

Voice Assistant for Avoiding Sedentariness in Elderly People Based on IoT Technologies

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Abstract

The rapidly expanding field of home automation can potentially revolutionize how people live. Other home automation systems assist those with particular requirements, such as the elderly and handicapped, while others appeal to those looking for wealthy and sophisticated platforms. Many social groups now have access to information and services that were previously unavailable because of the age-based digital divide, thanks to the rising popularity of virtual assistants like Siri, Google Assistant, and Alexa. Older people can now accomplish tasks and access services and apps more easily. Seniors may prevent sedentary habits by integrating Internet of Things (IoT) technologies and virtual voice assistants. But creating these appliances to work with the bulk of commercially available home automation systems' control units and each other is a hurdle.

Those who are elderly or disabled could need outside help getting about, while those who live alone might need help around the home. A voice-controlled home automation system has been created to help consumers solve this problem by enabling them to carry out particular operations using just their voices. The system also includes a hand-held device (remote) that allows users to swiftly provide commands without needing to approach the microphone. The interaction between older people and those with disabilities and their homes and surroundings might be revolutionized by this technology, encouraging more independence and self-sufficiency (Alwasel, 2020)

Keywords: voice assistant, voice commerce, artificial intelligence, Home automation, Elderly, Disability.

1. Introduction

By 2030, 23.8% of Europeans will be 65 or older, up from 20% now, according to the European Commission's "Ageing Europe" report. Most seniors also prefer staying home. As a consequence, there has been an upsurge in researchers aiming to speed up the aging process in senior living facilities and boost this population's accessibility to information and communications technology (ICT) (Valera Román, 2021).

On the one hand, several studies have concentrated on improving the living environment of older persons by utilizing home automation systems that streamline everyday activities and include ambient intelligence ideas like context-aware adaptation and Internet of Things (IoT) device utilization (Singh, 2015). However, these systems may be difficult for this demographic due to variables typically associated with aging, such as a lack of ICT skills or health issues. However, most of this population has difficulty accessing the most recent technology, prompting several researchers to create new entry points to make new technologies available to this expanding part of the population (Dobrinsky, 2006).

Parallel to this, the area of voice assistants (VAs) has seen a considerable change due to advances in natural language processing and related processes like voice processing and synthesis (Chaurasiya, 2022). The voice assistants (Google Assistant, Alexa, Siri, etc.) released by major technology firms like Google, Amazon, and Apple and other open-source initiatives provide a fully natural communication interface (Natale, 2010). A lot of the voice assistants that are now on the market also offer programmers the option to create features (sometimes referred to as "skills" or "actions") that can communicate with both the user and objects in the user's surroundings (El-Nasr, 2006). Because 56 million people use smart speakers and 90 million in

the US alone question their virtual assistants on smartphones at least once monthly, statistics on VA use are becoming increasingly important (Kepuska, 2018).

This user interface has a lot of promise for older folks because of its ease of use and short learning curve. Additionally, it offers the chance to easily incorporate it as a distinctive user interface with home automation gadgets and other internet-based services, such as news, multimedia, and e-commerce (Sin, 2021).

Because they have established communication networks that enable different smart gadgets to speak with one another, smart home automation systems vary somewhat from those in traditional houses (Ur, 2013). The capacity to monitor and regulate a home's operation is made possible by integrated communication systems, allowing residents to choose among the available amenities (Siano, 2014). Modern homes have various strategies, such as central heating and cooling, fire and security alarms, home theatres, TVs, and lights. These systems and gadgets often operate in total isolation from one another (Mitchell, 1999). A smart house, on the other hand, has the potential to transmit data and commands between numerous installed systems and gadgets. These facilities and controls make improved local and remote control possible, which also meets special requirements like senior services (Semunab, 2018).

2. Background

The research covers the digital divide, voice assistants, smart home technology, disabled users, and ambient intelligence. This section discusses these themes and the article's analysis (Benda NC, 2022).

