elderly. They can provide companionship, facilitate social interactions, and offer entertainment. Here are some examples:

- **Companionship:** Many elderly individuals experience loneliness and social isolation, which can negatively impact their mental health. Smart robots designed for companionship can engage in conversations, provide emotional support, and even participate in activities with the elderly, helping to alleviate feelings of loneliness through sophisticated artificial intelligence.
- **Social Interaction:** Smart robots can help elderly individuals stay connected with their family and friends. They can assist with making phone calls, sending messages, and participating in video chats through smart devices, ensuring that elderly individuals maintain social connections and reduce social isolation.
- **Entertainment and Cognitive Stimulation:** Smart robots can offer various forms of entertainment, such as playing music, showing movies, or engaging in interactive games. These activities can provide cognitive stimulation and enhance the overall well-being of elderly individuals through interactive and intelligent interfaces. (Heerink, 2010)

Smart technology and robots in household tasks

Household chores can become increasingly challenging for elderly individuals, and smart robots can provide valuable assistance in this area. Here are some ways smart technology and robots can help:

- **Cleaning and Maintenance:** Smart robots such as robotic vacuum cleaners and floor moppers can keep the living environment clean and tidy with minimal effort from the elderly. This can reduce the physical strain associated with household cleaning tasks through automation and intelligent navigation.
- **Meal Preparation:** Smart robots designed for kitchen assistance can help with meal preparation, ensuring that elderly individuals have access to nutritious and freshly prepared meals. These robots can assist with tasks such as chopping ingredients, cooking, and even serving food using smart technology to enhance precision and safety.
- **Home Security:** Smart robots can enhance home security by monitoring the premises, detecting intruders, and alerting the elderly or emergency services if necessary. This can provide peace of mind and a sense of safety for elderly individuals living alone through intelligent surveillance systems. (Cesta, A., Cortellessa, 2007)

Challenges and opportunities

While the integration of smart technology and robots into the lives of the elderly offers numerous benefits, several challenges must be addressed to maximize their potential. Some of these challenges include:

- **Cost:** The high cost of advanced robotic systems and smart technology can be a significant barrier for many elderly individuals and their families. Finding ways to reduce costs and increase accessibility will be crucial in ensuring that these technologies can be widely adopted.
- **Acceptance of Technology:** Some elderly individuals may be resistant to adopting new technologies due to a lack of familiarity or fear of change. Providing education and training can help ease this transition and increase the acceptance of smart robotic assistance.

- **Privacy and Security:** The use of smart technology and robots raises concerns about privacy and data security. Ensuring that data collected by these systems are securely stored and used in compliance with privacy regulations is essential [2]. On the other hand, there are several opportunities that make the use of smart technology and robots an attractive option for elderly care:
- **Improved Quality of Life:** Smart technology and robots can significantly enhance the quality of life for elderly individuals by providing physical, emotional, and cognitive support. This can lead to greater independence and improved overall well-being.
- **Reduced Caregiver Burden:** Smart robots can alleviate some of the burdens faced by caregivers, allowing them to focus on more complex aspects of care. This can lead to more efficient and effective caregiving.
- **Access to Remote Areas:** Smart technology and robots can provide valuable services to elderly individuals living in remote or underserved areas, reducing disparities in access to care and support. (Broekens, J., Heerink, M., & Rosendal, H., 2009)

Technology and improving the quality of life in old age

The world's population is aging, meaning the number of elderly people is increasing, and they require care. Concurrently, the number of young people is decreasing, necessitating a higher workload to provide services to the aging population. Given these trends, the risk of not being able to adequately care for the elderly is increasing day by day. Researchers believe that technology is the solution to this problem. The use of artificial intelligence can enhance the quality of life and well-being of the elderly and disabled individuals. Telecare, telehealth services, smart devices, monitoring systems, personal alarms, and smart living devices all contribute to creating an independent, high-quality, safe, and healthy life for the elderly. With these tools, the elderly can engage in appropriate physical activity and social interaction without needing others, reducing the risk of physical ailments or social isolation. (Topol, E. J, 2015)

Welfare technology refers to the use of technology for safety, activity, health, participation, and independence for those at risk of disability. Additionally, welfare technology will become a profitable business and a field for innovation in the future. Despite all this, we must understand that technology is meant to create a better life and improve communication between people, utilizing smart devices for this purpose. (Peek, 2014)

