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Exploring How Robots can Help Older Adults Live by Their Values

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Resumo

O envelhecimento da população está a aumentar e Portugal era o segundo país europeu com o maior número de idosos por 100 jovens, em 2021. Os idosos são uma população diversificada com possíveis condições de saúde crónicas, desafios cognitivos e físicos que podem impedir ou limitar a agência individual e a tomada de decisões nas atividades da vida quotidiana. Por este motivo, uma parte substancial da tecnologia focada em idosos tem um papel que compensa estas perdas cognitivas e físicas.

Similarmente, enquanto que a robótica é vista como uma área promissora para enfrentar estes desafios, as abordagens existentes atualmente, concentram-se principalmente em funções que promovem monitorização e segurança (como enfermeiras ou treinadores de exercícios) ou que se focam em melhorar a saúde e o bem-estar psicológico dos idosos, proporcionando companhia semelhante à de um animal de estimação. Estas abordagens enfatizam o foco robótico na assistência física e cognitiva, que enquanto válida e essencial, trata-se de uma visão pré determinística que pode resultar num ênfase excessivo nos aspectos funcionais da assistência, potencialmente ignorando a importância dos valores pessoais e das intenções individuais no design e utilização destes robôs.

Esta tese assenta nas bases estabelecidas pelo projeto ShiftHRI, cujo objetivo era investigar a transferência de agência para idosos no âmbito da interação humano-robô (HRI), visando capacitá-los. Através de entrevistas com idosos, foi descoberta a priorização e operacionalização dos seus valores: Laços Sociais, Altruísmo, Liberdade e Agência, Aprendizagem ao Longo da Vida e Viajar e (Re)decobrir.

Através de métodos de design participativo, pretendeu-se investigar a presença e expressão desses valores fundamentais na vida dos idosos. Assim, no primeiro estudo exploratório reunimos perceções e informações sobre as experiências dos idosos com valores e como usavam a tecnologia para os operacionalizar ou como gostariam de poder usá-la para atingir determinado valor que lhes fosse importante. Mais especificamente, abordámos 15 idosos através de entrevistas individuais. O estudo destacou as experiências e perspetivas de idosos que envelhecem nas suas próprias habitações e indivíduos em lares de idosos – revelando pontos em comum e disparidades nas suas expectsativas, limitações e interações com a tecnologia. As conexões sociais emergiram como um pilar fundamental do bem-estar para ambos os grupos. Embora a tecnologia seja reconhecida como um potencial facilitador para colmatar lacunas nos laços sociais, alguns participantes sublinharam a importância da autenticidade e do "lado humano" nas interações. A tecnologia foi

vista como tendo um papel potencial em esforços altruístas, particularmente em lares de idosos onde se observa uma abordagem prática ao altruísmo, impulsionada pela empatia com o próximo e preocupações pessoais sobre o seu bem-estar futuro. Os participantes manifestaram interesse em utilizar a tecnologia para fins altruístas, reconhecendo as suas potencialidades para operacionalizarem comportamentos filantropos.

Liberdade e a agência manifestam-se de formas diversas, com os indivíduos que envelhecem nas suas habitações a associá-los à independência financeira, às crenças pessoais e à saúde, enquanto os que vivem em lares de idosos os entrelaçam com as relações sociais, a autonomia pessoal e a noção reconfortante de ter um lugar para chamar de lar.

O desejo de (re)descobrir novos lugares e participar na aprendizagem ao longo da vida sublinha as motivações que vão para além de exercícios cognitivos ou físicos, usualmente tidos com tecnologia. Os indivíduos que se mantêm nas suas casas expressam entusiasmo pelas viagens possibilitadas pela tecnologia, reconhecendo a sua relação custo-eficácia e a capacidade de superar barreiras físicas. Em contraste, os indivíduos em lares de idosos podem ser mais hesitantes devido a preocupações sobre o desencadeamento de memórias negativas e às limitações sensoriais da exploração virtual.

Os idosos, em ambos os contextos de vida, reconhecem o papel da tecnologia na facilitação da aprendizagem ao longo da vida, que é vista como um meio para aceder a novas informações, perseguir interesses e permanecer conectado socialmente.

Os idosos demonstraram associar a tecnologia a um potencial facilitador na manifestação dos seus valores. No entanto, embora haja reconhecimento dos benefícios da tecnologia, existe um ceticismo generalizado, moldado por preocupações sobre o desconhecimento, a invasão da privacidade e o potencial impacto nos valores fundamentais. Compreender estas perspetivas diferenciadas é crucial para conceber tecnologias que se alinhem com as diversas necessidades e valores dos idosos, garantindo a inclusão e melhorando o seu bem-estar geral.

Com base nesses resultados e fazendo o balanço entre as oportunidades e acautelando as suas preocupações, na segunda fase do nosso trabalho, projetámos um conjunto de 15 cenários de HRI. Esses cenários foram apresentados a 6 idosos durante sessões individuais de co-design.

Os cenários relacionados com Laços Sociais, Aprendizagem ao Longo da Vida e Liberdade e Agência foram os que tiveram maior aceitação global.

Os cenários sobre viagens e (Re)descoberta, embora recebidos com abertura e entusiasmo geral, manifestaram a falta dos aspetos interpessoais destas experiências.

Os cenários relativos ao Altruísmo foram recebidos com respostas variadas. Embora alguns estivessem dispostos a ajudar e receber ajuda usando a robótica, preocupações orgulho e experiências negativas passadas com altruísmo moderaram essas inclinações positivas. Perceções negativas, relutância e incertezas sobre a prontidão da sociedade também foram evidentes.

Por último, avaliamos um cenário prototípico de HRI relativo a um robô (Temi) controlado remotamente por idosos em casa da sua família. Durante esta experiência, observamos uma dualidade nos idosos na Casa 1, que pretendiam usar o Temi para observar e interagir com as suas

netas, ao mesmo tempo que expressavam preocupações sobre uma possível intrusão na privacidade da sua familia. Apesar destas reservas, os participantes reconheceram o potencial do Temi para promover conexões e consideraram-no positivamente como um suporte tecnológico para os laços familiares.

Na Casa 2, adultos e crianças exibiram atitudes diversas, demonstrando uma mistura de desconforto e entusiasmo sobre o potencial do robô Temi. As preocupações com a invasão de privacidade e o controlo externo foram proeminentes, indicando perspectivas variadas e conflitantes sobre a integração de um robô social na vida familiar. A resposta a estes desafios poderá ser a implementação de mecanismos, como zonas da casa interditas ao robô, horas marcadas para as chamadas ou algum tipo de aviso sonoro aquando da sua ligação, de modo a garantir o conforto de todas as partes envolvidas.

A presença do Temi pareceu aumentar o sentido de ligação social dos idosos, suscitando interesse e entusiasmo pelas suas possibilidades. Além disso, as interações com a neta mais nova sublinharam o potencial de bem-estar emocional, à medida que ela se envolvia em atividades adaptadas ao seu gosto.

Os valores fundamentais esperados operacionalizados durante este caso de estudo, principalmente relacionados com Laços Sociais e Liberdade e Agência, foram verificados. As principais tarefas realizadas pelos participantes mais velhos envolviam conversar com os familiares e brincar com a neta.

Esta tese tem como principais contribuições:

- Uma revisão da literatura sobre Design Sensível a Valores e Design Participativo para idosos: Esta revisão da literatura explora a importância do Design Sensível a Valores (VSD) e do Design Participativo (PD) no desenvolvimento de tecnologias para idosos, enfatizando a integração de dispositivos individualizados e personalizados nas suas vidas. Além disso, discute os desafios e soluções potenciais na Interação Humano-Robô (HRI) com idosos, destacando a importância do design adaptativo para alinhar a tecnologia com os seus valores em constante evolução.

- Prespetivas derivadas de entrevistas a idosos, sobre seus valores e o papel da tecnologia para alcançá-los: As entrevistas com idosos forneceram-nos informações valiosas sobre os seus valores fundamentais e o papel instrumental que a tecnologia desempenha na sua operacionalização, contribuindo com perspetivas essenciais para um debate mais amplo sobre a tecnologia e o envelhecimento.

- Um conjunto de cenários VSD HRI co-projetados para idosos: Uma compilação de cenários de Interação Humano-Robô (HRI) que surgiram de sessões de co-criação idosos, integrando os princípios do Design Sensível a Valores (VSD). Este conjunto de cenários representa um esforço colaborativo para alinhar as interações tecnológicas com os valores e necessidades dos indivíduos desta população.

- Um cenário prototípico de interação remota e as suas implicações na vida dos participantes: Num caso de estudo etnográfico envolvendo uma família, explorámos como os idosos utilizam robôs controlados remotamente para se envolverem em diversas atividades, descobrindo motivações, dimensões emocionais e o impacto mais amplo nas relações familiares e no bem-estar geral.

Este estudo sublinha a diversidade de perspetivas entre os idosos ao examinar valores fundamentais idênticos e a sua implementação prática, particularmente através de meios tecnológicos. Destaca-se a necessidade de adaptabilidade na tecnologia, particularmente no que se refere atendimento das preferências e necessidades únicas dos idosos como utilizadores finais. A principal conclusão é a importância de adaptar os designs robóticos para se alinharem com as diversas expectativas dos idosos, sublinhando a sua importância para garantir a integração eficaz e bem-sucedida da tecnologia neste grupo demográfico.

Palavras-chave: Robôs Assistivos, Idosos, Valores, Agência, HRI

Abstract

The aging index has been increasing in Europe, and Portugal is currently one of the countries with the oldest population. In most cases, aging brings a physical decline that hinders a person's movement, physical and cognitive health and, consequently, agency. Several people see their autonomy jeopardized and their social lives slimmed, creating a sense of isolation and incapability.

Technology can aid by helping to overcome possible barriers derived from aging and act as an expanding agent of freedom and agency but traditional approaches often compel individuals to adapt to technology, neglecting the uniqueness of each person. In this research, we investigated the integration of human values into robotic technologies for older adults, emphasizing the principles of Value-Sensitive Design (VSD) and Participatory Design (PD).

Through interviews, insights were gathered into the core values of 15 older adults and the role of technology in achieving them. Findings revealed nuanced perspectives on Social Ties, Altruism, Freedom and Agency, Lifelong Learning and Traveling, and (Re)Discovering, emphasizing a diversity of attitudes toward technology adoption.

Utilizing these findings, we crafted 15 Human-Robot Interaction (HRI) scenarios tailored to align with these values for analysis in participatory design sessions. The outcomes indicated a higher overall acceptance of scenarios centred around Social Ties, Life-long Learning, and Freedom and Agency.

Additionally, we conducted an ethnographic case study to investigate the influence of a remotely controlled robot on familial relationships, providing valuable insights for the design of adaptive and value-driven robotic systems in the context of technology and aging.

Keywords: Assistive Robotics, Older Adults, Values, Agency, HRI

Contents

Lista de Figuras **xvii**

1 Introduction **1**
1.1 Motivation and Research Focus 1
1.2 Methods and Approaches 2
1.3 Contributions 3
1.4 Context of the Developed Work 4
1.5 Document's Structure 4

2 Related work **7**
2.1 Older Adults' Goals and Identity 7
2.2 User-Centered Design and Participatory Design 8
2.3 Studies on ICT Usage and Assistive robotics for Older Adults 10
2.4 HRI with Older Adults and Value Sensitive Design 14

3 Understanding Older Adults' Values and the Impact of Technology **17**
3.1 Methodology 19
3.1.1 Participants 20
3.1.2 Procedure 20
3.1.3 Data Analysis 21
3.2 Findings 21
3.3 Discussion 29
3.3.1 Older adults' Perspectives on technology: 29
3.3.2 Older adults' perspectives on values and how technology could be helpful: 30

4 Co-designing Value-Sensitive HRI Scenarios **35**
4.1 Methodology 36
4.1.1 Participants 36
4.1.2 Data Analysis 38
4.2 Findings 38
4.3 Discussion 41
4.3.1 The equilibrium between human bonds and robotic aid 41

4.3.2 Balancing attitudes and values in HRI assistance and engagement 42
4.3.3 The coexistence of openness to tech and uncertainty 45

5 Exploring Family HRI Scenarios with Older Adults: A Case Study 47
5.1 Methodology 48
5.1.1 Participants 48
5.1.2 Procedure 48
5.1.3 Data Analysis 49
5.2 Findings 49
5.2.1 Initial interviews 49
5.2.2 Auto-ethnographic observations 50
5.3 Discussion 52
5.3.1 Values 52
5.3.2 Affiliation of the robot and boundaries 53
5.3.3 Family, robots, and tomorrow: contextual considerations for social robots at home 54

6 Conclusions and Future Directions 57
6.1 Limitations 59
6.2 Future Prospects 59

Abreviaturas 62

References 81

Índice 82

A Understanding Older Adults' Core Values and the Impact of Technology - Informative Briefing 83

B Understanding Older Adults' Core Values and the Impact of Technology - Informed consent 87

C Understanding Older Adults' Core Values and the Impact of Technology - Interview Script 89

D Co-designing Value-Sensitive HRI Scenarios - Storyboards 91

List of Figures

2.1 Storyboard depicting an audio museum tour guide with explicit time indicators. [178]. 10
2.2 The home care robot temi used to establish video telephony between relatives and residents of two care facilities and patients of a geriatric clinic via the Skype application during COVID-19 pandemic visitor bans. [58]. 12
2.3 MATY v4: the last prototype materialized expressing examples of the multisensorial service provided to elicit the person with Alzheimer through the day[165]. . . 12
2.4 Example meal-eating HRI scenario with the robot Brian 2.1 [112]. 13
2.5 Vizzy a wheeled humanoid robot, used as an exercise coach, explaining the activity to the participant [13]. 13

4.1 Example of one of the presented scenarios - Travelling and (Re)discovering scenario 15 38
4.2 Last frame of scenario 15 with text 38

5.1 Interaction between participants through Temi 51
5.2 Desires and Concerns regarding value operationalization of each participant . . . 53

Chapter 1

Introduction

Over the years, the aging index has been increasing, meaning the population is getting older. According to the World Health Organization, the global population aged 65 and over is projected to reach 2.1 billion by 2050 [191]. In 2021, Portugal was the second European country with the most older adults by 100 young people [6]. Most older adults have multiple chronic health conditions, which result in increased healthcare expenditures and limitations in activities of daily living [53].