The phrase “digital divide” has tremendously influenced society since the dawn of the digital era. Scientific literature often discusses the difference between people accessing different information and communication technologies and those without (Graham, 2011). Other experts have emphasized that the digital divide has multiple dimensions and levels. The digital range has three levels: internet access, knowledge and usage, and online service results (Van Deursen, 2019). Several interrelated factors drive the digital divide. Key factors include:

The digital gap is related to the disparity in incomes among the people. At the start of the Internet era, digital gadgets were costly, and not everyone could afford them (Schradie, 2011). Economic differences are still a problem and contribute to the digital divide in many countries (Fang, 2022). Structural barriers and prejudice may influence the digital gap between various races they experience (Kvasny, 2005).

People with disabilities sometimes have trouble utilizing the internet because they need specific equipment that may be expensive and occasionally hard to get. For those without access to these particular technical tools, using the internet requires a third party's help (Ee Kim, 2012).

At employment, men predominate in technology. Most women are drawn to non-technical sectors by conventional schooling patterns. There is a considerable gender gap in technical occupations—the digital gap results from these factors and laws in certain countries (Sey, 2021).

Many older people struggle to access and learn how to use the internet. Because these people were not exposed to digital technology and the digital age while they were young, they are referred to as “digital immigrants” (Selwyn, 2004). Although some have developed digital skills, most do not because of various problems, including security worries, lack of support, desire, memory loss, expense, and lack of assistance. Some reside in regions without internet or subpar-quality networks (Hollis, 2017).

2.1. Voice Assistants

Voice assistants allow voice contact. Speech synthesis, conversation systems, voice recognition, and natural language processing help it understand and communicate with people. The user starts the discussion by asking the VA to do a job. The communication between the user and the VA is two-way. By connecting to smart home gadgets, home assistants like the Amazon Echo and Google Home provide many affordances and accessibility options. Research indicates that despite being a new technology, consumers are likelier to be happy with it if they give the item a personality (Iannizzotto, 2018).

Voice assistants make simple commands for home automation systems and other routine duties. Still, they have now developed the ability to conduct more complex discussions and provide answers. Although spoken words may be converted to text using APIs, language comprehension is still difficult owing to the variety of human expressions (Portet, 2013). Machines can “understand” user inquiries thanks to contemporary natural language understanding methods like tokenization, entity identification, sentiment analysis, and purpose and subject detection. Pertinent data is retrieved from databases like Wikipedia and Google’s

knowledge graphs. The replies are then generated using rule-based and generative approaches and spoken after being transformed from the text (Dobransky, 2006).

2.2. Smart Home Technology and Users with Disabilities

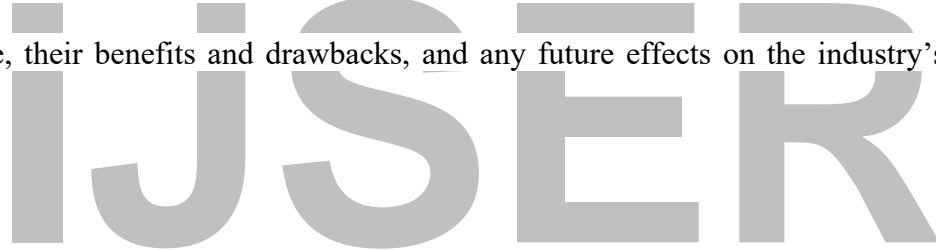
People with disabilities have significantly benefited from innovative home technology, but many options have been prohibitively costly or have only been researched prototypes up until recently. According to studies, the most requested characteristics of smart homes, especially among older persons, were emergency help, health monitoring, and environmental management (Chen, 2020). However, there are challenges with pricing, cost-dependence, and privacy and security concerns. It's interesting to note that persons with disabilities could be more inclined than those without disabilities to share and record data from smart homes (Graham, 2011). Studies have demonstrated that users with multiple sclerosis and mobility disorders, as well as older folks and those with visual impairments, prefer voice-based control (Iannizzotto, 2018). However, owing to the extensive usage of smart home technologies, voice control may have disadvantages, such as accessibility concerns for those with non-continuous speech and reduced perceived power compared to manual input (Blasimme, 2019).

