

Designing AURA: Integrating Stakeholder Insights into an IoT-Based System for Chronic Illness Management

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Abstract

Background: Chronic illnesses often impair mobility, memory, and daily functioning, creating challenges for both patients and caregivers. Smart Internet of Things (IoT) technologies offer promising solutions by enabling real-time monitoring and personalized support for physical and cognitive needs. The initial Audio and Radio connected (AURA) system was designed as a conceptual IoT-based solution integrating Wi-Fi sensing and voice assistance to enhance independence, safety, and quality of life.

Objective: This study aims to explore stakeholders' needs and preferences for using smart IoT monitoring and assistive technology to support home care, in order to inform the development of AURA prototype's essential features and functionalities for chronic illness management.

Methods: Semi-structured interviews were conducted with 5 patients and their caregivers who have Alzheimer's Disease and Related Dementias (ADRD) and 6 patients who were post-ostomy creation for colorectal or bladder cancer treatment. Input from additional stakeholders, including 2 healthcare providers, 2 community health workers, and 2 computer scientists, were also included in the report. Participants were introduced to the initial AURA system design through a video demonstration. A thematic analysis was employed to identify themes, guided by the extended Unified Theory of Acceptance and Use of Technology (UTAUT2).

Results: Five themes about stakeholders' needs and preferences for using smart IoT monitoring and assistive technology emerged: (1) Performance Expectancy, highlighting the need for cognitive support among ADRD stakeholders and physical health management for cancer patients; (2) Effort Expectancy, emphasizing simplicity for ADRD users and practicality for cancer patients; (3) Social Influence, revealing the critical roles of caregivers and clinicians in system adoption; (4) Facilitating Conditions, addressing barriers such as technological literacy and physical fatigue while identifying features to allow system customization and healthcare integration as facilitators; and (5) Hedonic Motivation, focusing on social engagement and emotional well-being for ADRD stakeholders and physical activity encouragement for cancer patients.

Conclusions: Stakeholders provided critical insights into the distinct needs and preferences of diverse populations to guide the development of the AURA prototype. By integrating these insights, AURA has the potential to deliver a user-centered, scalable solution that enhances independence, safety, and quality of life for patients with chronic illnesses. Future work will involve prototyping and real-world testing to refine AURA's design and functionality.

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Original Manuscript

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Abstract

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Keywords: Chronic Disease; Internet of Things; Assistive Technology; Self-Management; Cancer; Alzheimer's Disease

Introduction

Chronic conditions significantly impact the daily lives of patients and their caregivers by inducing challenges in maintaining independence, managing health, and ensuring safety.[1] These challenges stem from two major areas: these populations' physical impairments, which limit mobility and daily functioning[2], and cognitive impairments, which hinder memory, decision-making, and other functions that are critical for activities of daily living (ADL) [3]. Smart Internet of Things (IoT) technologies offer transformative solutions to support patients and caregivers in addressing these ADL challenges by seamlessly integrating data collection, real-time monitoring, and assistive features into daily living environments.

Smart IoT: An Overview

Smart IoT technologies represent a network of interconnected devices and sensors that communicate and share data to enable automated, real-time responses tailored to individual needs.[4] In healthcare, IoT devices have become increasingly valuable in tracking health metrics, enhancing communication between patients and providers, and automating care processes to reduce the burden on both patients and caregivers.[5] By leveraging advancements in wireless communication, data analytics, and machine learning, IoT systems can deliver highly personalized support to individuals managing chronic conditions.[6]

Applications of IoT in Monitoring Physical and Cognitive Impairments

For individuals with physical impairment, IoT-enabled monitoring systems can provide crucial assistance by tracking activity levels[7], detecting falls[8], and managing medical devices such as ostomy bags or wearable sensors[9, 10]. For individuals with cognitive impairment, IoT technologies offer substantial benefits by supporting patients and caregivers in addressing the ADL issues caused by memory and decision-making challenges. Voice-assistive technologies powered by natural language processing (NLP) can deliver personalized reminders for tasks such as taking medications, eating meals, or attending appointments.[11] Meanwhile, health monitoring systems empowered by IoT, such as Wi-Fi sensing or motion detectors, can noninvasively detect deviations in daily routines, potential safety issues, or the need for caregiver intervention.[12] Additionally, IoT systems can foster social interaction and reduce isolation and loneliness by providing reminders for social activities or virtual interactions through web-based chat, videoconferencing, group chat, and email. [13]

Introducing the Initial AURA System

Inspired by participants' needs identified during our previous PRISMS study [14], the research team designed the AUdio and RAdio connected (AURA) system. Leveraging IoT technology, AURA aims to address the challenges of managing chronic illnesses by providing smart health monitoring and assistance solutions. The initial AURA system integrates Wi-Fi sensing with voice-assistive functionalities to enable real-time activity tracking, personalized reminders, and context-aware alerts. By offering personalized support for both physical and cognitive impairments, AURA seeks to enhance independence, safety, and quality of life (QoL) while reducing caregiver burden.