Predicting the risk of falls in the elderly

Every year, millions of people, especially the elderly, are injured due to falls. As people age, the risk of falling increases. These falls can be very dangerous, leading to head injuries, fractures, hospitalization, and even death. Recently, the School of Nursing, in collaboration with the School of Engineering at the University of Missouri in the USA, has developed a method to predict the risk of falls in the elderly that can even notify nurses or caregivers up to three weeks in advance. (Centers for Disease Control and Prevention, 2017)

In this method, sensors in the living or care environment of the elderly record their walking and movement patterns. Software analyzes these recordings and, based on the walking speed, step size, balance, and changes in these parameters, predicts the likelihood of falls. It then notifies the elderly's relatives or caregivers via SMS or email. Data analysis has shown that a reduction in walking speed by five centimeters per second is associated with an 86% likelihood of a fall within the next three weeks. Additionally, a decrease in step size is associated with a 51% likelihood of a fall in the following three weeks. (Rantz, M. J., Galambos, C., & Chun, S. Y. 2017)

Technological solutions for elderly care

Researchers posit that technology, particularly artificial intelligence, can enhance the quality of life and well-being of the elderly and disabled individuals. Various technological tools, including telecare, telehealth services, smart devices, monitoring systems, personal alarms, and smart living devices, contribute to creating an independent, high-quality, safe, and healthy life for the elderly. These tools enable the elderly to engage in appropriate physical activity and social interaction without the need for constant assistance, thus reducing the risk of physical ailments or social isolation. (Topol, E. J. 2015)

Welfare technology

Welfare technology refers to the use of technology to enhance safety, activity, health, participation, and independence for those at risk of disability. Additionally, welfare technology is anticipated to become a profitable business and a field for innovation. It is crucial to understand that technology aims to create a better life and improve communication between people through the use of smart devices. (Peek, Luijkx. 2014). When designing these devices, it is essential to consider the needs and participation of the elderly. Organizations and individuals providing elderly care must transition from traditional methods to implementing technological solutions. The role of technology in elderly care depends on the design of specific technology, its application context, cultural habits, user skills, and knowledge. While the use of technology in elderly care can lead to integrated, efficient, patient-centered, and safe care, it may also result in fragmented, time-consuming, technology-centered, and risky care in some cases. (Peek, S. T. M., Wouters, 2016)

Neuro Rehab VR, which entered the market in 2017, is designed for elderly individuals requiring physical therapy, particularly after a stroke, brain injury, spinal cord injury, and neurological diseases. Each exercise is tailored based on the needs and abilities of the elderly person. During the exercises, both biological

activities and progress are assessed and scored. The virtual reality headset immerses the elderly in a virtual world where necessary movements and activities are performed as a game, helping them to forget about pain or physical limitations. For example, one scenario involves shopping at a grocery store where they must pick items from the shelves. (Howard, M. C, 2017). At first glance, it looks like an ordinary wristwatch, but this smartwatch, unveiled in 2018, has special features designed for the elderly. Connected to the internet, it quickly detects and reports falls, monitors vital signs and blood oxygen levels, controls physical activity and nutrition, and reports sleep quality. Additionally, it reminds the elderly to take their medication. If the elderly person falls, it notifies emergency services and up to five relatives via phone, email, or text message. The watch is waterproof, sweatproof, and charges with wrist movement. The monthly charge for this smartwatch ranges from $25 to $50. (Barnett, A., Cerin, E., & Baranowski, T, 2019)

Hasbro, a major toy manufacturer, produced robotic pets that could interact intelligently with children. However, they discovered that many of these toys were being purchased by elderly individuals. The interaction, companionship, and sense of calm and happiness these pets provided were especially beneficial for lonely elderly individuals or those in nursing homes. Consequently, in 2015, the company introduced these toys under the name "Joy for All." The cats and puppies have sensors that allow them to interact like real pets, with the cat rolling over when petted and the puppy's heartbeat slowing down when petted. In 2018, Hasbro launched the "Ageless Brand," selling 150,000 units to elderly individuals or care centers by 2019. These smart pets appear to be an effective method for reducing loneliness among the elderly. It is estimated that by 2050, the number of elderly people will double, reaching 20% of the population. (Wada, K., Shibata 2004)

