SAR (Social Assistive Robots)

Creating a New Era of Dementia Care with Socially Assistive Robots

Overview

The SAR (Social Assistive Robots) project was developed to address the increasing challenges of dementia care by integrating robotics and caregiving. The robot was designed to interact with older adults suffering from dementia, offering a wide range of functionalities, including medication management, cognitive stimulation through games like trivia, playing music, having conversations, and connecting patients with their families via video calls.

The project successfully combined academic and industry efforts, with a focus on developing a user-friendly and effective solution that can be used in real-world nursing home environments. The client played a crucial role in the development, serving as both the UX researcher and project manager to ensure that the research and technical development were aligned.

ROLE	DURATION	TEAM SIZE
Product Designer User Researcher Project Manager	5 Months Design	10

The Challenge

Addressing the Multidimensional Struggles of Dementia Care

Caring for individuals with dementia is a multifaceted challenge that affects both caregivers and patients:

- **Caregiver Strain:** Family caregivers often provide 24/7 care, leading to emotional and physical burnout.
- **Complex Needs:** Caregivers juggle medication reminders, emotional support, and cognitive engagement, creating a high stress environment.
- **Isolation:** The demands of caregiving can leave caregivers feeling isolated and overwhelmed.
- **Patient Struggles:** Patients face confusion, memory loss, and diminished social connections, leading to frustration and increased isolation.

Current dementia care solutions often lack the integration of social and functional support, highlighting the need for a more comprehensive and holistic approach.

My Role and Responsibilities

Leading Research and Development

As the project manager and UX researcher, I played a pivotal role throughout the SAR project, wearing multiple hats to ensure its success. My key responsibilities included:

1. Research Leadership:

- ✓ Conducted literature reviews to inform design decisions.
- ✓ Led ethnographic studies and user interviews with caregivers and patients to uncover pain points and needs.
- ✓ Performed task analysis to map caregiving workflows and identify areas for improvement.

2. Collaboration and Communication:

- ✓ Acted as the liaison between the research team (professors, students) and the development team.
- ✓ Used Python to work closely with developers, ensuring that the robot's language processing and functionality aligned with research insights.

3. Design and Development:

- ✓ Wrote use stories to guide development based on user feedback.
- ✓ Contributed to the robot's response development, ensuring that the interactions felt natural and intuitive for both caregivers and patients.

4. Project Management:

- ✓ Managed the alignment of research and development throughout the project lifecycle.
- ✓ Coordinated timelines, ensuring that milestones were met and the project stayed on track.

Our Primary Objectives

Crafting the Future of Dementia Care

The objectives of the SAR project were designed to address the gaps in current dementia care solutions:

01 **Enhance Patient Engagement:**
Provide cognitive and emotional stimulation, reducing isolation.

02 **Support Caregivers:**
Automate medication management and provide reminders, reducing caregiver burden.

03 **Foster Family Connections:**
Enable video calls to connect patients with family members.

03 **Create a User-Friendly Experience:**
Ensure both caregivers and patients could easily interact with the technology.

Discovery and Research

Design Process and Approach

Iterative Development Meets User-Centered Design

The design process followed a user-centered approach, beginning with in-depth ethnographic studies to understand the caregiving process and the needs of both patients and caregivers. The project then entered an iterative phase, where prototypes were built and tested with real users. Each iteration was informed by user feedback, ensuring that the SAR robot remained functional, engaging, and easy to use.

Research Methods

A Comprehensive Approach to User-Centered Design

The development of the SAR robot was grounded in thorough and diverse research methods, ensuring that the final product met the needs of both caregivers and patients. These research methods included:

Literature Review

A deep dive into existing studies on socially assistive robots, dementia care, and caregiving challenges to identify gaps in the market and opportunities for innovation.