To support the development of the prototype of AURA in addressing the multitude of challenges induced by chronic illnesses, this study aims to identify stakeholders' needs and preferences for using smart IoT monitoring and assistive technology that may shape AURA's essential features and functionalities for effective chronic illness management. The findings will inform a user-centered, scalable solution to transform home care for chronic illness management, ultimately enhancing health outcomes and QoL of these populations.

Methods

Study Design

This study employed a qualitative, exploratory design to collect the needs and preferences for the smart IoT system, AURA. Data were collected through semi-structured interviews with patients and caregivers from two distinct populations representing physical and cognitive impairments. Feedback from healthcare providers, community health workers, and computer scientists was also collected through interviews. The study protocols were reviewed and approved by the institutional review board (IRB) of the University of Texas Health Science Center at San Antonio (UT Health San Antonio) (IRB#20210261HU & 20220750HU).

Participants

Stakeholders who were enrolled in this study include patients with ADRD and their caregivers, cancer patients who have an ostomy, healthcare providers, community health workers, and computer scientists.

Eligible patients with ADRD and their caregivers must meet the following criteria: 1) the patient must be diagnosed with mild cognitive impairment (MCI) or early-stage ADRD by their referral clinician and have at least one caregiver living in the same household for at least 4 hours per day for at least the past 6 months; 2) both individuals must be at least of 18 years of age; 3) both individuals must have sufficient vision and speaking capabilities to use a voice-assistive system; 4) both individuals live in a community setting or assisted living setting.

Eligible cancer patients must meet the following criteria: 1) have an ostomy with curative intent for treatment of bladder or colorectal cancer; 2) be 18 years or older; 3) be able to read and speak English. Patients were excluded if they: 1) were unable to read, speak, or understand English; 2) had more than one type of ostomy; 3) had other cancer diagnoses (excluding non-melanomatous skin cancer).

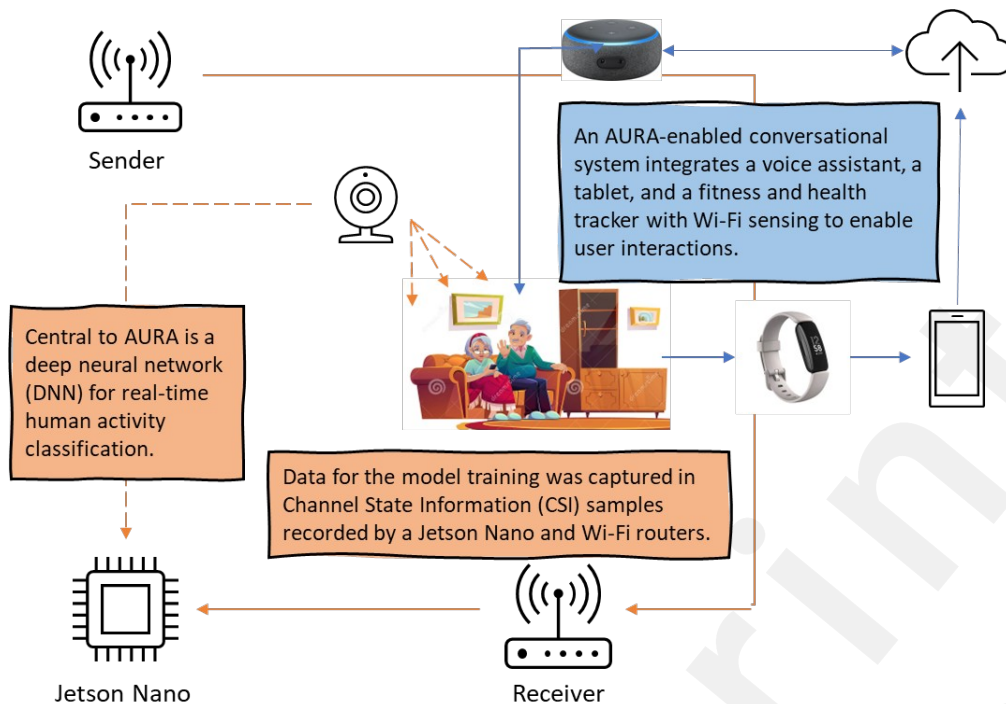
Healthcare providers (a neuropsychologist and a geriatrician) and two community health workers who provide direct care and service to cancer and ADRD patients were recruited to provide input on patients' needs and their feedback on AURA. Two computer scientists were recruited to provide recommendations on the system's development.