1.1 Motivation and Research Focus

Aging may present cognitive and physical challenges [67] that can impede individual agency and decision-making [164]. The autonomy of older adults is often diminished, particularly in nursing homes or residential facilities[164]. In such environments, older adults may face limitations in communication and interaction due to various factors, including personality traits, motor or cognitive impairments, and unfavorable institutional conditions [164].

The significance of purpose in life is linked to positive mental health and social integration [2]. While previous research has explored the use of assistive robots to enhance independence at home or in care facilities, existing approaches mainly focus on robots assuming roles such as nurses [3] [110], companions [153] [26], or exercise coaches [31] [13], emphasizing care and assistance on the robots' part. However, these approaches may fall short of empowering individuals to pursue their own goals.

A notable gap exists in addressing the specific values of older adults in the design of robotic technologies. There is an opportunity and a pressing need to explore technology as a catalyst for enhancing freedom and agency, shifting the focus from technology as a potential source of exclusion to a tool that enables older adults to achieve their objectives.

Research Objectives: Through participatory design methods, we aimed to investigate the presence and expression of values such as Social Ties, Altruism, Freedom and Agency, Life-long Learning, and Travelling and Rediscovery in the lives of older adults. Rooted on those results, we co-designed hypothetical real-life inspired scenarios where the use of robots was depicted and applied to situations related to the precedent values. The main goal of this study was to align robots

with older adults' values, empowering them to have more control and influence over their robotic support functions and origins.

1.2 Methods and Approaches

The term 'User-Centered Design' (UCD), a broad descriptor for design processes in which end-users shape the design [8], lays the foundation for our work. However, our approach goes beyond UCD by embracing the Value-Sensitive Design (VSD) framework [5]. VSD stands out as a methodology that aligns most closely with a design process rooted in human values, emphasizing the integration of ethical considerations into technology design. This framework emphasizes ethical and human values in technology design even before a concept. VSD acknowledges that values are complex and nuanced and helps designers consider these perspectives through a methodical and comprehensive approach. It serves as a bridge between the technical and humanistic aspects of technology development, considering users' values throughout the design process. This methodology is essential because values change, and it is important that the robot can evolve accordingly [163]. Recognizing the dynamic nature of values and the imperative for user engagement, our approach further extends into the realm of Participatory Design, fostering collaborative partnerships with end-users.

Participatory Design (PD) methods provide opportunities to harness older adults' experiences, capabilities, limitations, and preferences to design robots that will support successful aging [149]. To guide the PD process we started by using Semi-structured interviews. The interviews we conducted aimed to understand how each value was present in each of the older adults' lives and how they dealt with them. Each participant was probed to explain how they acted regarding each of those goals and how they envisioned technology could be helpful and meaningful to their beliefs and values. In the second stage, we created storyboards based on the findings of the previous phase. A storyboard is a short graphical depiction of a narrative and can be used for a variety of activities [178] and can help older adults envision how new technologies could be integrated into their daily lives [100]. To facilitate these sessions, we employed the speed dating method, as outlined by Zimmerman et al [196]. This dynamic approach encourages participants to actively engage in envisioning futuristic scenarios tailored to their unique perspectives and needs. The crafted probing questions served as a gateway to delve into the intricacies of their thought processes, aiming to uncover not just the "what" of their contemplated scenarios but, more importantly, the "why" behind each visualized change. This method allowed us to gain a deeper understanding of the participants' experiences, preferences, and aspirations, providing an understanding of their expectations and concerns regarding the integration of futuristic technologies in their lives.

To explore how older adults use remotely controlled robots to interact with family members, for what activities and intentions, and how it affects their relationship and their lives, we performed an ethnographic case study with one family.

Activities using the robot TEMI[1] were analyzed, encompassing routine tasks, family dynamics, and significant moments. We delved into intentional robot use to reveal motivations, expectations, and emotional dimensions. The investigation also addressed the impact of integrating these robots on relationship quality and overall well-being, beyond immediate functionalities. It aimed to address both challenges and opportunities in the integration of a robot into familial interactions.

To track the use and experience throughout the experiment, the participants were interviewed before and after the study period and prompted every other day to send a message with a diary log [146].

Our main findings suggest that older adults, emphasize the significance of social connections for well-being and express interest in using technology to operationalize that value, as well as life-long learning and freedom and agency. However, diverse manifestations of freedom, varying motivations for (re)discovering places, varying opinions on altruism and nuanced perspectives on technology highlight the need for adaptable designs to meet the unique preferences and concerns of older adults, underscoring the importance of tailoring robotic technologies for successful integration in this demographic.

1.3 Contributions

Our main contributions with this dissertation are:

- A literature review on Value Sensitive Design and Participatory Design for older adults : This literature review explores Value-Sensitive Design (VSD) and Participatory Design (PD) significance in developing technologies for older adults, emphasizing the integration of individualized and personalized devices into their lives. Additionally, it discusses the challenges and potential solutions in Human-Robot Interaction (HRI) with older adults, highlighting the importance of adaptive design to align technology with their evolving values.

- Insights from an interview study with older adults, about their values and the role of technology in achieving them: The interview study with older adults provides valuable insights into their core values, and the instrumental role technology plays in actualizing these values, contributing essential perspectives to the broader discourse on technology and aging.

- A set of co-designed VSD HRI scenarios for older adults: A compilation of Human-Robot Interaction (HRI) scenarios that emerged from co-creation sessions with older adults integrating the principles of Value-Sensitive Design (VSD). This set of scenarios represents a collaborative effort to align technological interactions with the values and needs of older individuals.

- A prototypical scenario of remote interaction and its implications in participants' lives: In an ethnographic case study involving one family, we explored how older adults utilize re-

[1]TEMI's website: https://www.robotemi.com/

motely controlled robots, to engage in various activities, uncovering motivations, emotional dimensions, and the broader impact on familial relationships and overall well-being.

1.4 Context of the Developed Work

This thesis project builds upon the foundation laid by the ShiftHRI project, previously undertaken by Tiago Guerreiro, Jodi Forlizzi, Alexandre Bernardino and Hugo Simão. The objective of this project was to investigate the transfer of agency to older adults within the realm of human-robot interaction (HRI), aiming to empower them. The central questions guiding that exploration were: How can we redirect the agency typically held by robots to individuals, enabling them to pursue activities they value, such as facilitating family interactions through remotely controlled robots? What are the values and goals that individuals cherish, and how can robots be designed to effectively support them in achieving these objectives? Through interviews with older adults, they uncovered their values prioritization and operationalization: Social Ties, Altruism, Freedom and Agency, Life-long Learning, and Travelling and Rediscovery. Derived from the aforementioned study, under the guidance of Professor Tiago Guerreiro, I collaborated with the PhD student Hugo Simão in the execution of the follow-up phase of the project.

1.5 Document's Structure

This document is organized as follows:

- **Chapter 2 – Related Work.**

  An exploration of existing robots designed for older adults, specifically focusing on those incorporating Value Sensitive Design. Overview of previous research in the field, emphasizing the importance of aligning robotic technology with the unique needs and values of older people Introduction to frameworks utilized in the development of value-driven robotic systems.

- **Chapter 3 – Understanding Older Adults' Core Values and the Impact of Technology.**

  Reports from the initial phase of our research involving Value Sensitive Design interviews with older adults. Individual discussions with older adults to understand their perspectives on values like altruism, social ties, and life-long learning through technology. Examination of current technologies used by older adults to embody these values.

- **Chapter 4 – Co-designing Value-Sensitive HRI Scenarios.**

  Utilization of the Speed Dating Approach, borrowed from Jodi Forlizzi and John Zimmerman, to engage older adults in envisioning potential future scenarios where robots could facilitate the realization of their values.

  Explanation of the design process for creating visual scenarios prototypes of robots that align with the identified values.

- **Chapter 5 – Exploring Family HRI Scenarios with Older Adults: A Case Study.**

  Description of implementing a user case study involving providing robots to a couple of older adults. Analysis of the impact of the robot on the perceived engagement, changes in family dynamics, and autonomy of the older adults. Examination of the older adults' ability to control the robot remotely and express their values from a distance.

- **Chapter 6 – Conclusions and Future Directions.**

  Final reflections on the research and its implications for the design and development of robots for older adults. Consideration of potential avenues for future work in enhancing the integration of human values into robotic technologies for older people.

Chapter 2

Related work

This chapter delves into the realms of what is known regarding older adults' diversity of identities and goals, highlighting the importance of User Centered Design (UCD) and Participatory Design (PD) and exploring their significance in designing technologies for older adults. Additionally, it discusses studies on Information and Communication Technology (ICT) usage and assistive robotics, emphasizing the heterogeneous nature of older adults and the potential benefits and challenges associated with integrating technology into their lives. Finally, the chapter delves into the evolving landscape of Human-Robot Interaction (HRI) with older adults, emphasizing the importance of adaptive design, user-centric approaches, and the integration of evolving values to create technologies that genuinely enhance the lives of older individuals.

2.1 Older Adults' Goals and Identity

At the core of the human experience lies the Sense of Agency. This sense is the experience of controlling one's motor acts and, through them, the course of external events [71]. As such, it is deeply entwined with our physical and cognitive capacities. As time progresses, especially in the realm of older adulthood, understanding and addressing the changes in these capacities become paramount to enhancing their well-being [122].

Geriatric rehabilitation articulates a vision of preserving independence, autonomy, and active agency [154]. The pursuit of these fundamental goals necessitates not only an awareness of the intrinsic connections between goals and subjective well-being but also the integration of individualised and personalised technologies into this landscape, developed preferably in cooperation with the users [154].

Delving into the intricate relationship between goals and well-being [84], research underscores the significance of the entire goal process—from selection to implementation, progress, and attainment [23]. Intrinsically motivated, autonomous goals, chosen by individuals for themselves, emerge as crucial contributors to heightened levels of subjective well-being [28].

Expanding this understanding to leisure activities reveals a large scope of experiences influencing well-being. The nature of these activities, whether passive or active, intricately shapes their impact on subjective well-being (e.g. watching television idling off is not the same as playing a

sport of one's interest) [23].

Similarly, travel satisfaction (TS) emerges as a backbone of the emotional and subjective well-being of older adult tourists [40], fostering Life Satisfaction (LLS) and Overall Life Satisfaction (OLS) [168]. The OLS of older tourists is also positively and significantly associated with time spent travelling for eating and drinking, religious activities, volunteering, and playing and watching sports [124].

Amidst life transitions, such as retirement, losses in social connections are palpable [131]. The departure from established networks can, however, be mitigated by meaningful completions and entries into new activities, offering a rich source of understanding and potential growth [131]. As retirees navigate these changes and their challenges, technology can become a critical ally.

In the interviews conducted by [90] it was found that the patients had ideas for maintaining their psychological wellness, but they still struggled with negative emotional moments. One of the main daily life challenges they pointed out was loneliness, closely related to their physical health problems and financial issues. They all mentioned that social interaction with friends, family members, and pets made them feel better, and social isolation increased feelings of depression. Two of the five older adults had pets but mentioned caring for them was challenging.

In this context, the concepts of User-centered Design and Participatory Design come to the forefront. Recognizing that technology should not only serve but also engage users, especially in the later stages of life, becomes imperative. The collaborative development of individualized and personalized devices, seamlessly integrated into the fabric of older adults' lives, ensures that technology becomes an empowering force in maintaining independence, autonomy, and active agency.

2.2 User-Centered Design and Participatory Design

User-centred design encompasses a set of methodologies dedicated to involving users appropriately throughout the product development process [55]. The primary focus of UCD is to actively engage end users in the design phase, tailoring products to their specific needs, capacities, and characteristics [55]. As an integral aspect of UCD, Participatory Design directs attention to user opinions in identifying suitable design solutions [90]. An inherent challenge in implementing participatory design lies in the concept of "designing for the other" [59]. PD methodology underscores user involvement throughout the entire project life cycle, spanning early concept generation to technology development and evaluation [24].

However, the UCD/PD processes offer limited guidance on involving older individuals in the development process [55]. Despite the broad applicability of these methods, they necessitate customization when creating applications for older adults [55]. The integration of technology into the daily lives of older adults holds significant potential, contingent upon meticulous design and the development of affordable, user-friendly products utilizing an older adult-centered methodology [162]. In various instances, the UCD principle has guided system design, concentrating on usability for target users [52]. Active involvement of older adults in the early stages of development has

proven instrumental in refining initial prototype designs [109]

PD places a premium on the tacit knowledge of users, valuing it as a crucial resource when constructing new systems [98]. This is accomplished with a strong political or ethical orientation, whereby users' knowledge is harnessed to design tools and workflows that empower them [98]. To realize this objective, PD emphasizes co-research and co-design, necessitating that researcher-designers reach conclusions in collaboration with users [98]. Taking individual dreams and preferences into account is especially important when considering how to design "the robot" to exist in human environments rather than just robot environments [172].

The main challenges regarding this methodology concern older adults' engagement and maintaining focus and structure in meetings; representing and acting on issues; envisioning intangible concepts, and designing for non-tasks (experimental aspects of the design) [86]. The facilitator must be mindful of using appropriate and accessible language when guiding discussions [86]. Furthermore, it needs to provide instructions and seek to keep the focus on the activity during group work [86]. Another challenge to HRI PD concerns older peoples' initial perceptions of the capabilities and appearance of robots. Popular robotic preconceptions can be influenced by mainstream Hollywood depictions of robots/fictional media [176].