Ethnographic Study

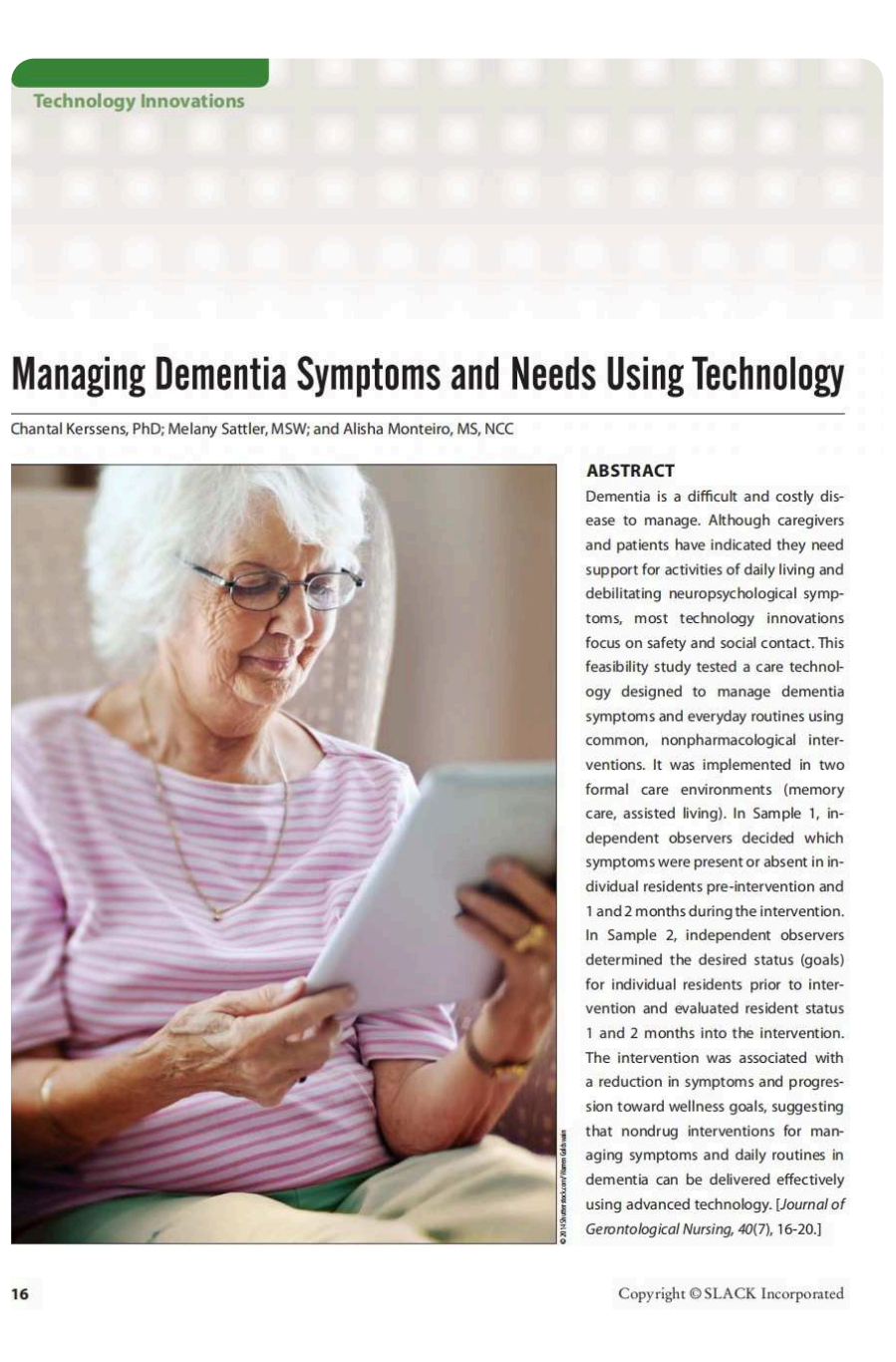
Immersive observation of caregiving routines and interactions between caregivers and patients to understand their day-to-day challenges, emotional needs, and task management strategies.

User Interviews

Conducting one-on-one interviews with both caregivers and patients to gather detailed insights into their experiences, expectations, and frustrations with current caregiving solutions.

Task Analysis

Mapping out caregiver workflows and identifying key pain points, such as medication management, reminders, and emotional engagement, which could be improved through automation and technology.