Initial AURA System

AURA system combines cutting-edge technologies to provide personalized, real-time support while remaining minimally intrusive (see Figure 1). At the heart of the system is a deep neural network (DNN)[15] trained on Channel State Information (CSI) data collected from Wi-Fi signals[16], a type of radio frequency (RF) sensing. Wi-Fi routers and a machine learning model running on Jetson Nano[®] can unobtrusively record and analyze user activities, enabling real-time human activity classification without requiring wearable devices.[17] This passive monitoring approach ensures consistent tracking of behaviors while preserving user comfort and privacy. In addition to its monitoring capabilities, AURA envisions the integration of voice-assistive and wearable technologies, including an Alexa and a health tracker, e.g., FitBit[®]. These interactive tools were designed to allow users to engage with the system intuitively, offering features such as reminders, personalized alerts, and health-related guidance. For example, users could receive prompts to take medications, check their health status, or maintain daily routines, all of which will be tailored to their

specific needs and conditions.

Figure 1. Initial AURA System



Setting and Procedures

Eligible ADRD patients and caregivers were referred by clinicians from the Geriatrics and Palliative Care Clinic. Eligible cancer patients were referred by a clinician from the Mays Cancer Center Urologic Oncology Clinic, all from UT Health San Antonio. After confirming eligibility by chart review of the medical records, the research team contacted the eligible patients and their caregivers. Participants were scheduled for the interview at the School of Nursing Community Simulation Lab if they were willing to participate.

During the visits, participants signed consent forms after their questions were answered. They were then introduced to the initial AURA system through a video demonstration showcasing its core infrastructures, including Wi-Fi sensing for passive monitoring and voice-assistive features for real-time alerts and reminders. Participants were asked to perform a series of standardized activities designed to be detected by the Wi-Fi sensing system. The activity sequence included: 1) leaving the testing room unoccupied for 30 seconds, then entering the room; 2) walking across the room 10 times (5 vertical, 5 horizontal, and 5 random paths); 3) sitting down and standing up 5 times; 4) drinking water 3 times; 5) eating food 3 times; 6) simulating a fall onto a yoga mat while standing up from a chair (for participants without mobility limitations); 7) standing up and walking to the center of the room; 8) performing basic exercises (clapping, waving, jumping, and running) each repeated 5 times; and 9) engaging in random daily activities for 30 minutes (see Figure 2). The Wi-Fi CSI data were collected to refine the DNN learning model for activity monitoring.

Figure 2. Examples of standardized activities



In the end, we conducted 30-45-minute semi-structured interviews, allowing patients and caregivers to share feedback, together or separately, based on their preferences. The interviews focused on gathering insights into participants' needs and preferences to inform essential features and functionalities of the AURA prototype for addressing care needs at home. All interviews were tape-recorded using a digital recorder and transcribed verbatim.

Other stakeholders, including two healthcare providers, two community health workers, and two computer scientists, were interviewed via Zoom®. They were introduced to the initial AURA system through the same video we demonstrated to the patient and caregiver participants. The same interview guide collected other stakeholders' feedback about patients' needs and their perspectives to guide the AURA design and development.

Data Analysis

We followed Braun and Clarke's thematic analysis framework[18] for data analysis, with additional guidance from the extended Unified Theory of Acceptance and Use of Technology (UTAUT2) framework[19]. NVivo™ 14[20] was used to assist in organizing and coding data. The thematic data analysis process consisted of the following five iterative steps.

1. Familiarization with the Data

The research team reviewed the transcribed data to ensure accuracy and a comprehensive understanding of the content. Repeated readings of the transcripts were conducted to reflect initial impressions and identify overarching narratives relevant to the development of AURA.

2. Generating Initial Codes

Two researchers (JL & DG) independently performed open coding to identify meaningful data segments related to stakeholder needs and preferences for AURA. This initial coding aimed to identify the needs and preferences that may shape AURA's essential features and functionalities. Coding discrepancies were resolved through discussion among researchers (JL, DG, LS & XW), ensuring inter-coder reliability.

3. Searching for Recurring Themes Across Stakeholder Groups

The UTAUT2 framework was applied to systematically structure and categorize the data. The UTAUT2 framework is an extension of the original UTAUT model, which was developed to examine technology acceptance in consumer contexts.[21] In UTAUT, there are four foundational constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions, which collectively explain the drivers of technology adoption.[19] UTAUT2 builds up on UTAUT and introduces three additional constructs (hedonic motivation, price value, and habit) to capture the

nuanced factors influencing behavioral intention and technology use in voluntary, consumer-driven settings. UTAUT2 offers a comprehensive framework for understanding how consumers perceive and adopt new technologies. This makes it particularly relevant for evaluating innovative solutions like AURA, designed for care support.