3. Voice Assistants in Healthcare

The ability to connect with technology through speech has made voice assistants like Amazon Alexa and Google Assistant more and more popular in recent years. These systems can be used in various fields, including healthcare (Hoy, 2018). Today, medical operations such as diagnosis, treatment, and surgery employ voice assistants. As healthcare professionals are expected to analyze data more and more remotely, chatbots—voice assistants that utilize natural

language processing (NLP) to engage with patients—have been used to gather information on patient’s health issues, symptoms, or disease processes (Benda NC, 2022).

Using voice assistants in the medical field presents both possibilities and difficulties. On the one side, voice assistants may provide patients with a quicker and more convenient method to contact their medical professionals (Stanberry, 2000). On the other hand, there are issues with the accuracy and dependability of the technology, as well as worries about the confidentiality and privacy of patient data. In this post, we’ll look at the several ways voice assistants are used in healthcare, their benefits and drawbacks, and any future effects on the industry’s future (Paul, 1999).



3.1 Healthcare Applications for voice assistants

Voice assistants have several uses in the healthcare industry, from patient involvement and education to diagnosis and treatment. The capacity of voice assistants to provide patients with quick access to health information is one of its most essential features. Patients may get precise and trustworthy information in real-time regarding their diseases, symptoms, and medications by asking questions and receiving answers. By reminding patients to take their pills and monitoring their compliance, voice assistants may also aid patients with medication adherence (Chen, 2020).

The diagnosis and treatment of medical disorders is another way that voice assistants are used in healthcare. Voice assistants may aid medical professionals in gathering information about a patient’s symptoms and medical history using NLP technology, enabling more precise and effective diagnosis and treatment. Patients may get personalized treatment programs from voice assistants based on their medical background, current health, and lifestyle (Blasimme, 2019).

Voice assistants are also employed to provide patients with counseling and assistance for their mental health. Voice assistants may aid patients with depression, anxiety, and other mental health disorders by recommending tailored coping mechanisms and urging them to seek professional assistance utilizing NLP technology. Voice assistants may also provide guided meditations and mindfulness activities to help patients manage stress and enhance their mental health (Werner, 2020).

3.2 Healthcare Voice Assistants' Benefits

Giving patients simple access to information and medical services is one of the key benefits of adopting voice assistants in healthcare. Patients may utilize voice assistants to obtain drugs, arrange appointments, and inquire about their health without leaving their homes. Patients with mobility difficulties or those living in distant places would significantly benefit from this (Kelly, 2021).

The capacity of voice assistants to enhance patient involvement and education is another benefit in the healthcare industry. Personalized information and services from voice assistants may inspire people to participate in their healthcare, improving health outcomes. Voice assistants may also provide patients with timely health feedback to encourage lifestyle and medical changes (Javaid, 2023).

Additionally, voice assistants may increase productivity and save time for healthcare professionals. Voice assistants may gather information about a patient's symptoms and medical background using NLP technology, which enables medical professionals to diagnose patients more precisely and quickly. Voice assistants may also aid healthcare professionals in managing

their calendars and appointments, freeing up more time for patient care and less administrative work (Chaurasiya, 2022).

3.3 Voice Assistants' Drawbacks in Healthcare

While adopting voice assistants in healthcare has numerous potential benefits, there are also several possible drawbacks. Patient data security and privacy are two of the critical issues. Voice assistants gather and retain sensitive personal data, such as medical history, prescription use, and other details. Patients must have control over their information and be secured from illegal access (Liao, 2020).