Technology Innovations

Managing Dementia Symptoms and Needs Using Technology

Chantal Kerssens, PhD; Melany Sattler, MSW; and Alisha Monteiro, MS, NCC

ABSTRACT

Dementia is a difficult and costly disease to manage. Although caregivers and patients have indicated they need support for activities of daily living and debilitating neuropsychological symptoms, most technology innovations focus on safety and social contact. This feasibility study tested a care technology designed to manage dementia symptoms and everyday routines using common, nonpharmacological interventions. It was implemented in two formal care environments (memory care, assisted living). In Sample 1, independent observers decided which symptoms were present or absent in individual residents pre-intervention and 1 and 2 months during the intervention. In Sample 2, independent observers determined the desired status (goals) for individual residents prior to intervention and evaluated resident status 1 and 2 months into the intervention. The intervention was associated with a reduction in symptoms and progression toward wellness goals, suggesting that nondrug interventions for managing symptoms and daily routines in dementia can be delivered effectively using advanced technology. [*Journal of Gerontological Nursing, 40*(7), 16-20.]

16

Copyright © SLACK Incorporated

These findings highlighted the need for a cohesive design strategy to address user pain points and unlock the platform's potential.

UX Research & Insights

Understanding the Needs of Caregivers and Patients

Research uncovered several critical insights:

Caregiver Strain

Caregivers Were Struggling With The Emotional And Physical Demands Of Their Roles, Leading To High Stress Levels.

Patient Engagement

Patients With Dementia Had Limited Interaction With Their Environment, Leading To Cognitive Decline And Isolation.

Need For Personalization

Caregivers And Patients Both Needed More Personalized Care Solutions That Could Adapt To Individual Needs And Preferences.

These findings highlighted the need for a cohesive design strategy to address user pain points and unlock the platform's potential.

Competitive Analysis

Standing Out in the Market of Assistive Technologies

The SAR robot competes in a rapidly growing field of assistive technologies, but it stands out for its unique combination of social interaction and practical caregiving functions. Key findings from major competitors include:

Competitor x Factor	Paro	Care-o-bot	AIBO
Target Audience	Dementia patients	Elderly and disabled individuals	Elderly and individuals needing companionship
Primary Focus	Emotional support and comfort	Physical assistance and mobility	Companionship and play
Medication Management	No	No	No
Cognitive Stimulation	Limited (simple engagement)	No	No
Emotional Support	Yes	Limited	Limited
Personalized Interaction	No	No	No
Physical Assistance	No	Yes (mobility, navigation)	No
Social Engagement	Minimal (comforting interaction)	No	Yes (limited social interaction)

Key Takeaways:

Paro and **AIBO** are focused on emotional support and companionship, but lack features like medication management and cognitive stimulation.

Care-o-bot excels in physical assistance but does not address the social or emotional needs of dementia patients, making it less comprehensive than SAR.

SAR will offer a unique combination of social interaction, cognitive stimulation, and practical caregiving, setting it apart from other robots that focus on a single area (e.g., emotional support, physical assistance).

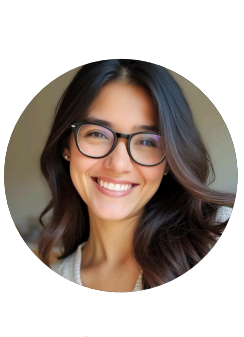
User Personas

Understanding the People We're Designing For

The primary personas included:

- **Caregivers**: Family members and professional caregivers who manage daily caregiving tasks and are looking for tools to alleviate stress and provide more effective care.
- **Patients**: Elderly individuals with varying stages of dementia who benefit from structured cognitive and emotional engagement.

Caregiver Persona: Laura



Laura

45

Family caregiver for her mother

Pain Points:

- Overwhelmed by managing medication schedules, coordinating family visits, and providing emotional support.

Goals

- To reduce caregiving stress, improve her mother's quality of life, and stay connected with family.

Patient Persona: James

James

72

Early-stage dementia

Pain Points:

- Struggles with memory, isolation, and difficulty staying engaged in activities.

Goals

- To stay mentally stimulated, connected with family, and manage daily tasks more independently.

The Proposed Solution

A Socially Intelligent Robot for Dementia Care

The SAR system is a multifaceted robot designed to assist with both caregiving tasks and emotional engagement.
Key features include:

01

Medication Management

- Timely reminders and alerts ensure that patients take their medications on schedule.

02

Cognitive Engagement

- Trivia games, music, and personalized activities are used to engage patients and stimulate cognitive functions.