This step, conducted by researchers JL & DG, involved identifying recurring themes related to the following constructs:

Performance Expectancy. Stakeholders' perceptions of the benefits AURA could provide in supporting health outcomes and caregiving tasks.

Effort Expectancy. The system's ease of use and perceived simplicity, particularly for individuals with physical or cognitive challenges.

Social Influence. The impact of caregivers, clinicians, and social networks on the potential adoption of AURA.

Facilitating Conditions. The resources and infrastructure required to support the adoption and integration of AURA into daily care routines.

Hedonic motivation. Hedonic motivation and habit were examined to capture nuanced user preferences and identify potential barriers to adoption.

4. Reviewing and Refining Themes

Identified themes were refined by researchers (JL, DG & XW) to ensure consistency and alignment with stakeholder feedback. This iterative process involved reviewing themes for overlap, redundancy, and relevance to the study's aim of informing the development of AURA. Any inconsistencies were resolved collaboratively among the research team members to maintain the integrity of the analysis.

5. Defining and Naming Themes

Each theme was clearly defined in relation to the research aims and the UTAUT2 constructs by researchers (JL & DG). Detailed descriptions and illustrative quotes were used to support and contextualize each theme, ensuring their interpretive robustness and relevance to AURA development.

Results

Patient Participant Demographics

The study included 11 patient participants: five patients with ADRD and six cancer patients with ostomies. The mean age of the participants was 78.7 ± 6.6 years. Among the five ADRD participants, three were female, all were non-Hispanic white except for one male Hispanic participant, and four were married. Regarding education levels, all patients held at least a bachelor's degree, and three had post-graduate degrees. Primary caregivers included spouses ($n = 4$) and adult children ($n = 1$).

The cancer patient group had an equal gender distribution (three females and three males). Most participants ($n = 4$) identified as non-Hispanic white, while the remaining identified as Hispanic.

Marital status varied with three married, one widowed, and two divorced. Among participating patients, five had at least a bachelor's degree, and one reported completing high school. The types of ostomies among cancer patients included urostomies (n = 5) and colostomies (n = 1). Detailed demographic information for patient participants is provided in Table 1.

Table 1. Patient Participants Characteristics

	Gender	Age	Marital Status	Race/ Ethnicity	Education Level	Caregiver	Type of Ostomy
<i>Patients with ADRD (n=5)</i>							
A1	Male	89	Widowed	Hispanic	College	Daughter	--
A2	Female	89	Married	White	Post-graduate degree	Husband	--
A3	Female	72	Married	White	College	Wife	--
A4	Male	82	Married	White	Post-graduate degree	Wife	--
A5	Female	80	Married	White	Post-graduate degree	Husband	--
<i>Cancer Patients with Ostomies (n=6)</i>							
C1	Female	75	Divorced	Hispanic	College	--	Colostomy
C2	Male	80	Married	Hispanic	College	--	Urostomy
C3	Female	78	Widowed	White	Post-graduate degree	--	Urostomy
C4	Female	80	Divorced	White	High school	--	Urostomy
C5	Male	68	Married	White	Post-graduate degree	--	Urostomy
C6	Male	73	Married	White	College	--	Urostomy

Major Themes of Stakeholders' Needs and Preferences

This study investigated stakeholders' needs and preferences related to the initial AURA system to support patients with chronic illness management. The patients with ADRD and their caregivers and cancer patients with ostomies represented cognitive and physical impairments, respectively. Other stakeholders, including two healthcare providers, two community health workers, and two computer scientists, provided insights into the usability, acceptability, and desired functionalities of the system, revealing contrasting needs and priorities across the two populations. Guided by the UTAUT2 framework, five major themes about stakeholders' needs and preferences for using this type of smart IoT monitoring and assistive technology emerged (See Table 2).

Table 2. Summary of Stakeholders' Needs and Preferences

Major Themes		Stakeholders' Needs and Preferences	
		ADRD Stakeholders	Cancer Stakeholders
1. Performance Expectancy		• Need support for routines (e.g., medications, meals, hydration) • Emphasize emotional/social engagement	• Prioritize physical health management (e.g., activity tracking, bag change reminders) • Emphasize EHR integration
2. Effort Expectancy		• Require simple, intuitive design • Prefer one- or two-step voice commands to avoid cognitive overload	• Tolerate moderate complexity if functional • Prefer practical, streamlined interfaces without unnecessary features
3. Social		• Caregivers are primary decision-	• Clinician endorsement builds trust

Influence	makers • Want features that ease caregiving, especially when caregivers are not present	
4. Facilitating Conditions	• Barriers include low-tech literacy and privacy concerns • Facilitators include perceived caregiving support	• Barriers include physical fatigue and device maintenance • Facilitators include customization and healthcare sync
5. Hedonic Motivation	• Emphasize social connection, emotional engagement, and cognitive stimulation through interactive features	• Interested in motivation for physical activity and habit formation

Theme 1: Performance Expectancy

Stakeholders across both groups highlighted the potential benefits of the AURA system in improving daily life and reducing caregiving burdens.