Several methods exist that try to overcome these challenges to gain insights into designing novel technology with/for older adults, such as card sorting [149] [123], sketching [149] [88], focus groups [95] [169] [149], workshops [149], storyboards [178] and interviews [149]. In this section we will focus on the last two.

Storyboarding

Storyboarding is a common technique in Human-Computer Interaction (HCI) and design for demonstrating system interfaces and contexts of use [178]. There are two main techniques used for storyboarding with older adults: unassisted and assisted [149]. Unassisted storyboarding involved creating a narrative by filling in a sequence of boxes with their own drawings, or images provided by study personnel [149]. This allowed older adults to brainstorm use cases and explore preferences for the steps involved in robot commands and input methods for specific tasks [149]. Assisted storyboarding, whereby researchers guided participants through a scenario, as exemplified in Figure 2.1 and can help participants visualize Human-Robot Interactions (HRIs) [149]. Assisted storyboarding may also alter the perceptions of older adults by increasing their understanding of potential robot use cases, and robot appearance preferences [20] and help older adults envision how new technologies could be integrated into their daily lives [100]. Because the specific wording in text-based scenarios can influence the understanding of and reaction to a system, designers often use storyboards rather than scenarios as a less biased visual depiction of the same information [178].

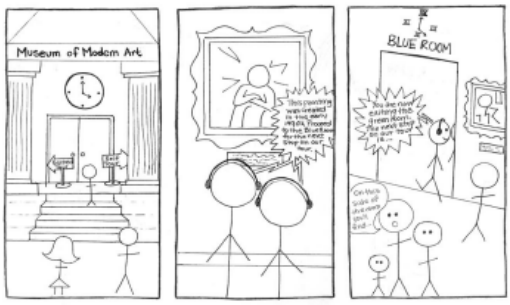

Figure 2.1: Storyboard depicting an audio museum tour guide with explicit time indicators. [178].

Interviews

Semistructured interviews are commonly used in PD studies [149]. Typically, researchers ask participants a series of open-ended questions to clarify or probe follow-up questions. HRI PD interviews can be performed with diverse stakeholders such as older adults, clinicians, therapists, and care providers [149]. This method allows participants to express feelings, thoughts, or brainstorm intimate use cases that they may be inhibited from sharing in group settings [149]. In addition, novel themes that emerge from initial stakeholder interviews can inform discussions in subsequent PD focus group interviews [149]. [165] conducted exploratory research in literature before the interviews to define a starting point. The interviews were conducted with stakeholders such as clinical psychologists, occupational therapists, caregivers, and people with Alzheimer's in the initial phase. [90] used this method in their study. The interviews covered topics related to participants' everyday pursuits and activity levels, their social circle, and the realities and challenges of ageing and living with depression. When interviewed, older adults documented their interest in participating in a project related to Socially Assistive Robots (SARs).

2.3 Studies on ICT Usage and Assistive robotics for Older Adults

Older adults are heterogeneous and many continue to help their families and friends even in their later years [136], which is beneficial for older people 'ageing in place', as it makes them feel part of a community [136] and needed [78].

Furthermore, as age-related conditions affect social relations and functional abilities, it is reasoned that ICT will facilitate older adults' social connectivity with family and friends and enhance involvement in leisure activities as well as simplify the completion of everyday tasks [189].

Of the studies addressing the relationship between ICT usage and social isolation in general, four demonstrated a positive result: the use of telephone befriending programs [37] computer and Internet [49] [82], and ICT, in general, [73] lessened social isolation. The reported effect of ICT use on the individual dimensions of social isolation was consistent across studies [41]. ICT interventions significantly fostered social support, social contacts, social connectedness/social connectivity, and social networks among the participants [70]. Of the studies examining loneliness, 15 of 18 revealed a significant reduction of loneliness among older people using ICT [41]. Studies

using communication programs (using landline phones, smartphones, iPads, emailing, and online chat rooms or forums) and high-technology apps (Wii, the TV gaming system, and a virtual pet companion) consistently reported a positive effect on alleviating loneliness [41].

This body of work suggests that, when given appropriate training, older adults are not only capable of using ICT interventions but can also derive significant benefits from them [41]. However, the considerable attrition rate among trial participants, coupled with inharmonious findings regarding ICT's impact on reducing loneliness, suggests that these tools may not be universally effective for all seniors [41].

Older adults use products because the functional aspects of products meet their current needs [161] As older peoples' bodies continue to decline, problems with products continue to be magnified; are less likely to be corrected; and ultimately result in messy, unsafe environments with more than one product to serve the same function [161]. Robotic products designed for an older adult ecology must be adaptive [161]. They should provide a solution for today as well as solutions that will support future change. When designing products, allow for extensible and mutable forms and functions [161]. If older adults can understand how assistive products can help them remain independent, they are likely to consider and accept using products such as hearing aids, dentures, canes, walkers, and wheelchairs. Without this understanding, there is resistance in acquiring and using assistive devices [161].

Socially assistive robotic (SAR) systems have been proposed to provide social companionship [166] [87] [58] [18] [160] [66] (Figure 2.2), entertainment [64] [47], support independent living [87] and autonomy [140] [120], support caregiving and improve quality of live [165] (Figure 2.3), facilitate healthy eating [88] [112] (Figure 2.4), encompassing frailty [21] [85] [80], cognitive decline [188] [147] [64], motor health issues [57] and engage older adults in various forms of physical activity [90][88][91] [96][101] [13] (Figure 2.5).

While promising, many of these initial robotic systems are open-loop or remotely operated [112]. In recent years, closed-loop SAR systems, which have the ability to monitor human interaction in real-time and adapt system behaviours, accordingly, have been proposed for older care [53]. Since the purpose of the SAR is to administer activity-oriented therapies and foster social interaction, the robot must dynamically guide older adults to perform the activity and fulfil task requirements related to the physical, cognitive, and social stimuli [53]. This requires the robot to understand and interpret multiuser HRI in terms of task engagement, performance, and HHI for task completion [53]. In order to address impairments, several steps may be taken to create a fulfilling HRI experience: large object sizes, addition of text to the objects, addition of sound when necessary, within the task, use of vibrant colours and increased colour contrast, making robot's speech slow and of low pitch, creating interfaces that do not require high hand dexterity and cognitive load, and simple task rules with repeated instructions and reminders [53].

Figure 2.2: The home care robot temi used to establish video telephony between relatives and residents of two care facilities and patients of a geriatric clinic via the Skype application during COVID-19 pandemic visitor bans. [58].

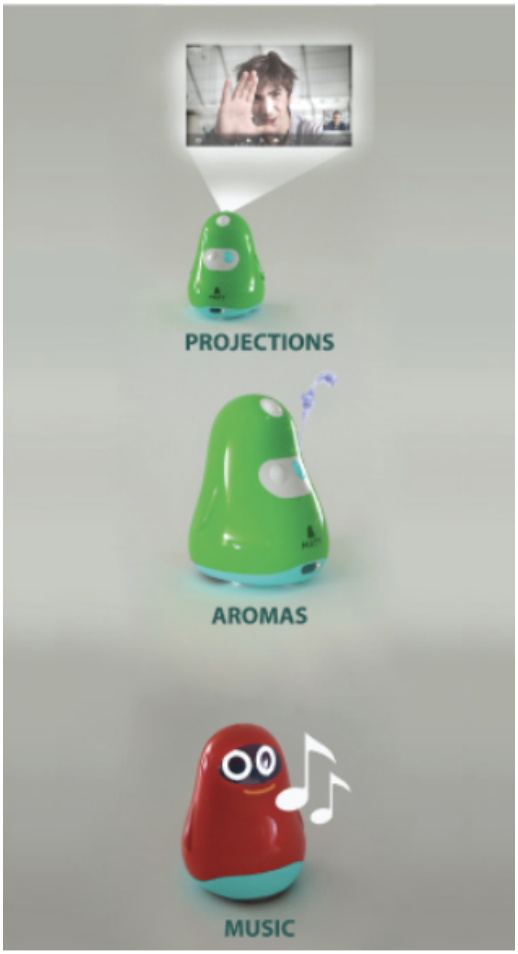

Figure 2.3: MATY v4: the last prototype materialized expressing examples of the multisensorial service provided to elicit the person with Alzheimer through the day[165].

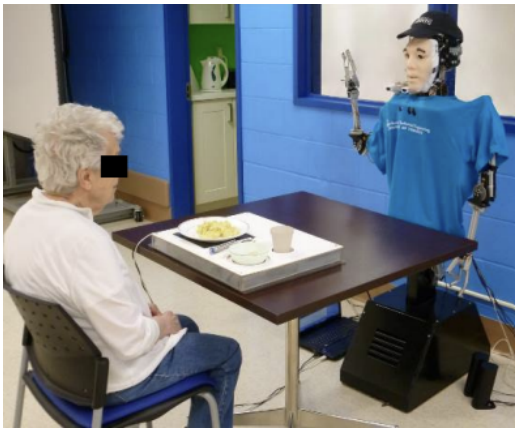

Figure 2.4: Example meal-eating HRI scenario with the robot Brian 2.1 [112].

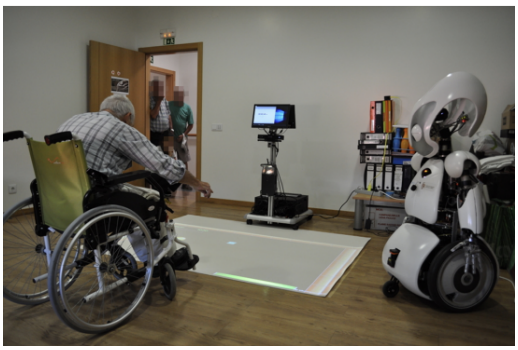

Figure 2.5: Vizzy a wheeled humanoid robot, used as an exercise coach, explaining the activity to the participant [13].

2.4 HRI with Older Adults and Value Sensitive Design

As we look ahead to the future of assistive robotic products, it is imperative to transcend mere task-based interactions [161]. The next generation of these products should not only be functional but also attractive, affordable, and devoid of any stigmatization [161]. Critical considerations for ageing users include accessibility, ease of use, and reliability [161]. Older adults, driven by the functionality of products meeting their current needs, face heightened challenges as their bodies decline. Persistent issues with products can lead to unsafe environments, necessitating adaptable robotic solutions that address both present and future changes [161].

In the realm of assistive robotics, agency should be prioritized for individuals rather than the robots themselves. Robots can serve as extension tools, executing actions in accordance with people's wills and intentions [163]. Studies, such as the one conducted by [164], demonstrate that providing older people with robots controlled by tangible blocks empowers them to take ownership of the robot for task-oriented activities, fostering a sense of control and agency [164] [163].

In guiding the landscape of assistive robotics, the need for adaptability and user-centric design becomes evident, particularly considering the evolving values of older adults. As older individuals undergo physical, cognitive, and emotional changes, expressing their values through robot interactions assumes paramount importance [163]. To address this, Value Sensitive Design (VSD) has emerged as a crucial methodology, integrating morals and values into the technological design process [5]. Expanding on this approach, Simão et al. introduce Value Sensitive HRI (VS-HRI), a method that engages individuals in programming robot behavior and contributing directly to its implementation, ensuring a more profound and meaningful Human-Robot Interaction by positioning users as decision-makers in defining the robot's concept [163].

While VSD has found extensive application in HCI contexts, such as intelligent agents, social media, dementia, and AI for social good [193, 179, 10, 180], its integration into HRI remains an emerging frontier, accompanied by distinctive challenges [105]. Given the physical embodiment of robots, maintaining alignment with evolving user values over extended periods poses unique challenges that demand nuanced solutions [156]. Recognizing this, value-sensitive design in HRI holds promise for fostering more meaningful and aligned interactions between older adults and robots [163]. Tailoring these interactions to individual values allows robots to reflect their users better [163], with previous efforts in personalized robot design, especially in older adult care contexts, demonstrating the potential for positive outcomes [182]. Effective implementation of value-sensitive design in HRI hinges on understanding older adults' intentions, goals, and underlying values guiding their interactions with robots [163]. The central challenge lies in operationalizing these human values within robots, enabling them to recognize and respond to these values and be influenced by them. The goal is to empower older adults to have positive, value-driven experiences with robots, fostering a desire for continued use and minimizing the likelihood of abandonment [192]. Inspired by VSD [60], we aim to explore robot scenarios that are responsive to contextual nuances, allowing users to prioritize their internal values in the face of external circumstances. This method ensures a deeper and more meaningful HRI by establishing individuals as decision-

makers in defining the robot's concept [163], and the incorporation of evolving values, ensuring that these technologies meaningfully enhance the lives of older adults, ultimately leading to more significant and sustained interactions [192].

Chapter 3

Understanding Older Adults' Values and the Impact of Technology

The global demographic shift towards an aging population necessitates innovative approaches to address older adults' evolving needs and aspirations. In the context of this demographic transition, Portugal stands out as a country with a significant proportion of older individuals, reflecting the broader European trend [6]. Robotics emerges as a promising avenue for supporting the aging population, offering potential solutions to enhance the well-being and independence of older adults [169]. It also underscores the increasingly pivotal role robots are poised to play in older adult care. Recognizing the anticipated heightened reliance on robots to cater to the distinctive needs of older adults [120] [25] [147], it becomes imperative to acknowledge their unique life experiences and evolving priorities while actively promoting value-centric processes.

Recognizing the diversity among older adults regarding health, interests, and life experiences, becomes imperative to move beyond generic, one-size-fits-all assistive technologies [161]. Traditional approaches often compel individuals to adapt to technology, neglecting the uniqueness of each person. One of the reasons for this to happen is due to, historically, robots have fulfilled a compensatory function in HRI within the context of older adults [155] [115] [104]. However, it is crucial to note that these approaches, though well-intentioned, may inadvertently manifest ageist tendencies [187] [106] [151]. This bias can occasionally result in an overemphasis on the functional aspects of assistance, potentially overlooking the importance of personal values and individual intentions in the design and utilization of these robots.