The future of aging with technology

By 2040, life expectancy is projected to reach 100 years. Many diseases such as diabetes and heart disease will be eradicated, and cancers will be diagnosed and treated in time. The retirement age will increase, and instead of being cared for in nursing homes, the elderly will benefit from "care anywhere technology." The goal of care will be prevention, lifestyle changes, and empowering the elderly to thrive and progress. All elderly individuals will have extensive personal medical information that will be accessible from anywhere, leading to timely interventions for prevention or treatment. However, mental and psychological illnesses, behavioral disorders, loneliness, and suicide are likely to increase and require more attention. (World Health Organization, 2019)

In the future, with the Internet of Things (IoT), homes will become smart. This will allow the elderly to stay in their homes. There is a saying, "Home is where the heart is." In the future, home will also be where your heart's health is. In future homes, the elderly will be closely monitored and cared for by biosensors. Insurance coverage for elderly care will increase, and rarely will any elderly person be deprived of comprehensive care services. These advancements are primarily related to developed countries that have long-term plans for caring for their elderly. It is clear that our situation will depend on our behavior and planning. (National Institute on Aging, 2018)

The company that produces this robot was founded in 2016 with the aim of designing a robot to prevent the loneliness of the elderly. This robot, named ElliQ, helps the elderly connect with family and friends, engage in appropriate elderly behavior, remind them to take their medication, and stay connected to the outside world. ElliQ can greet you in 117 different ways in the morning. For example, it checks the weather and then describes it to the elderly, encouraging them to take a walk if the day is sunny and beautiful. Family members and friends can contact ElliQ and send their photos to it, which it will show to the elderly at different times. The price of this robot is $1,500. (Intuition Robotic, 2019)

In the next 30 years, the world will be filled with lonely elderly individuals who will need more help than anyone else. The word "robot" is derived from the Czech word "robota," which means "forced labor," and from the Slavic word "rab," meaning "slave." In 1921, Czech playwright and director Karel Čapek staged a play titled "Rossum's Universal Robots" (R.U.R) in Prague. The play is about Mr. Rossum, who dreams of creating artificial humans to exploit them in the materialistic Western world after World War I and establishes a factory for this purpose. In this play, the word "robot" is used for the first time in history to mean "artificial human." Today, this word reminds us of a technology that, with the help of artificial intelligence, is striving to transform the future in various fields. Among these, assistant robots, especially those developed to aid the elderly, seem to be receiving the most attention in a world that is rapidly aging. This is because, in the next 30 years, the world will be filled with lonely elderly individuals who will need more help than anyone else. (Arabshahi, H. 2020)

Reports from the World Health Organization show that due to the increase in human lifespan, the number of people aged 60 and over will increase by 12% to 21% over the next 35 years. Additionally, assessments by the United Nations indicate that the number of people aged 60 or older will reach 2.1 billion by 2050 and 3.1 billion by 2100, requiring a very high cost to hire human caregivers. Therefore, in the coming decades, assistant robots could be a cheaper option than human caregivers in nursing homes, providing care and emotional support, entertainment services, and cleanliness to the elderly. (World Health Organization, 2018)

In 2018, a group of researchers from Trinity College Dublin in Ireland, in collaboration with the University of Southern California, led by Conor McGinn, developed a robot named Stevie to explore how robots could be used in elderly care homes. Stevie is a white robot with a rotating base, short movable arms, an animated mouth, a head, and two eyes. Between 2018 and 2019, Stevie resided at the Knollwood Military Retirement Community in Washington, D.C., which houses about 300 elderly residents. This robot took on several entertainment

activities, such as playing bingo, which is popular among the elderly, singing solo songs, and mastering multiple languages. At night, Stevie roamed the hallways, checked the rooms, and if an elderly person needed help, informed the nurse and performed some cleaning tasks. These scientists stated about the interaction between the elderly and robots: "As people age, their peer groups shrink and their desire for physical activity decreases, which can lead to boredom and depression. But social robots can help alleviate some of these feelings, especially loneliness and isolation, by entertaining the elderly." The results of this experiment, published in 2022 in the journal Nature, showed that having an AI robot to help elderly individuals in care homes, hospitals, or even at home can be beneficial for many people, helping the elderly to be more independent and less reliant on caregivers and family members. (McGinn, 2022)

Today, many examples of personal assistant robots, especially those suitable for helping the elderly, have been introduced. Some of these robots are designed solely for companionship, entertaining the elderly, reminding them to take their medications, and contacting emergency services if needed. Others have additional skills, such as accompanying the elderly when walking.