ADRD stakeholders need support for routines (e.g., medications, meals, hydration)

For ADRD stakeholders, the focus was on the system's ability to support cognitive tasks and routines (e.g., taking medications, having meals, keeping patients hydrated, etc.), which are essential for maintaining daily functionality. A caregiver explained, *"It's all about routine. If the system can help maintain that, it would take a load off me."* This highlights the pressing need for tools that not only assist in task management but also provide consistency in care.

The importance of reminders for medications and meals was frequently mentioned, with participants appreciating how such features could help reduce their own stress. One caregiver shared, *"If the system can remind them about medications and meals without waiting for them to ask, it would be a huge help."*

ADRD stakeholders emphasize emotional/social engagement

Beyond routine management, participants saw potential in the system to foster emotional and social engagement. A participant noted, *"If AURA could prompt him to talk to a family member or remind him to join an activity, it would really reduce his isolation."* This reflects the dual benefit of supporting caregiving tasks while also addressing patients' emotional well-being, which participants linked to improved QoL. Below are a few more exemplary quotes.

"Something that keeps them engaged socially and emotionally would make a big difference."

"Just having a system to be part of their day-to-day routine, like a family member almost, could be transformative."

Cancer stakeholders prioritize physical health management (e.g., activity tracking, bag change reminders)

Cancer patients with ostomies, on the other hand, focused on physical health management as their primary need. For these participants, practical features like activity tracking and ostomy bag change reminders were seen as transformative.

“Tracking my activity levels and reminding me to change my bag before it’s too late would be life-changing.”

“Reminders for bag changes or tracking how long I’ve been active—those would make things so much easier.”

“It’s reassuring to know something is monitoring me, especially when I’m on my own. It gives peace of mind.”

Cancer stakeholders emphasize EHR integration

The ability to integrate with healthcare systems further enhanced the perceived value of the system. Participants expressed a desire for seamless communication with clinicians, with one noting, *“Sharing my health data with my doctor could prevent unnecessary visits and give me more confidence in managing my care.”* These comments also underscore how AURA could address physical and emotional needs.

Theme 2: Effort Expectancy

Ease of use emerged as a critical consideration for stakeholders, though expectations differed between the two groups.

ADRD stakeholders require a simple, intuitive design

For ADRD participants and their caregivers, simplicity was paramount. Participants highlighted the importance of clear and intuitive design, as exemplified by the neuropsychologist's remark: *“If it’s too complicated, they won’t use it. It needs to be as simple as turning on a light switch.”* A caregiver echoed, *“I don’t want to spend hours teaching them how to use it. It should just work.”* This reflects the necessity for a system that minimizes cognitive strain for users with impairments.

ADRD stakeholders prefer one- or two-step voice commands to avoid cognitive overload

Voice interfaces were frequently mentioned as a solution, with stakeholders emphasizing the need for one- or two-step commands. One geriatrician explained, *“If you overload them with commands or steps, it just won’t work. They’ll shut down.”* This further explains that AURA can better serve individuals with limited technological experience by reducing complex commands.

Cancer stakeholders tolerate moderate complexity if functional

In contrast, cancer patients demonstrated a higher tolerance for complexity, provided the system delivered meaningful benefits. A participant explained, *“I’m okay learning how to use something if it really helps me keep track of my care.”*

Cancer stakeholders prefer practical, streamlined interfaces without unnecessary features

While this group was open to learning, they still valued streamlined interfaces.

“I don’t need all the bells and whistles. Just make it practical.”

“I don’t need a bunch of extras. Just give me a simple system that does the basics well.”

These inputs reflect participants’ preference for a system that is simple, functional, and free of unnecessary features.

Theme 3: Social Influence

Social influence refers to the impact of opinions and behaviors of non-patient stakeholders on the decision to adopt and use AURA. In this study, we observed that caregivers and clinicians played a pivotal role in the acceptance of the AURA system.

ADRD caregivers are primary decision-makers

For ADRD participants, caregivers were often the primary decision-makers. Their evaluations focused on how the system could significantly assist patients while alleviating their caregiving burden. One caregiver stated, *“If it helps me manage their medications and appointments, I’ll absolutely support using it.”* Participants described caregivers as both end-users and primary influencers in decisions about system use.