Our motivation for this study stems from a commitment to reverse this paradigm, placing older adults at the center of technological design by incorporating their values, agency, and intentions into the development of assistive robotics.

In a previous study, the shiftHRI team investigated how older adults can shape and guide robots based on their values to accomplish their goals [166] [163]. This project emphasizes the importance of understanding human values in the context of aging and recognizing these values' dynamic nature. The overarching vision is to establish a novel relationship between older adults and assistive robots that enhances their self-efficacy, intentions expressed through a robot, technology acceptance, and overall quality of life. This project uncovered older adults' values

prioritization to build future HRI scenarios to answer their intentions when using technology:

One value uncovered in that study was "Social Ties", held as a central value, supporting the importance of connections with others in well-being [19] [74], emotional [177], and cognitive [158] sustenance. Furthermore, altruistic aspirations manifested by participants (from volunteering to helping physically close people such as family or neighbors) highlight the willingness to practice selfless acts for the welfare of others. Freedom and Agency were highly valued, suggesting that people should be able to make decisions that affect their lives — participants mentioned small decisions ranging from controlling aspects of their daily routines to more significant decisions that influence years to come. Participants also highly valued Creativity and Self-Expression, showing the importance of allowing older adults to express themselves meaningfully and communicate their unique perspectives, experiences, and interests. Engaging in creative activities can also help people feel serene and find purpose. Older adults reinforce Achievement and Ambition as a value, cherishing past and current victories as self-improvement and personal satisfaction. Success is linked with measureless personal achievements, such as not walking with a wanderer or challenging themselves to study and learn new topics and overall personal growth. Traveling and Re-discovering are operationalized as opportunities to dig into new places, cultures, and experiences that open up deeper perspectives on the world and new possibilities for their futures.

In this work, we built upon those earlier research insights to propose a novel approach to HRI that empowers older adults to pursue their values through technological assistance. Our approach sought to incorporate and respond to the unique values and intentions of older adults, thereby creating technologies that are not only functional but also more personally meaningful and relevant, providing older adults with agency. The objective was to understand the display and manifestation of each uncovered value: Social Ties, Altruism, Lifelong Learning, Freedom and Agency, and Traveling and (Re)Discovering in older adults' lives, to co-design novel HRI value-sensitive scenarios with the participants and iterate over them, so in the end we had a deeper understanding of how older adults want to operationalize their goals through technology.

The interactions with the older adults were split into two phases: In the first phase, we conducted semi-structured individual interviews with older adults to gain insights into their values, goals, and lifestyles. With this information, we designed various scenarios of the robot's interaction possibilities, ensuring the design reflects the values and aspirations identified in the interviews. In the second phase, we presented the illustrated scenarios we developed for each technology role and collected participant's insights and perspectives. This iterative feedback process allowed us to adjust the design based on users' reactions and suggestions by altering, adding, and improving the robot's alignment with older adults' values and goals. The research question we propose to guide this phase of the exploration is as follows:

RQ1: How do older adults perceive the role of technology in supporting their values?

In this first phase, our focus was on the procedural details of engaging individual participants, whether aging in place or residing in care homes. We chose these two contexts because acknowl-

edging the influence of context is crucial in shaping the efficacy of technology designed for older adults. Previous research in HCI has delved into the significance of living context, suggesting that well-being is shaped by the alignment between individual capabilities and environmental demands [97]. However, a notable gap in extending this model to the technology domain indicates an area ripe for exploration. This gap results in technologically functional solutions that lack a nuanced understanding and adaptability to each individual's unique situation, potentially diminishing user satisfaction and engagement [129].

A compelling illustration of this principle is found in the concept of 'Casser Maison' (translated as 'breaking the house') [108]. Metaphorically exploring the profound transition individuals undergo when moving to a care facility, this concept underscores how such a relocation can profoundly impact one's sense of self and value systems, thus having cascading effects on their interaction and relationship with technological tools. This emphasizes the importance of having a context-aware approach when exploring technologies for this demographic.

Building on this foundation, we employed a targeted set of questions to extract valuable information regarding participants' perceptions of values such as Social Ties, Altruism, Freedom and Agency, Lifelong Learning, and (Re)discovery, in their context. Importantly, we sought to understand the presence of these values in their daily lives, their utilization of technology to achieve these values, and the potential ways emerging technology could facilitate realizing their goals.

Our methodology involved one-on-one interviews with participants from care homes and ageing in place, allowing for an in-depth exploration of their perspectives and intentions. Through this tailored approach, we aimed to uncover the nuances of how these values manifest in their daily routines, whether technology played a role in achieving them, and the specific ways technology could be applied to better align with their values.

In the ensuing sections, we detail the intricacies of our phase 1 procedure, articulating the methodology applied and the considerations made to accommodate participants with varying technological familiarity.

3.1 Methodology

Each participant engaged in an individual semi-structured interview session, lasting a maximum of 40 minutes, allowing for in-depth exploration.

The objective of the first phase of this study was to understand their looks at those values and their everyday usage and need for technology regarding those life goals.

For each of the five values, a set of questions was designed. These open-ended questions were posed to elicit participants' thoughts and feelings regarding the presence of these values in their daily lives. Participants were encouraged to share insights into their use of current technology to achieve these values and speculate on how emerging technology might further support them. Since older adults with varying levels of technological familiarity were considered, the questions were tailored to accommodate both tech-savvy individuals and those less accustomed to technology.

Through this methodology, we aimed to capture the richness of individual perspectives, laying

the groundwork for collaborative co-design scenarios that address older adults' multifaceted values and aspirations in diverse living contexts.

3.1.1 Participants

We conducted interviews with a total of 15 older adults, consisting of 7F and 8M, aged between 63 and 90 years (M=80.6, SD=8.48). The professional staff at the care home institution identified and selected participants who expressed interest and met the eligibility criteria. Additionally, the chosen participants from the Ageing in Place context were acquaintances of members of the research group.

To ensure meaningful participation, individuals with medium to advanced stages of neurological diseases, such as Dementia or Alzheimer's, were excluded from the study. This decision was made because the study necessitated participants to comprehend complex scenarios and questions, and formulate coherent answers, which might be challenging for those with certain cognitive impairments.

The selected participants were intentionally diverse, encompassing various literacy levels, a range of technological backgrounds, and different motor capabilities. This intentional diversity aimed to provide a comprehensive and inclusive understanding of the perspectives and experiences related to the study's objectives.

3.1.2 Procedure

Our study method started with describing our work and objectives for this study to all participants, indicating their rights and what is expected of them during the study. After reading and understanding the information leaflet and completing the voluntary consent form, sessions were held with the participants who demonstrated their willingness to participate.

The exploration encompassed five thematic areas:

- Social Connections, where participants detailed the significance of connections, preferred frequencies of contact, and means of communication;
- Altruism, involving discussions on participants' definitions of altruism, specific desires to help, and the potential role of technology in fostering altruistic activities;
- Freedom and Agency, where participants reflected on their interpretations of freedom, situations seeking more independence, and envisioned scenarios of technology facilitating freedom;
- Lifelong Learning, probing participants' thoughts on learning in retirement, recent learning experiences, and preferences for learning formats;
- Travel and (Re)discovering, wherein participants shared their desires to visit specific places and the emotional or sensory aspects driving those desires.

The findings from these individual interviews formed the foundation for subsequent discussions in Phase 2. The insights garnered guide the co-design process, ensuring that emerging HRI scenarios resonate with older adults' diverse experiences and expectations.

3.1.3 Data Analysis

The data that was obtained was qualitative. These were obtained by recording audio, involving the researcher and participant conversation when consent was given. The interviews were then transcribed. The data was coded thematically, using Miro Digital Whiteboard[1] to reveal needs and opportunities. From these data, a set of scenarios for different human-robot interactions was derived, leveraging the team's prior research on the design and appearance of assistive and social robots. All audio recordings were listened to and interpreted, maintaining the anonymity of the participants whenever people outside the research team accessed them. Publicly, and in this document, the information collected was disseminated through random numbers assigned to the participants, APX-APY when referring to aging-in-place participants, or CHX-CHY when referring to those in a care home.

3.2 Findings

We individually asked participants their thoughts and feelings regarding specific values such as Social Ties, Altruism, Freedom and Agency, Lifelong Learning, and (Re)discovering. The aim was to find how and if these values were present in their daily lives, if they used any technology to achieve them, and how and in what way technology could facilitate operationalizing these goals and values.

Aging in place.

Social Ties. The older adults aging in their homes expressed the desire for social connection. They placed significant value on authentic relationships with friends, family, and pets. Their aspirations included sharing stories, maintaining integration within local communities, and cherishing the irreplaceable essence of physical touch, as emphasized by the participants, for example, AP7. This underscores the crucial role of social interaction in the lives of older individuals, emphasizing their prioritization of meaningful relationships.

"The relationship between people is very important. I could never live in isolation. I need people. The affective part is essential. That is why I say technology can be good, but it is not the most important part. I think the human part is the basis of everything" - AP7

Technology-wise, participants acknowledged the potential of technology as a facilitator for bridging long-distance relationships. However, there were concurrent concerns expressed regarding technology's role in potentially fostering superficial interactions and contributing to feelings

[1] https://miro.com/app/dashboard/

of isolation. This nuanced perspective indicates a careful balancing act between the benefits and drawbacks of technology in the context of social connection for the aging population.

Within the aging-place living context exists an interesting paradox. Our findings showed that, despite the abundance of chances for social connection with friends, family, and pets, there exists a subtle desire—a longing for human contact that surpasses the immediate circle of familiarity. A house living context, while offering a stage for meaningful interactions, also serves as a silent context where the absence of human touch can be sometimes felt. The aging-in-place paradox relies upon the interplay between the comforts of home and the inherent human need for broader, diverse connections.

Perspectives on learning and using technologies.

Our findings uncovered diverse perspectives and trade-offs among participants regarding the acquisition of new technological skills. Some older adults shared the belief that the perceived effort required to learn new technologies could potentially outweigh the perceived benefits. Their rationale relies on their limited use of technology in their lives, leading them to question if it is worth immersing themselves in the complexities of a rapidly evolving technological world.

Additionally, if the previous point is true, a parallel rationale emerged which is a concern about becoming dependent on technology in the aging process. A few of the participants contemplated the idea that, if such dependency were to arise, they would have little choice but to engage in the learning process, as expressed by the participant AP5.

"(...) If I have any dependency that requires me to learn something, what remedy do I have? Now I can only pray that this does not happen and continue with the health I have." -AP5

This point shows that older people think about the pros and cons of learning new technologies but also how some might be hesitant to use technology unless they really have to. To some, the wish to stay healthy without relying on technology adds a strong feeling to these views, showing a want for independence and a careful way of dealing with technology as they get older. Moreover, it was expressed a sense of resignation or acceptance of the limited control they might have over potential future dependencies on technology. For AP5, there was an emphasis on continuing with a preference for maintaining their current state of well-being without the added challenge or necessity of learning new technologies.

Participants anticipate and desire that upcoming technological advancements will lead to instant presence, effectively diminishing the limitations of time and distance in our present communication methods."

"(...) a person wanted to go to Australia, instead of taking 16 hours, it would take microseconds. " - AP3

Moreover, they seek platforms that are easy to navigate yet do not compromise the authenticity of human interaction. For older adults, technology should support, not supplant, the richness of

genuine human connection.

Altruism. Participants also referred to this "human side" when talking about altruism. Many emphasized the significance of empathy and personal connections, particularly when engaging in acts of giving. Our study revealed diverse views on what altruism means to participants. Altruistic actions span a spectrum, from grand gestures requiring substantial means, such as wealth or winning the lottery, to everyday acts of kindness like providing a meal for someone in need or assisting a friend in moving furniture. This diversity shows the multifaceted nature of altruism, accommodating a range of expressions and scales within each participant's conceptualization.

Participants consistently stressed the importance of aligning altruistic actions with individual values and principles. This finding suggests the authenticity and the ethical foundation of altruism are critical components. Additionally, they recognized the significance of considering personal capacities—whether physical, financial, or health-related—in determining the scope and nature of altruistic engagements, as expressed by AP8. This broader understanding reflects a deeper approach to altruism, incorporating individual values and practical considerations into the decision-making process.

"I think that I am no longer altruistic due to physical availability, the bad health is sometimes too much and economical, I always try to help where I can, even so I would like to be able to help more." - AP8

A small subset of participants expressed concerns regarding scams and authenticity, particularly in the context of engaging in altruistic actions. They were aware that some people might try to deceive them or take advantage of their altruism, making them hesitant to get involved in acts of kindness. The emphasis on trust became a central theme, suggesting that the perceived legitimacy and authenticity of altruistic opportunities significantly impact their decision-making process to help or not. This shows that having trust was important for them to engage in altruistic actions. To overcome a lack of trust, some older adults mentioned to prefer to help people they know well. Trust therefore plays a significant role in their willingness to be altruistic with strangers and acquaintances versus familiar people.

Freedom and Agency. In exploring the concept of freedom and agency, a diversity of perspectives emerged, revealing nuanced and varied definitions of what it means to be free. Financial freedom and the ability to align actions with personal beliefs, ideologies, and principles were identified as relevant aspects for some participants. Others, however, associated freedom with the preservation of good health, allowing them to navigate life without pitfalls.

The participants' understanding of freedom was deeply contextual, influenced by factors such as their age, their living environment, and their flexibility to be in desired locations. Similar to the diverse views on altruism, this variation reflects the vast layers of freedom perceived by older adults.

Our findings unveiled existential concerns among participants about the potential dominance of technology over different aspects of their lives. This apprehension extended to considerations of trade-offs, particularly in terms of privacy. The participants expressed a delicate awareness of the balance required between technological advancements and the preservation of essential aspects of their lives as freedom, agency, and the impacts of evolving technologies.