03

Family Connection

- Through video calls, patients can stay connected with their families, alleviating loneliness.

04

Personalization

- The robot can adjust its behavior based on the patient's profile, which includes preferences, cognitive status, and daily schedules.

Brainstorming and Ideation

Creating the Perfect Companion for Care

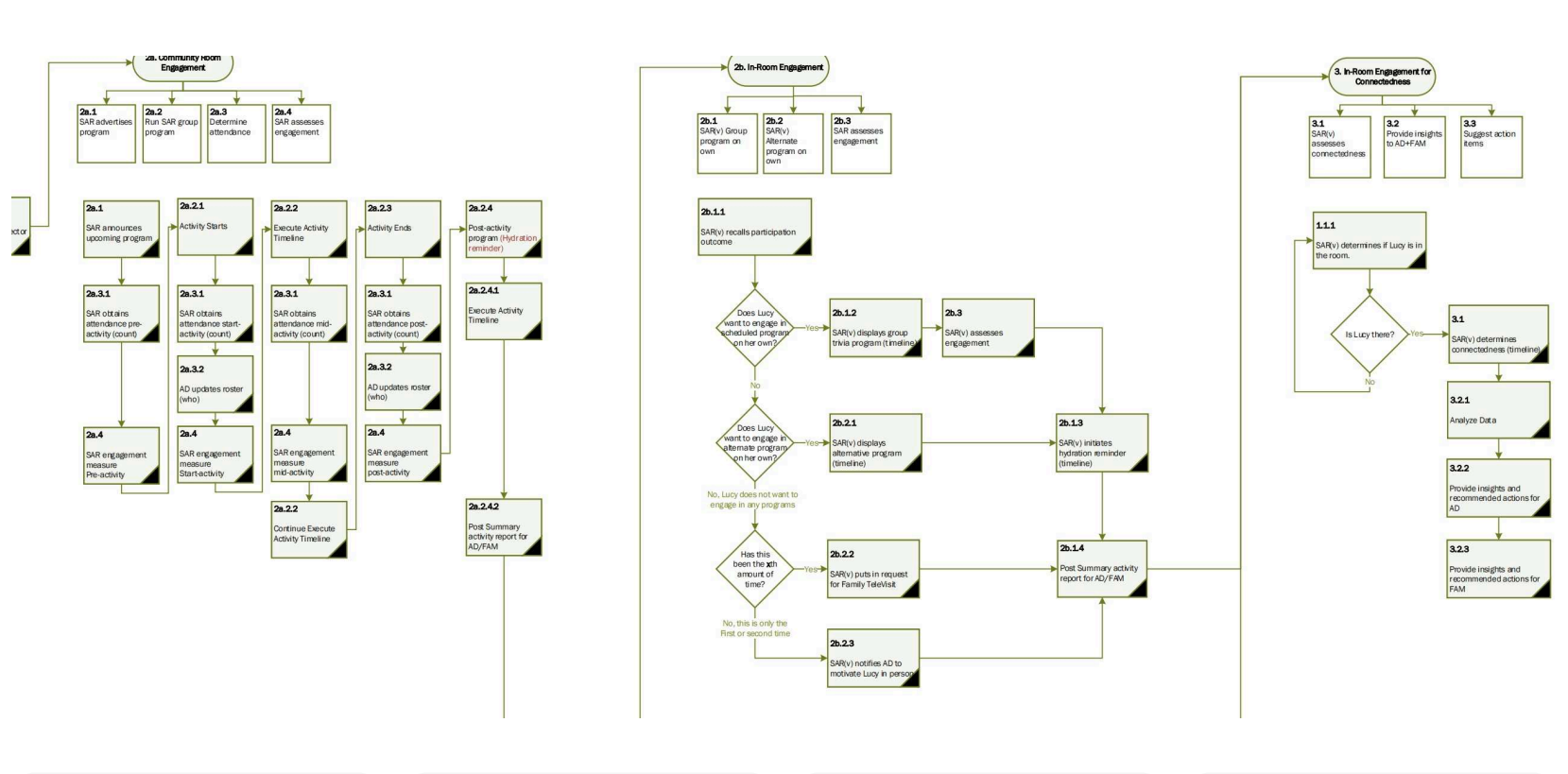
The ideation process revolved around combining practical caregiving functions with social engagement. The robot's design was shaped by early brainstorming sessions and insights from caregivers and patients about what would be most useful in their daily routines.