- **SAM:** The robotic company Luvozo in Maryland, USA, established in 2013, developed a robot named SAM to help improve the quality of life for the elderly and physically disabled by providing daily companionship and preventing their isolation and falls. This smiling robot, human-sized, combines advanced technologies to offer frequent inspections and non-medical care. Especially in elderly care homes, one of SAM's goals is to reduce caregiving and nursing costs. The robot is equipped with displays and cameras that caregivers can use to track and ensure the well-being of the elderly while minimizing intervention and managing tasks efficiently. This humanoid robot also has sensors and special software that enable it to move and detect obstacles and hazards that can cause falls when the elderly are walking. (Luvozo, 2019)
- **IPal:** This humanoid assistant robot is designed to serve children and the elderly as a social companion, coach, and safety monitor. The mobile robot has legs equipped with wheels suitable for moving around the house. IPal can sing, dance, chat, and provide essential services. It has a wide range of motion in its arms and neck. The robot is slightly taller than one meter and weighs about 12.5 kg, and is equipped with an internal camera, five microphones, and Wi-Fi and Bluetooth capabilities. These features allow the robot to record videos and sounds of the elderly or children and send them to doctors and family members for better support. Additionally, IPal provides medication reminders and other health services and can contact emergency services if needed. (AvatarMind, 2020)
- **Care-O-Bot:** This intelligent mobile assistant robot is designed to help the elderly in their daily lives. The humanoid robot with a round head, arms, hands, and rolling base can perform a wide range of household tasks, including delivering food, drinks, and medication to the user, and assist with cooking and cleaning. The robot can also make emergency calls and host video calls between the elderly and their family members or doctors, even participating in the conversations itself. Care-O-Bot features a touch screen display, microphone, and speaker with multi-faceted user input capabilities. (Fraunhofer IPA, 2021)

Materials and Methods

This research was conducted using a descriptive and correlational method of structural equations. The statistical population of the present study includes all elderly residents of Tehran who do not live in nursing homes. According to the United Nations definition, elderly individuals include all persons over 60 years of age. Based on the available resources in structural equation modeling methodology, the sample size can be determined as between 5 to 15 observations per measured variable. This is expressed as $Q5 < n < Q15$, where Q is the number of observed variables or questionnaire items, and n is the sample size. In this study, Q, the number of measured variables, is equal to 15. According to the views of Tabachnick and Fidell (2013), the minimum sample size for structural equation modeling is 200. Therefore, considering various resources on sample size in structural equation modeling and accounting for errors, 409 individuals were selected as the sample. The sampling method used in this study was convenience sampling. As such, 409 elderly individuals visiting community centers under the supervision of the municipality from districts 1, 2, and 5 in Tehran were selected. The inclusion criteria for this study were: age over 60 years, residing in Tehran, no major cognitive disorders, and not residing in a nursing home. The exclusion criteria were: age below 60 years, not residing in Tehran, having major cognitive disorders such as dementia and Alzheimer's, and residing in a nursing home. Given that the present study is descriptive and the required data are quantitative, the data were collected through questionnaires. Additionally, considering the research sample consisted of elderly individuals and the related limitations of this age group, the questionnaires were completed in a face-to-face interview with the presence of an examiner. Prior to administering the questionnaires, the Mini-Mental State Examination (MMSE) was used to assess the absence of major cognitive disorders. The questions were administered as interviews by trained individuals. Each participant received four questionnaires. Each question was completed in the presence of an examiner to ensure the participant's correct understanding of the question and accurate selection of the desired option in the response form.(Iranian Aging Journal, 2024)