While adopting voice assistants in healthcare has numerous potential benefits, there are also several possible drawbacks. Patient data security and privacy are two of the critical issues. Voice assistants gather and retain sensitive personal data, such as medical history, prescription use, and other details. Patients must be able to select who may access their data, and that information must be safeguarded from illegal access (Agarwal, 2022).

There are worries regarding the accuracy and dependability of voice assistants in healthcare and security and privacy issues. Although these systems have made great strides in comprehending and interpreting speech, they are prone to mistakes and misinterpretations. This is especially troubling in a hospital context when patients may suffer significantly due to erroneous information (Elderkin-Thompson, 2001).

Voice assistants in healthcare might potentially replace human contact and care, which is a drawback. These programs may help gather data and give basic instructions but cannot replace

a human healthcare provider's knowledge and compassion. Patients may feel abandoned or deserted, especially with complicated or continuing healthcare demands (Graham, 2011).

Concerns about voice assistants' use in the medical field have also been raised. Although certain patients, such as those with visual impairments, may benefit from these technologies, not all patients can utilize them. For instance, people with speech or communication impairments could find using these devices challenging (Ur, 2013).

Voice assistants may also exacerbate healthcare inequities. Patients who utilize these tools properly may get better care than those who don't. Overall, adopting voice assistants in healthcare has numerous advantages and drawbacks that should be considered. Security and privacy problems and difficulties with accuracy and dependability must be carefully considered. To avoid replacing human contact and care and to make voice assistants accessible to all patients, the function of voice assistants in healthcare must also be carefully studied. The general use of these systems must be prevented from worsening already-existing healthcare disparities. Thus efforts must be taken in this direction as well (Chen, 2020).

4. The rise of voice assistants for shopping

Voice assistants for shopping have grown in popularity recently. This trend is driven by smart speakers like the Amazon Echo and Google Home, allowing consumers to shop with voice-based virtual assistants like Alexa and Google Assistant. Voice assistants simplify shopping. Users may place orders, add goods to shopping lists, and monitor rankings with simple commands without a keyboard or a screen. Busy or multitasking users may not have the time or attention to traverse a regular online purchasing experience (Ee Kim, 2012).

Personalization is another benefit of utilizing voice assistants while shopping. Numerous voice assistants are made to gradually understand users' preferences and purchasing patterns and

provide individualized recommendations and suggestions. By eliminating items they are unlikely to be interested in, consumers may save time and effort and learn about new brands and goods they would not have otherwise investigated. Using voice assistants for shopping may be more interesting and enjoyable than conventional internet shopping, in addition to being convenient and personalized. Many voice assistants are built to be conversational and engaging, employing personality and humor to engage consumers and improve the shopping experience. Users and their virtual assistants may develop a feeling of loyalty and trust, which may enhance sales and encourage repeat business (Ehsani, 1998).

Using voice assistants for shopping has several possible disadvantages besides these benefits. The issues of security and privacy are among the primary ones. Voice assistants collect sensitive data, including shopping preferences, purchase history, home addresses, and credit card details. Users must restrict data access and protect it from unauthorized access. Accuracy and dependability might be another issue. Although voice assistants have made great strides in their comprehension and interpretation of speech, they are prone to mistakes and misinterpretations. This may be especially troublesome when users shop and depend on their virtual assistants to make necessary purchases. Concerns have also been raised concerning the likelihood that voice assistants would reinforce preexisting prejudices and disparities in the buying process (Hepperle, 2019). For instance, if a virtual assistant is set up to provide suggestions based on a user's prior purchases, it might unintentionally reinforce existing prejudices and preconceptions. Similarly, if a virtual assistant is not built to support users with impairments or communication issues, it may restrict such users from participating in online shopping (Günay, 2022).

The development of voice assistants for shopping has raised concerns that it may further undermine existing retail employment. The need for human salespeople, cashiers, and other retail

professionals may decline if more and more purchases are made through virtual assistants. This may significantly impact the economy as well as the employment market. The trend of voice assistants being used for shopping in the next years is expected to continue. While utilizing virtual assistants for shopping has numerous benefits, several possible disadvantages must be carefully examined (Rafaeli, 1987). The use of voice assistants in the context of shopping requires careful consideration of concerns related to security, accuracy, bias, and job displacement (Zeng, 2017).