Features like **personalized trivia games** and **medication reminders** were prioritized to address both physical and emotional needs.

Task Analysis

Understanding the Caregiver Workflow

A detailed task analysis was conducted to understand the existing workflows of caregivers and identify pain points that could be alleviated by the SAR robot. The analysis focused on the following tasks:



01

Medication Management:

Caregivers often struggled to track and manage medication schedules for multiple patients. SAR was designed to automate reminders, ensuring timely medication without caregiver intervention.

02

Activity Scheduling And Reminders

Caregivers had to constantly remind patients of scheduled activities, often leading to missed events. SAR's integration with activity calendars allowed it to handle this task, freeing up caregiver time.

03

Emotional Engagement

Many caregivers found it challenging to engage patients with dementia in meaningful activities. SAR provided personalized cognitive stimulation, such as trivia games and music, reducing the emotional strain on caregivers.

04

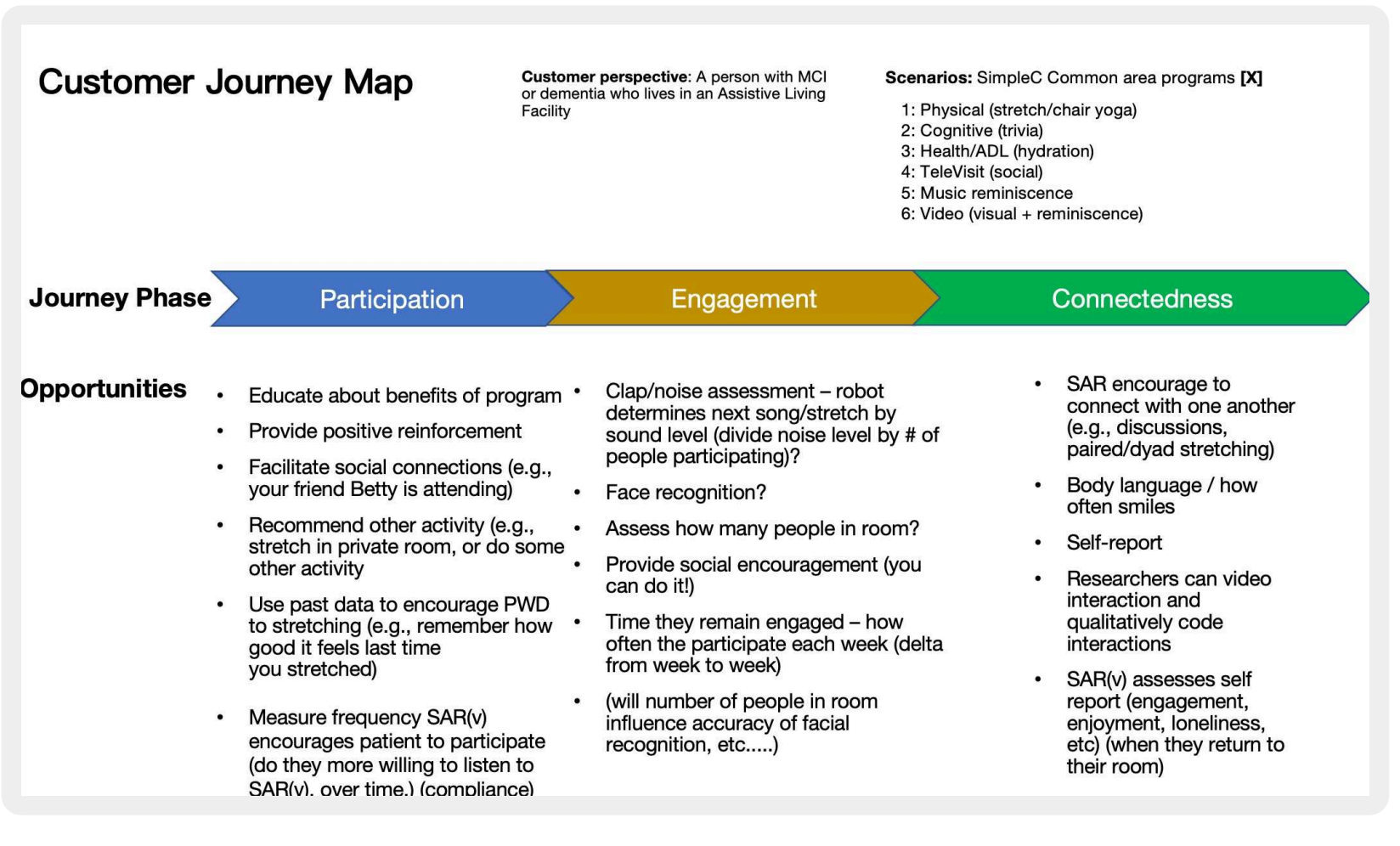
Communication

Family members were often out of reach, and caregivers needed a more efficient way to facilitate communication. SAR's video call feature allowed patients to connect with their families, reducing feelings of isolation.

By breaking down these tasks, the team was able to design specific features within the SAR robot to optimize caregiver efficiency and improve the overall caregiving experience.

Customer Journey Maps

To ensure that the SAR robot was both effective and meaningful, Customer Journey Maps were created to map out the experience from the perspectives of both caregivers and patients. These maps allowed the team to identify critical moments in the user journey, ensuring that the robot's interactions were both intuitive and emotionally resonant.