"In that aspect it has nothing to do with freedom. In terms of freedom, technology, one helps and the other does not. I don't know... technology is always positive in principle, that which is made for good, there is another that is made for evil, weapons." -AP3

As well as for Social Ties, participants stressed the importance of maintaining agency, and not wanting to be overly dependent on technology to express their freedom. While some view technology as beneficial for compensating for physical impairments, overcoming fears, and virtually exploring places, others expressed reservations about privacy invasion and the potential loss of control over their actions, currently, and in the future actions as they get older. They valued their ability to make decisions independently and expressed concern that technology could potentially infringe upon their autonomy and free choice that could persuade them/alter their original thought processes.

Discovering and Re-Discovering. The desire to visit new places or revisit others lay mostly in the curiosity and wish to explore different cultures, foreign cuisines, history, and the world's wonders. Some were also moved by emotional connections and nostalgia, wanting to relive memories and revisit places that bear memories of their past. Most have not traveled much during their younger days due to work and financial issues, and now have health impairments that make it difficult to explore the world as they would like. Some stated that the use of technology for virtual exploration would eliminate various risks associated with travel e.g. potential health hazards in unfamiliar territories. This method would also be more cost-efficient since the typical expenses associated with travel would not be needed, like flight tickets or hotel bookings.

"It doesn't have the same value, but I got to know places that my legs or financial possibilities wouldn't allow me to visit." -AP6

However, amid the enthusiasm for virtual travel, concerns emerged among older adults. They expressed reservations about potential limitations linked to technology, specifically the sensory gap that virtual exploration may not fully bridge. Elements such as the nuanced touch, taste, or smell are viewed as irreplaceable aspects of physical travel that technology might struggle to replicate. This duality of excitement for virtual exploration and acknowledgement of its limitations showcased the intricate considerations and ambivalence among older adults as they navigate their travel aspirations in a rapidly advancing technological landscape.

Lifelong learning. When asked about lifelong learning, the participants overall mentioned how continuous engagement in learning helps expand their cognitive abilities, leading to more

flexible and broader thinking patterns. Participants articulated multifaceted motivations for engagement in lifelong learning. Intrinsic factors emerge prominently, reflecting a desire for personal growth and intellectual stimulation. Family influence also plays a pivotal role, with younger generations serving as catalysts, inspiring and encouraging older adults to pursue new learning experiences. A specific emphasis is observed on the motivation to explore topics related to technology, underscoring a keen interest in staying abreast of technological advancements. In many cases, the chosen topic regarding learning is related to new technologies. Older adults acknowledge the importance of technology as a facilitator to access new information, pursue interests, maintain contact with others, and distance learning.

Concerns and impediments with technology. Our study unveils an acknowledgement of the challenges associated with technology-driven learning. Concerns include biases inherent in technological information, the prevalence of misinformation, privacy apprehensions, and the rapid evolution of technological terms. There was a common perception that contemporary society often overlooks individuals who have experienced life in a different era or context. People highlighted a contrast in how people from older generations, who have lived through different times, are currently navigating technological challenges, implying that these technologies are not readily considered or accessible to those alienated, as expressed by AP5.

"Currently, new technologies, nobody looks at those who have lived life in a different way and today they need to solve something and they don't have it. Go to the internet and the internet solves it. The person does not solve anything and is left with things to do and learn." -AP5

AP5 laments that individuals from older generations when faced with a challenge, might turn to the internet for assistance. However, AP5 suggested a sense of helplessness or inadequacy in this process, conveying a sentiment that relying on the Internet for solutions may not be empowering or fulfilling for individuals from older generations. With the acquisition of knowledge through technology or about technology comes several concerns. One is regarding biases and misinformation. With the large flow of information that technology can offer there is a need to curate and select the materials and "fact-check" continuously. Another concern relates to privacy. There is an underlying fear of being rendered obsolete due to the rise of automation. Personalization, although intended to enhance user experience, can sometimes feel invasive. Older adults also expressed concerns about their data being misused.

For many of the older adults, the absence of adequate social support to learn is one of the main impediments. They require someone to help them navigate the large amount of information available to them. While some participants gravitate towards traditional methods like reading and observation, others lean into technology-enabled methods such as using computers or smartphones. However, the importance of tailored learning is acknowledged, catering to individual needs and pace. The value of the intergenerational exchange is highlighted, where learning from younger individuals is seen as beneficial. Some participants value collective learning experiences,

while others believe they might get lost in groups, preferring one-on-one sessions or learning from a younger individual.

Impediments can also be related to health, both cognitive and physical. Older adults pointed to how their state of mind and health influences their predisposition to learn, and thus believe that their time for learning has passed. Others mentioned challenges such as reduced memory retention which can result in a slower learning pace. Perceived lack of capacity also influences their motivation and ambition to start a new learning endeavour. Most categorized these difficulties as "age-related".

" At the moment learning is slower, the 80 years don't forgive people, the mentality starts to get a little more... to go slower to all things, the speed is different. and things I already forget, I forget certain things" -AP2

Care Homes.

Social Ties. In the context of care homes, a deep sense of community emerges among the participants, often likened to the concept of a "second family." The significance of relationships with both family members and friends has consistently emerged, with these connections being perceived as crucial contributors to their overall well-being. However, an intriguing aspect of this social dynamic is the discernible selectivity in socializing patterns. Some individuals expressed a deliberate choice to engage more prominently with those individuals with whom they share a heightened level of comfort and familiarity.

"(...)in Australia, video call, I still spoke with them today. It's just to talk to them, I don't have anyone else... I mean, apart from my children, I have a family, but there are months when we don't talk or call." -CH5

Many also said that even though they were interested in socializing, alone time to reflect was also appreciated. On the other hand, some individuals feel neglected or abandoned, leading to a sense of isolation and loneliness. Technology was recognised by most older adults as a facilitator to maintain social connections. Many utilize technology to communicate, mostly through phone calls and sometimes video calls. However, for many, there is also a resistance to further their use due to unfamiliarity or fear. Some express difficulty in understanding or using technology, feeling alienated or out of touch with the digital world.

Altruism. Within the care home setting, altruism resonates among residents, being manifested in multiple forms of assistance and support. The motivations for these altruistic acts are diverse, reflecting the complex interplay of emotions and values. Empathy standed out as a driving force, with residents expressing concern for the well-being of others. Participants also expressed fairness, a belief in the importance of treating others with equity and kindness. Personal gratification emerged as another motivator, where the act of helping brings a profound sense of satisfaction

and fulfillment to those engaging in it. Additionally, redemption becomes a theme, with some residents viewing altruism as a means of making amends or contributing positively to the community. Some participants noted boundaries in their ability to help based on their living situation (e.g., being in an institution) or moral/ethical considerations (e.g., gender dynamics). These boundaries shape how they can and cannot act altruistically.

"I get along well with everyone here. I can't help more, if I could I would" -CH2

Also, physical limitations, occasionally impose constraints on the extent to which residents can engage in altruistic acts. Despite the intrinsic motivation to help, motor limitations sometimes set the boundaries of their altruistic behavior.

A distinctive aspect of altruistic motivations in care homes involves fear-based considerations linked to future assistance needs. Residents, being aware of their own potential dependency on others, care homes residents find motivation by proactively addressing this concern through engaging in acts of kindness and offering support.

Perceptions of technology. Several participants showed interest in using technology to aid their altruistic efforts, while others were skeptical. For some, there were expressions of enthusiasm, recognizing the potential efficiency and reach that technology can offer. Meanwhile, others stated reservations and concerns, mostly their perceived lack of technological knowledge, leading to apprehensions about using digital tools for altruistic purposes. There was also a nuanced fear of depersonalization, where technology might inadvertently diminish the personal touch and emotional connection inherent in altruistic acts. The need for additional staff guidance in navigating technological platforms further underscored the complexity of integrating technology into altruistic endeavors within care home communities.

Freedom and Agency. The overarching theme of personal autonomy takes a big place as participants in care homes stressed their perspectives on freedom and agency. This concept extended beyond physical liberty, encompassing a multifaceted understanding of independence within their social, personal, and environmental contexts.

In care homes, freedom was tangled significantly with their social relations. The ability to make new friendships and sustain existing ones, both within the care home and with family members outside, emerges as a central piece of their perception of freedom. The sense of belonging and security, as concepts derived from having a designated "home," was stated as very important. This home, whether the care facility or a prior residence, served as a fundamental source of comfort and stability that contributed significantly to their perceived freedom.

The tangible measure of freedom is often associated with physical independence. The ability to move around and navigate their environment without significant constraints is considered a tangible manifestation of freedom.

However, the complex layers of external and internal factors introduced challenges to this autonomy. External factors such as caregiving duties and institutional rules within care homes,

coupled with internal limitations including physical and cognitive constraints, create barriers to their freedom. While the desire for independence is unquestionable, these external and internal dynamics shape the extent to which residents can exercise their agency. Weighing the benefits of personal autonomy against the realities of their circumstances, participants navigate the delicate balance between the desire for freedom and the recognition of limitations imposed by their living context.

One resident captures a dichotomy, emphasizing the profound impact of the external world on their perceived freedom:

"It's all on foot, I don't use public transport. The pandemic is what pushed me the most, I go where I have to, I stay at home." -CH5

CH5's statement encapsulated the balance between personal agency and external impositions, showcasing the dynamic nature of their autonomy within the care home setting. External factors such as caregiving duties, lack of social support like friends or family, external impositions like care homes' rules, or internal ones including physical and cognitive limitations, pose constraints on their sense of freedom. The use of technology to aid in this regard is sometimes viewed with reluctance, as many residents struggle to recognize the tangible benefits of technology and feel that their technological knowledge is insufficient to operate such devices.

Lifelong learning. When asked about life-long learning, participants mentioned various ways they perceive it can benefit them. They feel like life-long learning is not just about skill acquisition; it's also a source of joy, pride, and satisfaction. Engaging in learning activities can uplift their spirits and offer a sense of accomplishment. Most of them mentioned learning new technology skills and how it can help them stay connected with friends and family, and how it can grant them some autonomy and empowered decision-making. Technology can also help them stay updated with global events and help them engage in their personal interests.

"There are people who don't care about these things (learning). I myself, through Facebook, I like to read certain things, I like to know what's going on. There are things I don't understand, but there are things I understand" -CH1

Some participants pointed out that their health, their context and their already existing learning difficulties are some of the challenges they feel hinder their learning at this stage. For most participants, these difficulties came from self-perception. Feeling like they are too old or incapable of learning due to low formal education levels, or that it is too late and "not worth it", since they learned a lot while at school when they were younger, or even lack of interest at this point of their lives, impedes their learning.

"Maybe for other people, but I'm not into that. People... lessons in anything, even games, but I won't, it doesn't interest me. I don't care anymore." -CH7

However, for others, there is a clear interest and willingness to learn and a recognition that the benefits outweigh the difficulties. They valued learning and liked to do it, even if it is something they do not apply in their daily lives. Learning brought them happiness. They used it for leisure, e.g. to read about different topics on their phone, even if sometimes they did not understand it completely. The majority felt like they had more to teach than to learn. They mentioned their wisdom, skills, and hobbies accumulated throughout their lives and how they would like to be able to share it with others, particularly with younger generations.

Traveling and Re-Discovering. Traveling and Rediscovering are mostly fueled by seeking emotional experiences or wanting to delve into the past. The idea of an immersive technology that allowed them to visit places of their liking on demand, was received with positive feedback from the majority of the participants. Experiencing different cultures, visiting historical places, and visiting places that align with their religious and spiritual beliefs are also relevant.

"(...) seeing and knowing don't fill up space. Seeing and knowing do not occupy a place, the place we occupy is only in our brain. It can only give us... a chance for people who have a little bit of willpower," -CH3

For many, there are current physical and financial issues that limit their ability to travel. Technology could be a way to overcome these barriers. Some view this with immediate acceptance, noting that it would make them feel good and wish for something immersive. Others are a bit more reluctant, fearing it could trigger bad memories or disappoint them. Some pointed to the need to filter information to avoid seeing what they do not wish to. Moreover, a few participants showed no interest in this option as they lost loved ones and feel like it would not be the same without them.

"I went to London, but I would like to go again, I can't go like I did with my husband, I can't go... " -CH1

3.3 Discussion

The findings from our study helped us understand the relationship between older adults' values, their aspirations, and the role of technology in supporting these values, particularly within the context of aging in place and care homes. Our investigation focused on key values, including Social Ties, Altruism, Freedom and Agency, Lifelong Learning, and (Re)discovering, providing insights into the perspectives and challenges faced by older individuals.

3.3.1 Older adults' Perspectives on technology:

Exploring the dynamics of older adults' engagement with technology showed a landscape shaped by perceived effort, benefits, and hesitancy. Some participants balanced the challenges of learning new technologies against potential advantages, expressing some reluctance to immerse themselves

in an evolving digital world due to limited prior exposure and a strong desire for independence. Pang et al. discuss how older adults often perceive themselves as slow learners, occasionally requiring repeated assistance from technology support personnel. This scenario contributes to a lack of confidence and a hesitancy to seek help [135] On the other side, Mitzner et al. revealed that older adults who have adopted technologies perceived positive outcomes from their use. The study underscores the pivotal role of ease of use and usefulness as critical factors predicting technology acceptance, emphasizing the importance of clear communication of benefits for increased acceptance [119].

Concerns regarding potential dependence on technology in the aging process also surfaced, leading to a sense of resignation or acceptance of future technological dependencies. Our study additionally underscores the desire for upcoming technological advancements to enhance human connection and alleviate the constraints of time and distance in communication. Moreover, it reveals various impediments and concerns related to technology-driven learning, including biases in technological information, misinformation, privacy apprehensions, and the rapid evolution of technological terms. Older adults expressed a need for tailored learning, social support, and intergenerational exchange to effectively navigate challenges associated with technology-driven learning.