5. Functional characteristics of voice assistants

VAs can contextually comprehend and react to requests, learn from errors, and communicate organically with customers (Kinsella, 2018). Honest discussion distinguishes this new channel. Voice assistants resemble human communication. VAs interact like humans when summoned. VAs may “remember” significant details from past dialogues, producing consistency (Mari, 2019).

Vas is context-aware. Any information that may characterize an important occurrence to consumers is a device’s context (Lafia, 2019). Context-aware computing examines a device’s surroundings to adjust services to contextual clues, including the user’s identity, location, time, date, purchase history, and preferences (Pradhan, 2018). VA will be context-aware if it personalizes its interactions with humans and machines. Context is essential to learn priorities and automating tasks (Pridmore, 2020).

Self-learning helps VAs understand consumers’ language and eliminate friction. VAs may now automatically remedy bad interactions and comprehension issues thanks to unsupervised systems, which operate without human annotation. If a user says “Play ‘Good for What’” when they mean “Nice for What” by Drake, the VA will correct them and start a music

request. The system swiftly addresses accuracy issues after learning how. VAs may learn faster by automatically updating several simple questions (Paschek, 2020).

6. Interactional characteristics of voice assistants

Voice assistants are designed to converse with users in a friendly and natural way. These gadgets use machine learning and natural language processing (NLP) to comprehend spoken language and react correctly. Voice assistants must have certain interactional qualities to improve user experience and make the technology more widely available (Bharti, 2020).

The capacity of voice assistants to distinguish between various accents and dialects is one of its primary capabilities. This is accomplished using NLP algorithms, which examine the speech's linguistic and acoustic characteristics to determine the language and precise words and phrases. To increase their accuracy and decrease linguistic interpretation mistakes, voice assistants are trained on enormous datasets of spoken language. The capacity of voice assistants to comprehend context is another crucial feature (Ehsani, 1998). Voice assistants employ context cues to interpret a user's request and provide pertinent information or instructions. For instance, the voice assistant will utilize location information to deliver a detailed weather report for the user's present location if the user asks, "What's the weather like?"

Additionally, voice assistants can customize their replies following user preferences and past communications. By observing user behavior, they may make adjustments to their answers. For instance, if a user often uses a voice assistant to order a certain kind of meal, the device could recommend that choice first in the future. Additionally, voice assistants are made to seem accessible and kind. They avoid seeming robotic or mechanical by speaking in a way that sounds

genuine. Users have a more delightful and engaging gadget engagement as a result (Wienrich, 2021).

Voice assistants' capacity for multitasking is another quality. They can carry out numerous tasks simultaneously, such as playing music while giving weather updates or taking a call while setting a timer. This capability allows users to utilize voice assistants more easily and quickly (Hoy, 2018).

The interactional features of voice assistants do have certain restrictions, however. For instance, voice assistants may have trouble comprehending complicated questions or identifying specific accents and dialects. Additionally, they could struggle to distinguish between many users or provide individualized replies in communal areas. Further, some consumers' adoption of voice assistants may be constrained by privacy concerns around the gathering and storing of speech data (Pal, 2019).

Voice assistants must have certain interactional qualities to improve user experience and make the technology more widely available. While these traits have certain limits, advances in NLP and machine learning continually enhance voice assistants' precision and efficacy. Voice assistants are poised to become an increasingly bigger part of everyday life as technology advances, notably in retail and shopping settings (Iannizzotto, 2018).