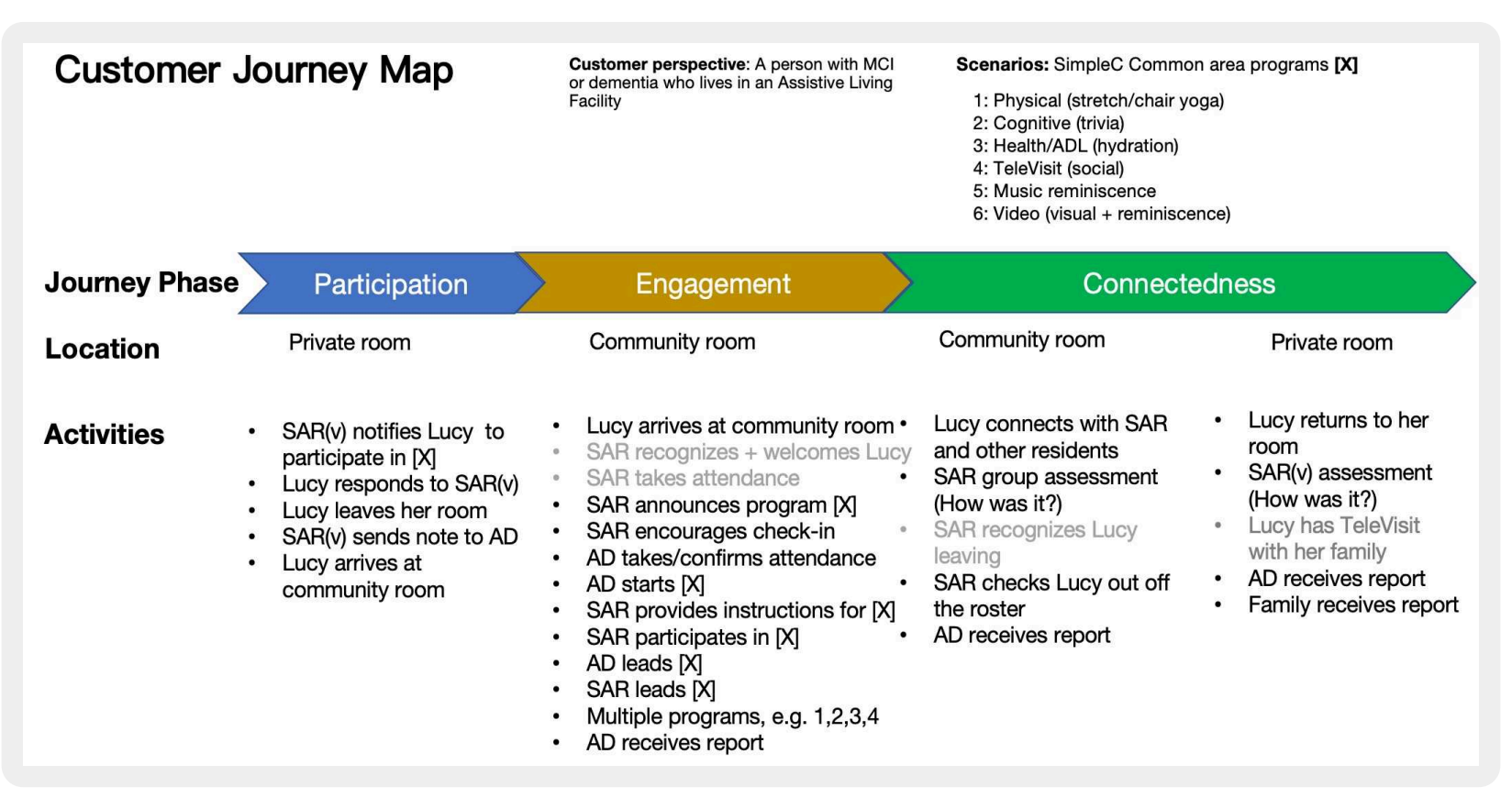


Customer Journey Map

Customer perspective: A person with MCI or dementia who lives in an Assistive Living Facility

Scenarios: SimpleC Common area programs **[X]**
1: Physical (stretch/chair yoga)
2: Cognitive (trivia)
3: Health/ADL (hydration)
4: TeleVisit (social)
5: Music reminiscence
6: Video (visual + reminiscence)

Journey Phase	Participation	Engagement	Connectedness
Opportunities	• Educate about benefits of program • Provide positive reinforcement • Facilitate social connections (e.g., your friend Betty is attending) • Recommend other activity (e.g., stretch in private room, or do some other activity • Use past data to encourage PWD to stretching (e.g., remember how good it feels last time you stretched) • Measure frequency SAR(v) encourages patient to participate (do they more willing to listen to SAR(v), over time.) (compliance)	• Clap/noise assessment – robot determines next song/stretch by sound level (divide noise level by # of people participating)? • Face recognition? • Assess how many people in room? • Provide social encouragement (you can do it!) • Time they remain engaged – how often the participate each week (delta from week to week) • (will number of people in room influence accuracy of facial recognition, etc.....)	• SAR encourage to connect with one another (e.g., discussions, paired/dyad stretching) • Body language / how often smiles • Self-report • Researchers can video interaction and qualitatively code interactions • SAR(v) assesses self report (engagement, enjoyment, loneliness, etc) (when they return to their room)



Customer Journey Map

Customer perspective: A person with MCI or dementia who lives in an Assistive Living Facility

Scenarios: SimpleC Common area programs **[X]**