Furthermore, the study delves into the impact of health, both cognitive and physical, on older adults' inclination to learn. Many cited age-related difficulties such as reduced memory retention and perceived lack of capacity. Gell et al.'s study highlights significant variations in technology usage among older adults based on sociodemographic and health characteristics. Factors such as younger age, sex, race, higher education level, and being married are associated with a higher prevalence of technology use [119]. Adjusting for these factors, technology use decreases with greater limitations in physical capacity and disability, with vision impairment and memory limitations associated with a lower likelihood of technology use [119].

Finally, the information emphasizes nuanced perceptions of technology. Some older adults expressed interest in using technology to support altruistic efforts, while others harbor reservations and concerns about the depersonalization of altruistic acts due to technology. The need for additional staff guidance in integrating technology into altruistic endeavors within care home communities is also emphasized. The multifaceted nature of the perspectives and concerns uncovered in the study underscores the importance of considering the unique needs and challenges of older adults in the ever-evolving technological landscape.

3.3.2 Older adults' perspectives on values and how technology could be helpful:

Social Ties: Social isolation, identified as a catalyst for chronic loneliness and boredom, significantly impacts both physical and mental well-being [16]. In this initial phase of our investigation, a resounding theme emerged: social connections hold unparalleled significance for both groups of participants. The foundation of well-being was identified in relationships with family and friends. Engaging in leisure, social, cultural, and spiritual activities within the community emerged as vital

for older individuals, aiding in the maintenance of self-esteem and the cultivation of supportive and caring relationships [4]. This is achieved through the promotion of social integration, identified as the key to staying informed and engaged [4].

Despite a recognition of the value of authentic relationships and an openness to technology's role in maintaining connections, aging-in-place participants expressed concerns about potential superficial interactions and isolation, revealing a delicate balance. Anxiety surrounding technology, and its potential as a barrier to adoption, may stem from poor design considerations for the capabilities of aging adults. Human factors and ergonomics specialists argue for attention to age-related changes in basic human abilities to align technology demands with user capabilities [39]. This paradox underscores the interplay between the comforts of home and the need for diverse connections, emphasizing the importance of addressing not only physical but also emotional well-being. In the context of care homes, while technology was acknowledged as a facilitator for maintaining connections, resistance persisted due to unfamiliarity or fear. Hence, it becomes imperative for technology to complement, rather than replace, the richness of human connection, ensuring accessibility for all, irrespective of technological proficiency.

Life-long learning: Lifelong learning has emerged as a source of joy, satisfaction, and motivation for participants in both contexts, reflecting a keen interest in acquiring new knowledge. A significant motivation for individuals engaging in learning is the desire to maintain cognitive health [16]. This includes a strong inclination to keep the brain active, relish the challenge of acquiring new skills, and delve into subjects aligned with personal interests [16].

Aging in place participants emphasized the positive impact of continuous learning on cognitive abilities, fostering flexible thinking. Inspiration from younger generations and family members was identified as a driving force behind their learning endeavors. For older individuals in care homes, participating in learning activities was seen as a potential morale booster, providing a sense of achievement.

Many participants highlighted the importance of acquiring new technology skills, emphasizing their role in maintaining connections with friends and family. Additionally, these skills were noted to contribute significantly to a sense of autonomy and empowered decision-making. There is ample evidence supporting the idea that learning in older adulthood enhances both personal and community well-being [116].

However, some participants acknowledged challenges such as health issues, specific circumstances, and pre-existing learning difficulties as hindrances to their learning at this stage. Poor health or limited mobility were identified as barriers to participation in lifelong learning [16].

Older adults have diverse learning needs that can be addressed through formal, non formal, and informal modes of learning [116]. These needs encompass various aspects, including employment, literacy (especially computer and media literacy in the 21st century), health and wellness, personal interests and development, caregiving, leisure and travel, and cognitive development [116].

A shared motivation across both contexts was the interest in exploring topics related to tech-

nology, with most participants emphasizing a keen desire to stay abreast of technological advancements. They recognized the importance of technology as a facilitator for accessing new information, pursuing interests, maintaining contact with others, and engaging in distance learning.

Altruism: Altruism emerged as a pivotal value, showcasing distinctive characteristics between institutionalized older adults and those aging in place. The findings illuminate a more hands-on approach to altruism among individuals in care homes compared to their counterparts residing in their own homes. Motivations in care homes were primarily empathic, intricately linked with concerns about their own future, propelling them to extend help in ways they would appreciate. Care Home participants demonstrated a profound sense of empathy, intricately interwoven with personal concerns about their future well-being. This hands-on approach to altruism emphasizes the richness of emotional engagement within care home communities.

Notably, a study found that altruistic attitudes, volunteering, and informal helping behaviors uniquely contribute to the maintenance of life satisfaction, positive affect, and other well-being outcomes [11]. Other studies have indicated that these prosocial behaviors tend to increase with age, possibly justified by factors such as financial situation, available time, obtained benefits, sense of meaning/connection, and pure altruism [111] and [46]. Moreover, recent experimental research has underscored that altruism remains a significant factor associated with prosocial behavior in older adults [46]. Prosociality is also linked to improved health outcomes, including higher relief from negative states, an increase in the helper's mood, higher levels of satisfaction and well-being, reduced morbidity, and lower mortality rates [27].

However, the potential role of technology in aiding altruistic efforts garnered both interest and skepticism, with participants expressing concerns about scams, authenticity, and the need for trust in altruistic actions. Privacy and the perceived invasion of technology raised apprehensions, revealing a nuanced perspective on the intricate balance between technological assistance and ethical considerations.

Freedom and Agency: The expressions of freedom and agency among participants took on various forms, revealing a spectrum of perspectives influenced by age, living conditions, and concerns regarding technology's dominance. Older adults aging in place associated these concepts with financial independence, the ability to act in accordance with their beliefs, and the maintenance of good health. Conversely, for those residing in care homes, these notions intertwined with social connections, personal autonomy, and the reassuring feeling of having a place to call home. A pivotal aspect of agency lies in the conviction of personal efficacy, as indicated in a systematic review on interventions and measurement instruments used for falls efficacy in community-dwelling older adults [171].

It's important to note that perceived self-efficacy is not a universal trait but rather a nuanced collection of self-beliefs linked to specific areas of functioning instruments used for falls efficacy in community-dwelling older adults [171]. Falls efficacy, often equated with balance confidence,

may disproportionately emphasize the capacity to perform activities without losing balance, potentially overshadowing other aspects such as the perceived ability to manage a fall if it occurs instruments used for falls efficacy in community-dwelling older adults [171].

External factors, including caregiving responsibilities and institutional regulations, present challenges to residents' sense of freedom. Despite acknowledging the potential benefits of technology, skepticism prevailed due to a perceived unfamiliarity with these advancements.

Discovering and Re-Discovering: The innate desire to explore new places and revisit memories underscored a multifaceted motivation for travel including curiosity, emotional connections, and nostalgia. While technology presented virtual exploration as a solution, participants from both contexts highlighted its limitations, especially in sensory experiences. The potential for immersive technologies to bridge physical and financial limitations is acknowledged, but reservations about technology's ability to fully replicate the richness of physical travel persist. Some participants expressed reluctance due to fears of triggering bad memories or disappointment. Filtering information and the perception that the experience wouldn't be the same without lost loved ones were additional considerations. This highlights the diverse attitudes among older adults regarding the adoption of technology for virtual travel, emphasizing the importance of considering individual preferences and emotional factors.

Research has shown that leisure travel can lead to various forms of well-being among older adults, with processes such as reminiscing the past, bonding with family members, rediscovering oneself, and forming informal networks of care being key contributors to these outcomes [195].

Online communities play a significant role in older adults' tourism, providing a platform for sharing experiences, exchanging practical information, and expressing age-related issues [130]. These communities are often dedicated to older people and can offer valuable insights into their travel preferences and interests [130].

Chapter 4

Co-designing Value-Sensitive HRI Scenarios

In this phase of the study, we built upon the valuable insights gathered during the previous phase's interviews. The interviews served as the foundational source of information, providing us with a deeper understanding of the perspectives of our participants regarding the place of each value in their lives. In this subsequent phase, we leveraged this wealth of qualitative data to construct scenarios aimed at further exploring and analyzing situations in which robots could be applied while aiming towards the five value categories: Social Ties, Altruism, Lifelong Learning, Freedom and Agency and Traveling and (Re)Discovering. A total of 15 scenarios, which then were presented to each participant, for discussion.

During the initial phase of this study, we conducted interviews with two distinct groups of participants: individuals residing in care homes and those ageing in place within their communities. These two participant groups were selected to provide a comprehensive perspective on older adults' values and goals. While we intended to analyze and present findings from both groups in the subsequent phase of the study, practical constraints, including time limitations, have necessitated a focused approach.

As a result, the second phase of this study will primarily emphasize the results obtained from the interviews conducted with individuals in care homes. This decision has been made to ensure an in-depth and thorough analysis of this specific participant group, allowing for a more rigorous exploration of the research questions at hand. Although the interviews with individuals ageing in place are a valuable part of the study, due to time constraints, we will defer their detailed analysis to potential future research.

By translating real-world experiences and narratives into hypothetical situations, we aimed to gain a more comprehensive understanding of the factors and variables at play within the studied context.

The research question guiding this phase of the study is:

RQ2: How do older adults residing in care homes perceive and respond to value-based scenarios involving the application of robots in various aspects of their lives?

The subsequent sections of this document will delve into the methodology employed for scenario creation, the scenarios themselves, and the analysis of the results, all of which are intrinsically connected to the knowledge gleaned from our earlier interviews.

4.1 Methodology

The objective of the second phase of this study was to facilitate critical discussions with participants, with a specific focus on constructing the advantages and evaluating the suitability of the presented scenarios for different individuals based on their unique perspectives.

The foundational step in Phase 2 involved the systematic categorization of data derived from Phase 1 interviews. Using the Miro board, interview data was organized based on two primary criteria: the inherent value under investigation (e.g., Social ties, Altruism, Freedom and Agency, etc) and the specific type of participant (care home residents or individuals ageing in place). This meticulous categorization process laid the groundwork for a structured approach to scenario design.

Within each category defined in the first step, the interview data was further clustered into thematic groups. These thematic groups were shaped by the key themes and insights distilled from the initial interviews, effectively aggregating related data points into coherent groups.

To ensure a hierarchical and organized approach, the thematic groups were subsequently classified into main areas. These areas encompassed broad categories such as possibilities for technology, issues, intentions, and other pertinent overarching themes. This hierarchical organization facilitated the formulation of scenarios rooted in the multifaceted insights garnered during Phase 1.

For each value, a set of three distinct scenarios was carefully crafted. This trio of scenarios was designed to encompass a diverse array of perspectives, potential outcomes, or interventions.

The construction of scenarios was an intricate process, with each scenario being meticulously created to convey unique narratives. These narratives were inherently shaped by the insights, data, and thematic content organized on the Miro board during Phase 1.

Particular attention was given to ensuring the diversity of scenarios. Each scenario was conceived to represent varied approaches, solutions, robot types or contexts concerning the selected value. This diversity was deemed essential to stimulate rich and varied discussions during the subsequent participant sessions.

4.1.1 Participants

We interviewed 6 Older adults in total, 3F and 3M, aged 63-90 (M=80.5, SD=8.34). The professional staff at the care home institution identified and selected participants who expressed interest and met the eligibility criteria.

To ensure meaningful participation, individuals with medium to advanced stages of neurological diseases, such as Dementia or Alzheimer's, were excluded from the study. This decision

was made because the study necessitated participants to comprehend complex scenarios and questions, and formulate coherent answers, which might be challenging for those with certain cognitive impairments.

The selected participants were intentionally diverse, encompassing various literacy levels, a range of technological backgrounds, and different motor capabilities. This intentional diversity aimed to provide a comprehensive and inclusive understanding of the perspectives and experiences related to the study's objectives.

Procedure

Our study method started with describing our work and objectives for this study to all participants, indicating their rights and what is expected of them during the study. After reading and understanding the information leaflet and completing the voluntary consent form, sessions were held with the participants who demonstrated their willingness to participate. Interviews were conducted in a controlled and comfortable setting, ensuring minimal distractions and a conducive environment for open and honest discussions.

The interviews commenced with an introduction, explaining the objective of Phase 2, which was to explore scenarios and understand participants' perspectives on them. Participants were informed that they would be asked to put themselves in specific situations. Each interviewee was presented with the designed scenarios(Figure 4.1), one at a time. The scenarios were read aloud and provided in written form (Figure 4.2) to ensure participants had a clear understanding of the context. Participants were exposed to scenarios methodically and sequentially. The presentation sequence was designed to ensure a comprehensive analysis of all scenarios, covering a range of values. The scenario presentation followed a structured sequence, with participants systematically analyzing one scenario from each value before returning to the initial value to evaluate the next scenario. This pattern continued for subsequent scenarios until the interview time reached 40 minutes. To maintain consistency and optimize the use of the allocated interview time, each new participant picked up where the previous participant had left off.

Throughout the interviews, the following probing questions were posed to participants, encouraging them to evaluate the scenarios and articulate their feelings and perceptions critically:

a. If you were X, how would you feel about this situation? And if you were Y, would something change in your perception? How? Why? In what way?

b. How would you feel about using the robot for Z if you were person X?

c. How would you change this story to make it more according to you? How so?

d. How do you think these actions helped by the robot can help X in their life?

e. What challenges and advantages do you identify in using a robot in this situation? What makes you say that?

Interviews encouraged open-ended discussions where participants were free to express their

thoughts, concerns, and any additional insights related to the scenarios presented.