7.1. Household IPA Devices and privacy debates

Amazon Echo, Google Home, and Apple HomePod are becoming more popular, raising privacy worries. These gadgets have an always-on microphone that listens for a wake word or phrase to conduct a command or operation. These gadgets are convenient, but their constant listening raises privacy and data security issues. These gadgets may record conversations without

the wake word, a major worry. Sounds or phrases that resemble the wake word may activate the devices. Third parties may access these records, violating privacy (Sacks, 2018). In 2019, hundreds of Amazon workers listened to Alexa speech recordings to update the software. This caused a public uproar and prompted questions about how these gadgets utilize data (Valera Román, 2021).

These gadgets might be hacked, exposing sensitive data. Researchers were able to hack an Amazon Echo and convert it into a listening device in 2018. Amazon soon patched the issue, but this event exposed the hazards of these devices. These gadgets gather data that raises privacy issues. IPA devices must save voice recordings and personal data to work. This data may enhance device performance and give tailored suggestions and services (Ramaswamy, 2015). Concerns have been raised concerning how this data is utilized and if it is shared with other parties for marketing or other reasons. Large tech businesses storing and using user data may also bother them (Heartfield, 2018).

Some firms have included privacy measures to address these concerns. Alexa lets customers review, delete, and deactivate voice recordings. Google Home devices offer speech recording deletion. These functionalities are typically hidden in device settings and may not be available to all users. Household IPA devices have raised privacy and data security issues. These gadgets are convenient, but they pose hazards. Companies must address these issues by increasing device security and privacy and being honest about data collection and usage (Meng, 2021).

7.2. Platform Logic and surveillance capitalism

Platform logic refers to the basic economic principles that govern digital platforms like Facebook, Google, Amazon, and others. These systems acquire massive amounts of user data by monitoring user activity, collecting data from smartphones and smart speakers, and analyzing user behavior patterns. Then, this information is utilized to develop user profiles, customize and target advertising, and train machine learning algorithms (Sadowski, 2020).

This economic strategy, which fundamentally entails monetizing user data, has been called “surveillance capitalism.” Targeted advertising is the main source of income for businesses like Google and Facebook, and the more user data they have, the more lucrative that advertising is (Zuboff, 2015).

The possibility for personal data to be misused is one of the major issues that the growth of surveillance capitalism has brought up. As the Cambridge Analytica incident showed, companies may exploit this data to influence political campaigns or sway public opinion. Because algorithms might reinforce existing inequities when taught on partial data, there are also worries about the possibility of discrimination (Iannizzotto, 2018).

Furthermore, the massive collection of personal data has important privacy consequences. The privacy of family talks is an issue due to the growing usage of smart speakers and other voice-activated devices in the home. Due to their constant listening capabilities, these gadgets can secretly record users’ private conversations. There are still worries about the possibility of data breaches or abuse of this data, even though firms like Amazon and Google have developed

privacy tools to address these issues, such as enabling users to erase speech recordings or deactivate the voice activation capability (Hoy, 2018).

Data breaches and misuse are concerns. Companies may use data for market research, sharing, or personalized advertising. GDPR and CCPA have been passed to address these challenges, although their efficacy is unknown.

Platform logic and surveillance capitalism have made voice assistants and smart speakers viable but have also caused severe privacy and data exploitation issues. As these technologies increasingly integrate into our daily lives, we must consider the repercussions of this business model and how to properly and ethically gather and utilize personal data (Agarwal, 2022).

8. Conclusion

Voice-controlled conversational interfaces and home-based IPAs are becoming more popular. Thus disabled people should help develop them. Voice-based systems now make potential contributions. It decreases the manual effort required to acquire and identify the command for operating household appliances and improves the quality of life for impaired individuals in communities. VA should be seen as a supplement to multimodal digital solutions for elders. However, there are still accessibility concerns with voice input and output and issues with the device ecosystem. The goal is to provide voice control over some of the most significant household appliances. It is meant to provide individuals with a healthy and enjoyable lifestyle. Patients who cannot read or use technology may prefer smart speaker-delivered voice-only content. Home care for seniors uses artificial intelligence to help them live well and safely. The future design must be more streamlined, user-friendly, and able to operate several appliances.

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