Results and Discussion

The objective of the present study was to determine the relationship between cognitive flexibility, social participation, and purpose in life with successful aging, mediated by the use of technology. The results indicated that cognitive flexibility, social participation, and purpose in life are associated with successful aging through the mediating role of technology use. This means that enhancing factors such as social participation, cognitive flexibility, and purpose in life, coupled with greater use of technology, increases the likelihood of achieving successful aging. Based on the findings of this study, cognitive flexibility has both direct and indirect relationships with successful aging, mediated by technology use. Cognitive flexibility empowers individuals to handle difficulties, challenges, and various emotional and social issues efficiently. Consistent with the results of this study, research has shown that higher cognitive flexibility leads to a more successful aging experience. This is because increasing cognitive flexibility and having its components in elderly individuals enables them to consider stressful situations as favorable conditions. When facing life events and relational challenges, they have the ability to adopt multiple alternative perspectives and replace difficult conditions with effective solutions. They can also reconstruct self-related thoughts positively and handle psychological problems effectively.

Moreover, numerous studies have shown that the use of technology increases successful aging. For instance, a study demonstrated how the relationship between elderly individuals and technology impacts their identification of capabilities and capacities, enhancing self-care, which is related to the subjective experience of successful aging.(Iranian Aging Journal, 2024)

In response to the question of how technology use mediates the achievement of successful aging, it can be attributed to the impact of cognitive flexibility on increasing technology use. One of the challenges elderly individuals face in using technology is the complexity of these tools and the lack of necessary digital skills in this area, particularly since many new technologies are not adapted for elderly age groups. Bali and colleagues (2024) explored the role of cognitive flexibility in enhancing digital skills in the use of new technologies such as computers and smartphones. They showed how cognitive flexibility, by increasing confidence in learning new technologies and reducing tech fear (which are emotional components), leads to higher digital skills and greater technology use.(Iranian Aging Journal, 2024)

In this study, 409 elderly individuals over the age of 60 participated, with their demographic information categorized by age, gender, education, and marital status, as reported in **Table 1**.

Table 1. Distribution of Demographic Characteristics of Participants

Variables	Frequency	Percentage
Age		
60 to 65 years	183	44.7%
66 to 70 years	134	32.8%
71 to 75 years	46	11.2%
76 to 80 years	31	7.6%
81 years and above	15	3.7%
Gender		
Female	219	53.5%
Male	190	46.5%
Education		
Below Diploma	37	9%
Diploma	209	51.1%
Bachelor's	121	29.6%
Master's	35	8.7%
PhD	7	1.7%
Marital Status		
Single	36	8.8%
Married	312	76.3%
Divorced	18	4.4%
Widowed	43	10.5%

The data were analyzed in two sections: descriptive and inferential statistical indices. **Table 2** reports the descriptive indices (mean, standard deviation) of the research variables by group.

Table 2. Descriptive Indices of Research Variables

Variable	Component	Mean	Standard Deviation
Use of Technology	Type of Use	11.5	5.2
	Software Use	5.8	2.7
	Type of Internet Use	11.4	5.2
	Use of Internet Services	18.1	6.9
Successful Aging	Healthy Lifestyle	17.2	3.0
	Adaptive Coping	24.1	3.3
	Interaction with Life	28.6	3.9
Cognitive Flexibility	Alternatives	36.2	8.9
	Control	5.1	1.4
	Human Behavior Alternatives	9.8	2.5
Social Participation	Social Participation	9.0	3.6
	Civic Participation	8.0	3.2
Purpose in Life	Purpose in Life	104.1	20.9

To evaluate the assumptions of the structural equation model, the normality of variables was calculated using the univariate normality assessment method. In the hypothetical model, the skewness of the observable variables ranged from an absolute value of 0.499 to 1.6, and their kurtosis ranged from 0.211 to 1.7. Pearson's correlation test was used to examine the relationships between the variables in this model. Using these relationships, structural equation modeling can be applied to evaluate this relationship in an integrated model. The results of the bivariate correlations are reported in **Table 3**.