ADRD stakeholders want features that ease caregiving, especially when caregivers are not present

Caregivers also emphasized the importance of having a system that could support patients during times when they were not physically present. One participant shared, *“Caregivers need something that can fill in the gaps when we’re not around.”* Another elaborated, *“A system that reminds them and keeps track of things when I’m not there—it would make a huge difference for both of us.”* Participants described a need for features that assist with patient monitoring and task reminders in the caregiver’s absence.

Cancer stakeholders believe clinician endorsement builds trust

For cancer patients, clinician endorsement was a significant factor in building trust and encouraging adoption. One participant remarked, *“If my doctor tells me it’s useful, I’m more likely to trust it.”* Another echoed this sentiment, noting, *“Knowing my healthcare team can access the data makes me feel more confident.”* Participants indicated that integration with their healthcare team increased their confidence in the system’s relevance and reliability.

Theme 4: Facilitating Conditions

Barriers and facilitators to adoption varied across the two groups.

Barriers for ADRD stakeholders include low-tech literacy and privacy concerns

ADRD stakeholders identified technological literacy and privacy concerns as significant barriers. Caregivers and healthcare providers frequently noted that older adults often struggled with technology. One healthcare provider remarked, *“They’re not tech-savvy, so anything overly complicated won’t work.”* Another added, *“Technology is hard for older adults. If something goes wrong with the internet, they might not know how to fix it.”* These challenges highlight the need for robust support systems and fail-safe mechanisms to address user concerns.

Privacy was another prominent concern, with participants emphasizing the importance of data security. One participant stated, *“I worry about who else might have access to the data. We want to feel safe, not monitored.”*

Facilitators for ADRD stakeholders include perceived caregiving support

Despite these challenges, many participants recognized the system’s potential. As one caregiver put it, *“If it can help me manage daily routines, that’s worth overcoming the tech challenges.”*

Barriers for cancer stakeholders include physical fatigue and device maintenance

Cancer patients, on the other hand, focused more on physical barriers such as fatigue and device maintenance. One participant explained, *“Some days, I don’t have the energy to keep up with everything. The system needs to be low maintenance.”*

Facilitators for cancer stakeholders include customization and healthcare sync

Facilitators for this group included customization and integration with healthcare platforms. A participant noted, *“If it syncs with my doctor’s system and reminds me to do things like hydrate or exercise, that would be a game-changer.”*

Theme 5: Hedonic Motivation

ADRD stakeholders emphasize social connection, emotional engagement, and cognitive stimulation through interactive features

While both groups valued practical applications of the system, emotional and social benefits were emphasized primarily by ADRD stakeholders. For this group, social engagement features were seen as essential.

“Sometimes they just need a reminder to call a family member or take a break—it helps them feel less isolated.”

“Engagement features that give them something to look forward to would be wonderful.”

Participants also highlighted the value of mental stimulation. One caregiver noted, *“Features that*

promote mental stimulation, like games or conversation prompts, could really improve their mood and quality of life.” Participants expressed interest in features that support emotional well-being by providing cognitively engaging and uplifting experiences.

Cancer stakeholders are interested in motivation for physical activity and habit formation

Cancer patients focused less on hedonic motivation but expressed an interest in features that encouraged physical activity. One participant shared, *“Having a system reminds me to move, even if just a little, keeps me motivated to stay active.”* Another added, *“Something that motivates me to get up and move, even a little bit, would be great.”* These responses reflect the potential for the system to support healthier habits and improve overall QoL.

Discussion

This study explored stakeholders' needs and preferences, mostly older adult patients aged 70 years and older with either physical or cognitive impairments, to inform the development of a preliminary smart IoT, AURA, a user-centered solution designed to support chronic illness management. Guided by the UTAUT2 framework, the thematic analysis results revealed distinct yet complementary need and preference priorities across two target populations - patients with ADRD and their caregivers and cancer patients with ostomies, as well as valuable insights from healthcare providers, community health workers, and computer scientists. These key themes underscore the importance of developing smart systems that address personalized cognitive and physical care needs while offering valuable guidance for optimizing AURA's design and functionality to ensure its acceptability and effectiveness.

Performance Expectancy

Stakeholders across both groups recognized the potential of AURA to support ADL and reduce caregiving burdens, but their needs and preferences differed significantly. For ADRD stakeholders, the system's ability to provide cognitive support through reminders for medications, meals, and activities was critical. These findings are consistent with the systematic review that the ability of passive monitoring and assistive technologies to provide immediate and tangible benefits, such as enhanced safety and support for daily routines, facilitates acceptance and adherence.[22] Emotional well-being and social engagement also emerged as important findings, with participants emphasizing the need for features that combat isolation and foster interaction.