1: Physical (stretch/chair yoga)
2: Cognitive (trivia)
3: Health/ADL (hydration)
4: TeleVisit (social)
5: Music reminiscence
6: Video (visual + reminiscence)

Journey Phase	Participation	Engagement	Connectedness	
Location	Private room	Community room	Community room	Private room
Activities	• SAR(v) notifies Lucy to participate in [X] • Lucy responds to SAR(v) • Lucy leaves her room • SAR(v) sends note to AD • Lucy arrives at community room	• Lucy arrives at community room • SAR recognizes + welcomes Lucy • SAR takes attendance • SAR announces program [X] • SAR encourages check-in • AD takes/confirms attendance • AD starts [X] • SAR provides instructions for [X] • SAR participates in [X] • AD leads [X] • SAR leads [X] • Multiple programs, e.g. 1,2,3,4 • AD receives report	• Lucy connects with SAR and other residents • SAR group assessment (How was it?) • SAR recognizes Lucy leaving • SAR checks Lucy out off the roster • AD receives report	• Lucy returns to her room • SAR(v) assessment (How was it?) • Lucy has TeleVisit with her family • AD receives report • Family receives report

Prototyping

Bringing the Vision to Life

Prototypes were created to showcase the core functionalities, with real-time testing by caregivers and patients. These prototypes evolved over time, with each iteration improving based on user feedback to ensure the product was effective and user-friendly.

Challenges and Solutions

Overcoming Obstacles in Design and Development

Every project faces challenges, and the SAR project was no different. Some of the key challenges and solutions included:

Challenge:
User Adoption And Trust

Solution:
The team focused on designing a user-friendly interface and provided comprehensive training for caregivers to ensure smooth adoption.