Table 3. Correlation Matrix Between Research Variables

Variable	1	2	3	4
Successful Aging	1			
Use of Technology	**0.558**	1		
Purpose in Life	**0.457**	**0.627**	1	
Cognitive Flexibility	**0.466**	**0.355**	**0.284**	1
Social Participation	**0.529**	**0.403**	**0.390**	**0.495**

Note: **$\alpha \geq 0.01$**

The results from **Table 3** indicate that all research variables have significant correlation relationships at the level of $\alpha \leq 0.01$. Consequently, higher cognitive flexibility, social participation, purpose in life, and technology use lead to more successful aging. Before testing the research model, the assumptions of the normal distribution of variables and sample size were reviewed. These reviews indicated that the assumptions were not violated and that conditions were ready for the research model test. Additionally, in this model, to evaluate the assumption of multicollinearity between the independent variables, variance inflation factors and tolerance were used. As a result, no linear multicollinearity was found between the independent variables. The structural equation modeling method and the AMOS statistical software version 26 were used for the research model test. Given the complexity of the model and the number of observable variables, the Parceling Item model was used to comply with parsimony. Based on the available questionnaire characteristics, three parcels were considered for the variable "Purpose in Life." The Bootstrap method was used to assess the mediating role of the variables and to calculate significance levels in this research. The direct and indirect relationships of the research hypotheses are reported in **Table 4**.

Table 4. Coefficients and Significance of Relationships Between Research Variables

Independent Variable	Dependent Variable	Mediating Variable	Type of Relationship	Path Coefficient	Significance
Cognitive Flexibility	Successful Aging	Use of Technology	Direct	0.201	0.012
			Indirect	0.063	0.003
			Total	0.264	0.001
Social Participation	Successful Aging	Use of Technology	Direct	0.148	0.056
			Indirect	0.209	0.002
			Total	0.357	0.001
Purpose in Life	Successful Aging	Use of Technology	Direct	0.371	0.001
			Indirect	0.042	0.049
			Total	0.413	0.001

As shown in **Table 4**, all t-values are significant. For testing the mediating hypothesis, given the significance of the relationships between cognitive flexibility, social participation, and purpose in life with the use of technology, and their significance with successful aging, it can be concluded that the use of technology serves as a mediator between cognitive flexibility, social participation, and purpose in life with successful aging. According to the results in **Table 4**, the research hypotheses are confirmed. Consequently, the standardized and unstandardized research model, standardized path coefficients, and the error of each indicator are reported in Figures 2 and 3, respectively. (Iranian Aging Journal, 2024)

Conclusion

The results of this research show that cognitive flexibility, social participation, and purpose in life, along with increased use of technology, predict successful aging. These findings can highlight the importance of technology use for gerontology specialists and suggest that these professionals focus on strategies that facilitate access to and use of technology. Additionally, the results of this research can draw the attention of technology specialists to the necessity of developing new technologies that are specifically designed for the elderly and compatible with their characteristics and needs.

The future of elderly care is likely to be profoundly influenced by the integration of robots. By addressing healthcare needs, providing social and psychological support, and assisting with household tasks, robots have the potential to significantly improve the quality of life for elderly individuals. Robots can offer continuous health monitoring, timely medical interventions, and reminders for medication, thus reducing the risk of medical emergencies and promoting better health management. Moreover, they can facilitate telemedicine consultations, ensuring that elderly individuals have access to medical care without the need for physical visits to healthcare facilities. In the realm of social and psychological support, robots designed for companionship can alleviate loneliness and social isolation by engaging in conversations, providing emotional support, and helping the elderly maintain connections with family and friends. These social robots can also offer entertainment and cognitive stimulation through interactive activities, which can enhance mental well-being and reduce the risk of cognitive decline. For daily household tasks, robots can assist the elderly by performing cleaning, cooking, and home security functions.

This can reduce the physical strain associated with these tasks and allow elderly individuals to maintain their independence for a longer period. Robots equipped with smart technology can navigate their environment, detect obstacles, and ensure the safety and comfort of their users. While the integration of robots in elderly care presents significant opportunities, it also poses challenges such as the high cost of advanced robotic systems, the need for technology acceptance among the elderly, and concerns about privacy and data security. It is essential to develop affordable and user-friendly robotic solutions, provide education and training to facilitate technology adoption, and ensure that data collected by robots are securely stored and used in compliance with privacy regulations. Despite these challenges, the potential benefits of robotic assistance in elderly care are immense. Embracing these advancements can lead to a more inclusive and supportive environment for the aging population, ensuring that they can live with dignity and independence. As technology continues to evolve, it is crucial to prioritize the needs and preferences of the elderly in the design and implementation of robotic solutions. By doing so, we can create a future where the elderly are empowered to lead fulfilling and autonomous lives, supported by the innovations of modern technology. (World Health Organization, 2021)

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