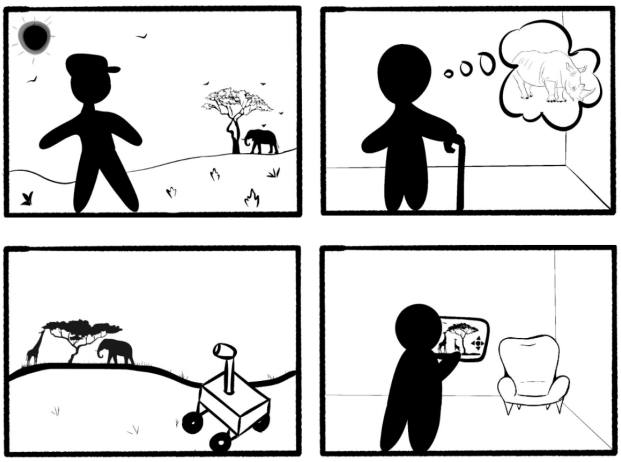

Figure 4.1: Example of one of the presented scenarios - Travelling and (Re)discovering scenario 15

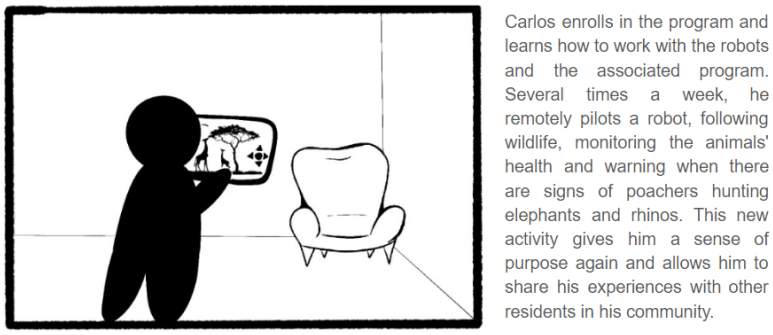

Figure 4.2: Last frame of scenario 15 with text

4.1.2 Data Analysis

. The data that was obtained was qualitative. These were obtained by recording audio which involves the conversation between the researcher and participant when consent was given. The interviews were then transcribed. Data were coded thematically to reveal needs and opportunities. All audio recordings were listened to and interpreted, maintaining the anonymity of the participants whenever people outside the research team accessed them. Publicly, the information collected was disseminated through random numbers assigned to the participants (CHX-CHY).

4.2 Findings

We presented 15 scenarios (S1-S15) related to each of the values under research. Through the use of prompting questions, we collected the participants' points of view regarding not only the stories themselves but also how they could be transposed to their daily lives.

Participants CH1 and CH4 emphasized the significance of staying active and having a meaningful life regardless of their ages. They stressed that such engagement leads to fulfilment. CH4, in particular, engaged in self-imposed activities like walking to maintain physical condition, ultimately leading to higher independence. This theme prominently relates to freedom, agency, altruism, and travel.

"She, no matter how much it costs her, I say against myself, young girl, [laughs] she should walk, I don't need to go out into the street to walk a bit. I go and do it... but I've lost that a little bit." - CH4 S8 (Freedom and Agency)

The majority of participants (CH1, CH2, CH3, CH4, CH6) expressed openness to technology and enthusiasm for the robots presented in the scenarios. They highlighted the robot's potential to bring joy and pride to its users and assist in various aspects of life, such as social ties, lifelong learning, altruism, and travel.

"I would get younger, and more active, I like being active and communicating with other people. I would feel very happy, her manner is good and healthy in the same way as João's, the story is different but it will lead to the same thing. She feels happy and will benefit other people." - CH1 S2 (Social Ties)

Participants stressed their need for human connection and companionship, acknowledging that a robot could help bridge this gap. Participant CH5 explained that they think the social ties created through a robot would be similar to the ones created in person. Participants CH1, CH2, CH5, and CH6 highlighted the differences between robots and humans, emphasizing the warmth, personal touch, and unique qualities of human interactions that they value.

"It's not easy for a person... not to have anyone to talk to. I am... who can dialogue, have a conversation, head, trunk and limbs. I've been here... for a long time... since I've been here, I've only had one person." - CH4 S9 (Lifelong Learning)

CH6 showed openness to the robot's assistance, conditional on its proper behaviour, particularly in scenarios related to lifelong learning. Concerns were also raised regarding the appropriate functionality of robots in altruism scenarios.

"I felt... good on the one hand, on the other hand, I had to pay attention to see if things were working as they should." - CH6 S6 (Altruism)

Participant CH5 felt no need to acquire a robotic device for altruistic tasks while CH3 saw no problem in using a robot for travel and altruistic tasks.

CH1 displayed openness to learning in all presented scenarios, expressing a willingness to learn about different topics, including how to use the various robots featured in the stories. CH2 expressed happiness if they successfully used the robot but also uncertainty about their lack of prior knowledge in this area. They found it challenging to imagine how they would feel using a robot. CH1 displayed some uncertainty about their technological knowledge, while CH3 expressed a desire for more knowledge.

"We don't have the age or possibilities, nor are we going to take place from the young ones, but it's good to learn." - CH1 S4 (LifeLong Learning)

When asked about a scenario where robots were remotely controlled to travel and discover new places, participant CH4 mentioned already using current technology, such as a computer, in a similar way, to "travel" and gather information about different places worldwide. However, they shared that they felt a lack of communication and the ability to share these experiences with others.

"I have a computer, a little PC, I know very little, almost nothing, I try to figure out some things. But the Trevi Fountain, I thought it was flat and thought it was at eye level, no, it has 3 or 4 steps down and then it's the fountain. I didn't know, I saw it on the computer." - CH4 S5 (Travel and (Re)discovering)

"I miss communication, whether written or spoken. One thing completes the other. or will it be the same thing." - CH4 S5 (Travel and (Re)discovering)

Regarding social ties, CH4 also mentioned using an agenda to remind themselves of important dates like birthdays, when presented with a scenario where a robot would set reminders for the user regarding communications with friends.

Two participants, CH1 and CH5, expressed their willingness to help through a robot. CH1 emphasized the positive impact of helping others on both parties, while CH5 had some uncertainty due to past negative experiences with altruism itself. Participants associated the ability to help with willpower and a sense of pride. CH1, CH4, CH5, and CH6 expressed their willingness to receive help through a robot, highlighting the importance of assistance, even if controlled by someone else.

"(...) she has a great willpower within her to feel proud, satisfied... to be helping old people" - CH3 S11 (Altruism)

Half of the care home participants (CH1, CH3, CH6) did not foresee any disadvantages in using robots in scenarios related to social ties, lifelong learning, and travel. Additionally, participants CH2, CH3 and CH6 highlighted the advantages of using robots, primarily related to altruism, social ties, freedom, and agency. They noted that robots could facilitate learning and assist others, ultimately enhancing agency.

"(When a person is weak and cannot make certain movements, it is good to have a robot, it helps a lot." - CH6 S8 (Freedom and Agency)

Conversely, participants expressed negative thoughts or perceptions about robots. Some participants, such as CH6, CH2, and CH4, mentioned reluctance to accept help from robots and a lack of trust in their ability to assist. Others, like CH5 and CH3, questioned the sense of being assisted by a robot, particularly in altruistic scenarios, worrying about others' opinions. Participant CH6 simply rejected the idea of travelling through technology, while CH1 cited the high monetary cost of robots as a barrier to its adoption.

"I don't know, I've never trusted any robots." - CH2 S13 (Freedom and Agency)

"Oh my god... [laughs] I don't see my daughters doing that, they have children to raise and all that. If it were something like that, a kind of totoloto (lottery game) like that... " - CH1 S4 (Lifelong Learning)

Participant CH6 emphasized the superiority of live experiences over technology. They expressed reluctance to accept the robot's help unless there were no other options, particularly in scenarios related to travel.

Participants expressed concerns about societal readiness for robot usage in scenarios such as shopping and street walking. They also mentioned the need for institutional authorization for communication between care homes and expressed concerns about the impact of robots on education. All of the participants suggested some ideas of functionalities they find useful and important for assistive robots. Socialization and housework tasks were the areas with the most input, but other ideas related to the travel scenarios were also suggested, such as guided tours and translation to possibilitate communication with locals. Other ideas encompassed transportation, to help children with disabilities and outside leisure.

"The robot... the robot did my housework, I was always happy" - CH6 S8 (Freedom and Agency)

"But in order to talk to people, there has to be a translation." - CH4 S5 (Travelling and (Re)discovering)

4.3 Discussion

Our exploration of 15 scenarios uncovered nuanced perspectives among care home participants regarding the integration of robots into their lives. These perspectives reflected diverse attitudes toward technology, independence, and assistance. Key themes included the delicate balance for older adults between valuing human connections and recognizing the potential benefits of robot assistance. Participants express optimism towards altruistic robot use, emphasize the importance of lifelong learning, and acknowledge the potential advantages of robots in travel scenarios. However, concerns about the limitations of robot-human interactions and uncertainties regarding technology adoption highlight the complex dynamics influencing the acceptance of robots among older populations.

4.3.1 The equilibrium between human bonds and robotic aid

Our findings showed that older adults desire human connection, emphasizing its irreplaceable value while simultaneously acknowledging the potential benefits of robot assistance. The narratives depicted a subtle equilibrium between the yearning for profound human connections and the recognition of the pragmatic advantages that robots could offer. While participants cherished the

emotional depth of human interactions, they were open to leveraging technology for assistance, learning, and enrichment. This balance emerged as a paradoxical dilemma where individuals grapple with the contrasting appeal of both human interactions and the assistance provided by robots.

As seen before, older adults generally embrace robot assistance for tasks related to housekeeping, medication reminders, new learning, and hobbies but prefer human help for activities such as decision-making and personal care, indicating that their acceptance of robot assistance varies depending on the nature of the task and their familiarity with technology [170]. Additionally, specific robot characteristics may influence older adults' interactions with robots. In particular, functionality (i.e., the ability to perform a non-social task) has been shown to be influential on older adult acceptance [170].

4.3.2 Balancing attitudes and values in HRI assistance and engagement

Altruism. Participants expressed optimistic attitudes toward altruistic robot use, stating they would happily help through a robot. As stated previously, across various studies, a strong and consistent pattern of altruism increased with age, supported by a significant average age-related effect [173]. This suggests a potential avenue for enhancing individual well-being through robotic assistance in altruistic tasks. Older adults also associated altruistic acts facilitated by robots with positive emotions, including happiness and a sense of fulfillment. Altruistic and charitable acts can boost mental and physical health and longevity while influencing happiness, avoiding feeling overwhelmed, fostering social connections, reducing self-focus, and promoting positivity [142]. Understanding these positive perceptions provides insights into the potential psychological benefits of incorporating robots in altruistic scenarios, not only from an agency perspective but also from a well-being point of view [142]. Participants linked altruistic acts facilitated by robots to willpower, suggesting that engaging in acts of kindness through technology enhances personal determination and motivation [138]. Furthermore, participants felt a sense of pride in helping others through robots. This perceived positive impact of technology-assisted altruism on individuals brought a potentially increased self-esteem as they can help other people remotely or themselves with/through technology. HCI studies showed that online altruism includes the ability to facilitate spontaneous acts of kindness, create immediate emotional connections, and offer a platform for people to make a positive difference in the lives of others, all within the online environment [99].

Despite the participants' positive first approach to altruism, some, like CH5, simultaneously expressed uncertainty and hesitation about practicing altruism through robots, citing past negative experiences like scams or fraud attempts. These reservations, along with societal norms, personal experiences, and cultural backgrounds, shaped their perceptions, showing that internal and external factors might bring older adults challenges and concerns regarding using robots in altruistic contexts. This spectrum of attitudes toward altruistic robot use indicates a complex relationship between individuals and technology in the context of altruism that might be person-dependent.

Social ties. The participants conveyed an optimistic perspective, demonstrating openness and

enthusiasm regarding the role of technology, specifically robots, in enhancing social connections. They recognized the potential of robots to contribute significantly to improved communication, and stronger ties with friends and family, expressing a willingness to incorporate them into their lives. Notably, social robots can play a crucial role in alleviating loneliness among older adults and diversifying their interactions, possibly addressing sentiments of monotony by providing added freedom, fostering autonomy, increasing engagement levels [36], and promoting attachment and social integration [141].

As an illustration, Sunshine's robot [92], a Korean-manufactured, English-speaking doll-chatbot system, engages in various activities such as playing songs, triggering reminiscences, quoting inspirational passages, telling stories, and playing "Simon Says" [94]. These interactions have the potential to encourage social engagement, and yield positive effects on geriatric depression and cognition [94], highlighting the tangible benefits of integrating social robots into the lives of older adults.

Contrary to optimistic perspectives, there were also apprehensions regarding disparities between interactions with robots and authentic human connections. The emphasis was on human interactions' unique warmth and personal touch, which may be challenging for robots to replicate.

Crucially, attending to these concerns necessitates thoughtful consideration and proactive measures during the design phase of robots intended to enhance social connections. It is imperative to recognize that the challenges stemming from perceived insufficiencies in robot-human interactions are genuine and pertinent and possible dissatisfaction points if not addressed. Moreover, emphasizing the pivotal role of design becomes paramount, highlighting its significance in overcoming these difficulties and aligning with users' preferences for a more seamless technology integration into their lives. This shift underscores the responsibility of designers to create user-friendly and adaptable solutions that cater to the unique needs and preferences of older adults.

Lifelong learning. Participants emphatically emphasized the importance of maintaining an active and meaningful life irrespective of age, stressing that sustained engagement leads to a profound sense of fulfillment. Notably, a subset of participants demonstrated openness and eagerness to learn across diverse scenarios, showcasing a willingness to acquire knowledge on various subjects, including technology and the operation of presented robots. The notion that success in learning, especially in mastering new technological tasks, translates into feelings of happiness and fulfillment was a recurring theme. This concept could extend beyond the area of technology, suggesting that acquiring new information in other domains contributes significantly to fostering a sense of well-being, self-efficacy, and agency among older adults [56].