Challenge:
Limited Interaction Capabilities

Solution:
The robot's features were expanded to include personalized interactions, such as trivia games and music, tailored to each patient's preferences and cognitive needs.

Challenge:
Real-Time Response In A Caregiving Environment

Solution:
Through iterative testing and feedback, the team enhanced the robot's response time and ensured that it seamlessly integrated into daily caregiving tasks.

Usability Testing

Ensuring the Robot is Easy to Use and Effective

To ensure the SAR robot was both effective and easy to use, usability testing was conducted with both caregivers and patients. This phase focused on evaluating the user interface (UI) and the overall user experience (UX).

- **Task Completion Rate:** We measured how easily caregivers could use the robot to perform key tasks such as scheduling activities, managing medications, and connecting with patients' families. The goal was to ensure that these tasks could be completed with minimal training and without confusion.
- **Time to Task Completion:** The time it took caregivers to complete tasks using SAR was compared to the traditional methods they used. SAR's efficiency in reducing time spent on administrative tasks was a key factor in its usability success.
- **User Feedback:** After testing, caregivers and patients were asked to rate the ease of use of the robot, its helpfulness in daily routines, and their overall satisfaction. This feedback was crucial in identifying areas of improvement and fine-tuning the robot's features.
- **Accessibility:** Ensuring the robot was accessible for dementia patients with various cognitive impairments was a critical component of the usability testing. The robot's ability to respond to simple commands, offer clear visuals, and provide personalized engagement was tested to meet diverse cognitive needs.

Insights That Shaped the Final Solution

The usability testing revealed that:

01 **Caregivers** found the robot to be an effective tool for managing medication schedules and activity reminders, reporting a reduction in caregiving stress and improved efficiency.

02 **Patients** enjoyed engaging with the robot, especially in activities like trivia and music, which led to higher engagement levels and decreased feelings of isolation.

03 Overall, usability satisfaction was high, with both caregivers and patients appreciating the personalized interactions and ease of use.

Impact Measurement

Tracking Success with Quantifiable Data

To evaluate the success of the SAR robot, several metrics were tracked throughout the testing and deployment phases, including:

Caregiver Stress Reduction

Caregiver stress levels were measured before and after using SAR, showing a significant decrease in daily stress and emotional strain.

Patient Engagement

Metrics on how often patients interacted with the robot, the types of activities they participated in, and their level of cognitive engagement were collected to assess the robot's effectiveness in improving patients' quality of life.

Usability

User testing sessions measured how easy and intuitive the SAR robot was for caregivers and patients to use, ensuring it met the accessibility requirements.

Family Connection

Feedback was collected from family members on how well the robot facilitated communication, with many praising its ability to reduce feelings of isolation among dementia patients.

Key Learnings and Future Directions

Continuing the Journey of Innovation

The SAR robot has proven to be a revolutionary tool in dementia care. It alleviates caregiver stress while providing dementia patients with meaningful engagement, improving their quality of life. The project's success is a testament to the power of user-centered design, extensive testing, and collaboration between academic and industry partners.

The SAR project provided invaluable insights that will guide future developments in socially assistive robots. Looking ahead, the SAR project will continue to evolve with the goal of making socially assistive robots a mainstream solution in dementia care.

Takeaways

- **The Importance of Personalization:** One of the most critical success factors was the robot's ability to adapt to individual patient needs, ensuring personalized engagement and care.
- **User Feedback is Essential:** Iterative testing and real-time feedback from caregivers and patients were crucial in shaping the final design, proving that a user-centered approach is key to developing successful healthcare technologies.
- **Scalability:** The project highlighted the importance of designing technology that can be scaled to different caregiving environments, from nursing homes to private homes, ensuring broader adoption.

Scaling for the Future

- **Expanding Features:** Adding more interactive capabilities, such as real-time emotional recognition and enhanced communication tools.
- **Scaling Deployment:** Working to integrate SAR robots in more nursing homes, care facilities, and private homes, ensuring wider accessibility.
- **Long-Term Monitoring:** Conducting longitudinal studies to measure the long-term impact of SAR on caregiver stress and patient health.