Conversely, cancer patients with ostomies prioritized physical health management, particularly features like activity tracking, fall detection, and ostomy bag maintenance reminders. Integration with healthcare systems was also a key expectation, reflecting the importance of seamless communication with clinicians to improve care coordination. Interestingly, this group placed less emphasis on emotional support, diverging from the literature that underscores the psychosocial needs of cancer survivors.[23] These findings suggest that cancer patients may prioritize practical, health-focused functionalities over emotional engagement tools.

Effort Expectancy

Ease of use was universally important, yet expectations differed for participants. ADRD stakeholders emphasized the need for simplicity, with preferences for intuitive design and minimal steps to reduce cognitive strain. They also preferred voice commands and intuitive interfaces as key facilitators and worried that complex systems would likely result in disengagement. In contrast, cancer stakeholders demonstrated a higher tolerance for a complex system as long as it effectively met their health

management needs. Although they also favored practicality and intuitive interfaces, this group prioritized a balance between essential functions and ease of use. These findings not only align with studies showing that simplicity and ease of use are critical to technology adoption among older adults[24] but also highlight the need for a flexible system design that adapts to varying user capabilities and expectations.

Social Influence

The stakeholders highlighted the vital role of caregivers and clinicians in shaping the acceptance and adoption of the AURA system. For ADRD stakeholders, caregivers acted as gatekeepers and decision-makers, which underscores the importance of designing a system that alleviates caregiving burdens and enhances patient care and well-being. They emphasized the importance of features that could provide continuity of care when they are unavailable. This aligns with existing research emphasizing the central role of caregivers in technology adoption for patients with dementia.[25]

For cancer patients, clinician endorsement and integration with healthcare platforms emerged as critical facilitators in building trust and encouraging system adoption. Integrating AURA with healthcare systems was viewed as critical for enhancing its perceived value and credibility, which reflects the importance of clinician-patient collaboration in chronic disease management.[26]

Facilitating Conditions

Barriers to adopting the AURA system varied across the two groups. ADRD stakeholders identified technological literacy and privacy concerns as major challenges. Older adults often struggle with managing complex technology, and privacy concerns related to voice-assistive devices like Alexa[®] were particularly commonly expressed.[27] Despite these barriers, participants acknowledged the system's potential to support caregiving when caregivers are not available and improve routine care management. Cancer patients highlighted barriers such as physical fatigue and the complexity of device maintenance. Customization options and integration with healthcare platforms were identified as key facilitating factors for system adoption, which is consistent with research emphasizing the value of interoperability in healthcare technologies.[28] Addressing these barriers will ensure the long-term success of supportive digital health systems such as AURA.

Hedonic Motivation

While both groups valued practical applications, ADRD stakeholders particularly preferred features for emotional support and social engagement to improve emotional well-being and reduce isolation, which highlights the system's potential to enhance QoL beyond basic caregiving tasks. In contrast, cancer patients focused less on hedonic motivation but appreciated features that encouraged physical activity and health tracking, which demonstrates the system's potential to support physical health and healthy behaviors.

Summary: Implications for AURA Development

The findings highlight the need for AURA to be adaptable and customizable to meet the distinct needs of diverse populations. For ADRD patients and caregivers, simplified interfaces, proactive reminders, and privacy safeguards are essential. For cancer patients, advanced health tracking, customization, and seamless healthcare integration are critical. By integrating these features, the system can provide personalized, context-aware support that enhances independence, safety, and QoL.

Limitations and Future Directions

This study focused on two elderly populations with distinct care needs for chronic illness self-

management in home settings, which may not fully represent the broader spectrum of chronic conditions. Future research should explore the applicability of smart IoT systems to other patient groups and settings. Additionally, the majority of our participants are white Americans despite the team's efforts to recruit a diverse population, which may limit the generalizability of our findings. Future research should further strategize effective enrollment of stakeholders of people of minorities to elicit diverse perspectives and experiences with technologies and smart IoT system development. Finally, testing a functional prototype in real-world environments will provide valuable insights into usability, effectiveness, and scalability.

Conclusion

This study examined stakeholders' perspectives on the smart IoT system AURA for supporting patients with ADRD and cancer patients with ostomies, along with stakeholders of healthcare providers, community health workers, and computer scientists. By applying the UTAUT2 framework, this study provides a structured understanding of stakeholder needs and preferences for using this type of technology that varied between the ADRD and cancer stakeholders. Integrating these different yet complimentary stakeholder inputs, this study provides valuable guidance for developing a user-centered smart IoT system that enhances the supportive care for chronic illness self-management in home settings, such as supporting ADL, facilitating social engagement, promoting healthy behaviors, all of which will improve the QOL of patients while alleviating caregiving burdens for patients with chronic illnesses. Future work should focus on functionality refining to enhance prototypes and real-world testing to assess the system's impact on caregiving and self-care at home.

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Conflict of Interest

The authors have no relevant financial or non-financial interests to disclose.

Abbreviations

ADL: activities of daily living

ADRD: Alzheimer's Disease and Related Dementias

AURA: AUdio and RAdio connected system

CSI: Channel State Information

DNN: deep neural network

IoT: Internet of Things

IRB: Institutional Review Board

MCI: mild cognitive impairment

NLP: natural language processing

QoL: quality of life

RF: radio frequency

UTAUT2: extended Unified Theory of Acceptance and Use of Technology

UT Health San Antonio: the University of Texas Health Science Center at San Antonio

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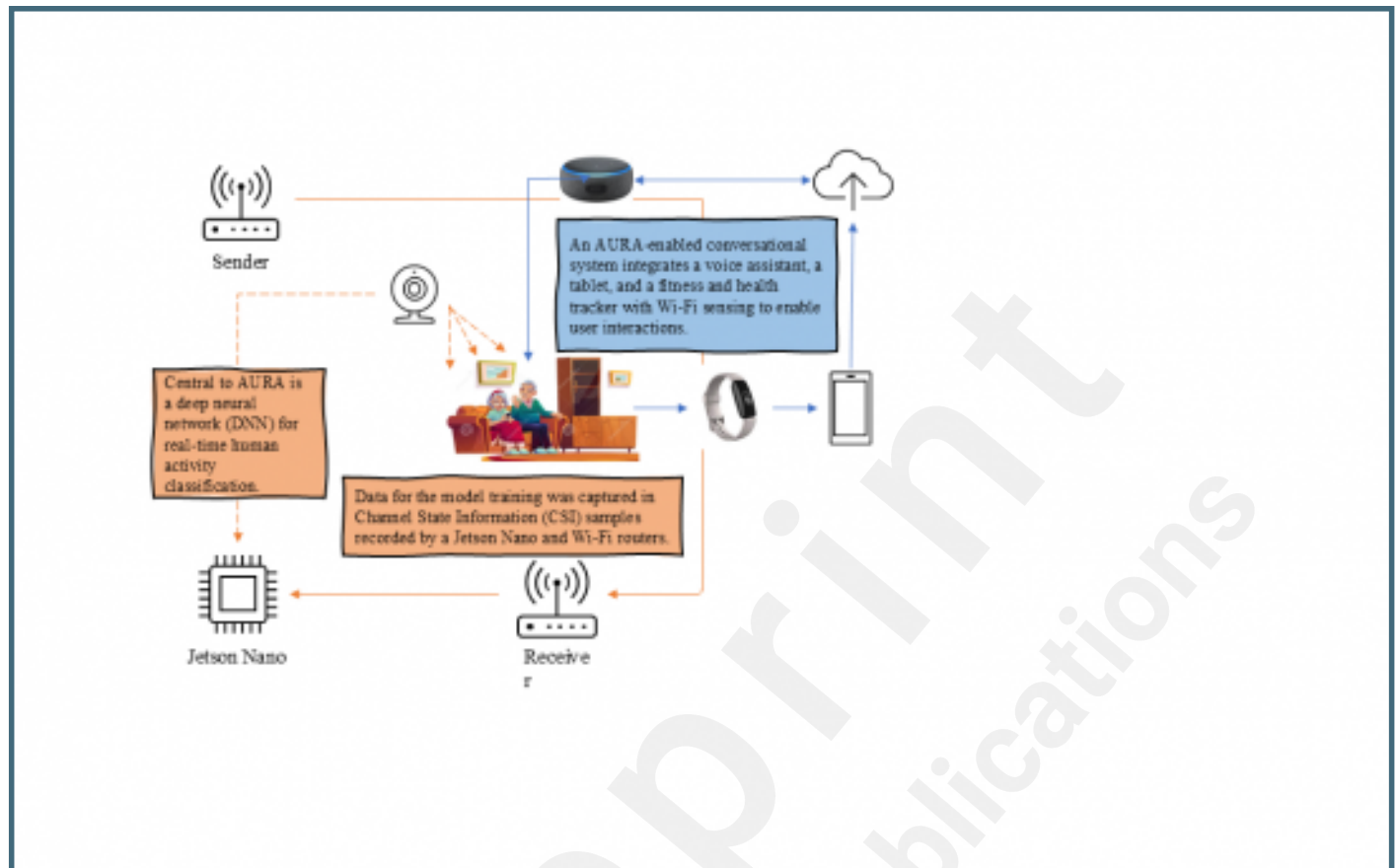
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Supplementary Files

Figures

Initial AURA system.



Examples of standardized activities.