The literature corroborates our findings, indicating that older adults exhibit a high level of motivation and active participation in mobile learning endeavors, despite generally having less experience with advanced technologies compared to their younger counterparts [77]. This resilience and proactive engagement underscore the potential for older adults to embrace and benefit from learning experiences across a spectrum of subjects, affirming the multifaceted positive impact of

ongoing education on their overall well-being.

Our participants did not foresee any negative aspects associated with learning through robots. Their enthusiasm for acquiring new knowledge and skills through robotic technology was consistently positive. This absence of negative feedback might suggest a level of acceptance of the idea of integrating robots into their learning experiences. In contrast to other values where apprehensions were reflected, to learning it was observed a readiness to engage with technology as a means to enhance their overall well-being and maintain a life with more purpose.

Travelling and (re)discovering. Participants acknowledged the benefits of incorporating robots into travel scenarios, particularly in areas like guided tours and translation assistance. Their overall positive response to the concept of remotely controlled robots for travel and exploration reflects a recognition of the potential advantages this technology could bring.

Notwithstanding this optimism, some participants were reluctant to fully embrace the idea of technology-mediated travel, expressing a distinct preference for live, tangible experiences. Their reservations centered around concerns regarding the perceived shortcomings of technology in facilitating genuine communication and shared experiences during ”virtual” travel. This skepticism aligns with previous research, which has observed that older adults tend to resist adopting assistive technologies unless there is a direct, personal need [137] [185]. Furthermore, when such needs arise, factors such as privacy concerns, costs, social stigma, and challenges related to usability and the necessity for training can act as barriers to adoption [194] [185].

This juxtaposition of recognizing the benefits of robotic travel assistance while harboring reservations about embracing technology for travel underlines the nuanced perspectives among participants. It underscores the importance of addressing not only the functional aspects of robotic travel assistance but also the emotional and experiential dimensions to enhance user acceptance and bridge the gap between technological innovation and personal preferences.

Freedom and Agency. Participants underscored the pivotal importance of maintaining an active and meaningful life, highlighting the transformative potential of robots in bolstering freedom, agency, and independence by helping them surmount inherent limitations. Notably, technological devices and systems were identified as instrumental in partially supporting the active agency of older adults [154]. However, substantial reservations surfaced in the acceptance of assistance from robots in real-life occasions, justified by a lack of trust in their abilities. Some older adults articulated a belief that robots would not be taken seriously, either by themselves or by others. This skepticism may be rooted in the limited exposure of older adults to technology, particularly that which is less simplistic and not directly related to routine tasks. Such unfamiliarity could contribute to the perception that technology is not a viable aid in more meaningful situations. As highlighted by [154], participants in their study exhibited a considerable lack of awareness regarding ’mid-tech’ or ’high-tech’ assistive devices, communication technologies, and safety systems, impeding their understanding of how these innovations could enhance independence and security

in daily activities.

Consequently, there is a pressing need to direct more attention to the strategic introduction of new technologies among older individuals, with a specific focus on overcoming the apparent fear of technology. This proactive approach is essential for ensuring a comprehensive understanding of the potential benefits and addressing the underlying concerns that hinder technology's effective integration into older adults' lives.

4.3.3 The coexistence of openness to tech and uncertainty

In all five value themes, participants demonstrated an openness to technology while concurrently expressing doubts and uncertainties about using robots for such. This duality showed a paradoxical relationship between receptiveness to innovation and apprehension about its implementation. The factors influencing this coexistence include participants' prior experiences, concerns about privacy, and the perceived complexity of robotic technology. For instance, past negative encounters with technology and the perceived difficulty of adapting to robotic interfaces contribute to the ambivalence expressed by participants. These specific concerns must be addressed to design effective interventions that facilitate the smooth integration of robots among older populations without bringing up insecurities [139] and negative self-perception of aging [107]. The outcome of the interviews showed a nuanced balance of dynamics between human emotions, societal expectations, and technological advancements that match their proficiency. While older adults may willingly embrace the concept of new technologies, practical hurdles, and perceived complexities often emerge as substantial barriers, impeding the seamless integration of these innovations into their lives, a phenomenon known as the *technology adoption gap* [9]. The technology adoption gap reflects the disparity between the eagerness to adopt innovation and the practical obstacles encountered, emphasizing the need for tailored interventions to bridge this divide among older populations [9].

The identified paradoxes highlight possible future challenges in bridging the gap between positive attitudes toward technology and the uncertainties surrounding its practical implementation. A deeper examination of these factors of the evolving relationship between humans and robots can offer valuable insights for tailored interventions for aging populations.

Chapter 5

Exploring Family HRI Scenarios with Older Adults: A Case Study

Significant challenges, such as social isolation, emerge as a significant concern, attributed to factors such as retirement, physical and cognitive changes, loss of social networks, and living arrangements [45].

The potential of information and communication technology (ICT), particularly assistive robotics, to address the challenges posed by aging is promising [41]. Assistive technologies can not only assist in tasks but also contribute to a sense of community and purpose for older adults, crucial elements for successful ”aging in place” [78] [136]. Nevertheless, challenges persist, notably in delivering consistent and equitable services tailored to the unique needs of individual users [163].

In the realm of Human-Robot Interaction, there is a growing but still limited understanding of how older adults interact with robots in domestic settings and the subsequent impact on familial dynamics and personal experiences. This study addresses this gap by focusing on using remotely controlled robots within family homes involving multiple generations. By investigating the specific activities and intentions for which older adults use these robots, we seek to comprehend their implications on family dynamics, communication, and relationships.

The core research questions guiding this study are as follows:

RQ1: What are the specific activities and intentions for which older adults use the remotely controlled robot in the family environment, and how do these activities impact family dynamics, communication, and relationships?

RQ2: How does the presence of the remotely controlled robot influence the older adults' sense of social connectedness and emotional well-being, particularly during times of social distancing or limited physical interactions?

Given the imperative to address the challenges of an aging population, this study aims to provide valuable insights into the evolving dynamics of human-robot interaction in family settings. Through interviews and observation logs conducted over a 7-day period, we aim to understand the nuanced changes in family dynamics influenced by the presence of a remotely controlled robot, identify primary activities, and derive insights crucial for the design of future domestic robots.

5.1 Methodology

This study aimed to explore the ways in which older adults employ remotely controlled robots to interact with family members, for what activities and intentions, and how it affects their relationship and their lives. To track the use and experience throughout the experiment through interviews and diary logs. Specifically, we took notice of:

- Investigating the changes in family dynamics influenced by the presence of a robot
- Identify the primary activities the robot is used for and the impact of these activities on the overall family dynamics
- Developing a comprehensive picture of the challenges and benefits of integrating robots into the family environment, especially from the perspective of older adults.
- Deriving insights to guide the design of future domestic robots, focusing on understanding the types of activities, tasks, and objectives that older adults might have for a robot in a secondary home environment.

5.1.1 Participants

The robot experiment occurred at the residence of a researcher from the research group and their family. The participants were divided between two households. Household 1 included two older adults in their 70s residing at the time of the experiment with an adult in her early 50s. Household 2 consisted of two adults in their early 40s and their two daughters, aged 9 and 13.

Each participant completed a consent form for participation (which included a short briefing of the terms of participation).

5.1.2 Procedure

Our study method started with describing our work and objectives for this study to all participants, indicating their rights and what was expected of them during the study. After reading and understanding the information leaflet and completing the voluntary consent form, sessions were held with the participants. The basics of the functioning of the robot were explained to the participants as well as how it was controlled, without going into too much detail regarding specific actions/activities and possibilities, to avoid influencing the participants and thus creating a bias.

Before any interaction with the robot, participants from both households underwent interviews to explore their concerns, expectations, and perspectives on the upcoming interactions.

The investigator conducted the follow-up of the participants, subsequently documenting the observed changes and developments, during the experimental period.

Once the experiment was over, a debriefing interview was conducted with each participant individually, to further understand possible issues, benefits and future considerations.

5.1.3 Data Analysis

The acquired data was qualitative, obtained through the audio recording of the initial interviews where the researcher and participant discussed consent. Subsequently, these interviews were transcribed and analyzed, generating documents categorized by household. These documents encapsulated information regarding concerns, opportunities, and expectations articulated by each interviewee.

Data on the experimental phase was documented by the investigator, detailing the participants' interactions with the robot throughout the case study. The records also included the participants' thoughts and opinions on these interactions, along with their evolution over time.

5.2 Findings

Overall, the findings highlight varying levels of engagement, comfort, privacy and invasion concerns and attachment among household members, providing insights into the dynamics of human-robot interaction in a domestic setting.

5.2.1 Initial interviews

The initial interviews conducted with members of House 1 and House 2 revealed a spectrum of concerns, expectations, and perspectives regarding the integration of Temi, the social robot, into their family dynamics.

House 1 - Older adults

The older adults aimed to utilize the robot to observe and engage with their granddaughters, ensuring their well-being. They expressed the intention to use the robot as a conduit for messages, such as encouraging the eldest granddaughter to study or playing with the youngest one when in control. Additionally, they expressed a desire to communicate with the adults and extend greetings to everyone. However, they also acknowledged a sense of uneasiness about potentially becoming a source of annoyance or intruding into the privacy of their family members and their lives.

When considering the reverse scenario, where the granddaughters might control the robot, the older participants expressed a positive perspective. They clarified that such a scenario would not replace the importance of their in-person interactions but rather complement them as needed.

House 2 - Adults and Daughters

The adult in House 2 expressed unease at the prospect of external control over the robot, citing concerns about potential privacy invasion. Even if it were their family controlling the robot instead of their partner's, they admitted it would still be uncomfortable, albeit to a slightly lesser extent. Similar apprehensions were voiced by the eldest daughter, who found it peculiar and invasive

that the robot could be activated at any moment, especially if controlled by someone outside the household. When asked about the reverse situation, the response remained consistent, indicating discomfort at controlling a robot in the grandparents' home without their presence.

In contrast, the youngest daughter did not express any concerns regarding the interactions and conveyed excitement about engaging more with her grandmother through the robot.

The adult in House 2 acknowledged the robot's potential for fostering surprising and positive interactions between children and their grandparents, particularly with school-aged children. Additionally, they considered the robot useful for monitoring home entries and exits, especially for the adolescent. In situations where roles were reversed, the idea of using the robot to ensure everything is okay, especially in cases where older adults face mobility impairments, was deemed valuable.

The eldest daughter recognized the value of the robot in providing companionship and conversation for the grandmother, alleviating her loneliness. She did not anticipate the robot significantly altering the family routine or dynamics but saw the potential for shared activities like watching a movie or having dinner with the grandparents, though she acknowledged the potential awkwardness of setting the table for a robot.

Furthermore, the eldest daughter suggested improvements to the robot's physical appearance, proposing a more human-like look and the addition of mechanical features like robotic arms to enable it to perform tasks akin to those of the grandparents.

5.2.2 Auto-ethnographic observations

The introduction of Temi into the household sparked a dynamic and varied series of interactions, revealing a tapestry of enthusiasm, experimentation, and evolving engagement.

The youngest daughter, driven by excitement and curiosity, greeted Temi as a companion (Figure 5.1). Her attempt to adorn Temi with necklaces and a headband reflected a desire for personalization, albeit with the realization that certain accessories interfered with the robot's functionalities. Undeterred, she focused on accessorizing Temi's "neck," showcasing her eagerness to make the interaction uniquely her own.

Experimentation unfolded as the youngest participant of Household 1 delved into the features of Temi. From in-house video calls to trying out the "Follow me" feature, where a simple gesture over Temi's head put it into follow mode. The novelty of having Temi navigate the house while she played the guide added an extra layer of engagement.

The remaining members of the household exhibited curiosity but displayed a lesser degree of enthusiasm.

The first demonstration at the grandmother's house, facilitated in the researcher's presence, was met with genuine excitement. The grandparents eagerly anticipated connecting with their granddaughters through Temi, despite encountering initial challenges in fine-controlling the robot's movements using specific functionalities. The grandmother's initial lack of awareness about the robot's setup and bidirectional connection dissipated when shown a picture of the granddaugh-

Figure 5.1: Interaction between participants through Temi

ters interacting with Temi. This visual aid illuminated the potential interactions and possibilities, deepening their understanding. However, the interactions primarily occurred when either the investigator or the adult cousin was present.

After the first few interactions, the youngest daughter assumed agency over Temi, activating the ”Follow me” mode and leading the grandparents on an exploration of the house. This showcased not only the robot’s capabilities but also the potential for personal agency and enjoyable interactions within the family.

The older adults found comfort in using Temi only when the adult cousin who is currently living with them, was present. During dinner time, they connected with the robot, engaging with family members, interacting with their granddaughters, and even venturing into the kitchen to converse with the researcher while cooking. The household delved into discussions about scenarios concerning the safety and companionship of the girls when home alone. While these scenarios hadn’t transpired, the potential benefits, such as checking on the granddaughters after school, were acknowledged.

Despite initial reservations, the family became attracted to the connection that Temi fostered. The robot facilitated daily interactions between the grandparents and the granddaughters, providing a unique avenue for communication beyond routine daily conversations.

However, some interesting dynamics emerged, such as the youngest granddaughter/daughter occasionally forgetting about Temi after some interactions leaving it to wander around the house without paying attention to it, highlighting the difference between in-person interactions and technology-facilitated ones.

Additionally, upon Temi’s connection, if the oldest daughter/granddaughter happens to be in the bathroom with the door slightly ajar, she promptly closed the door out of concern that Temi

might inadvertently enter, displaying a remaining concern regarding her wish for privacy.

Notably, there was a period during the experiment where Temi remained disconnected in a corner for over a week, surprising the observers as it was mentioned but mostly ignored. The experiment's conclusion reflected a mix of emotions within the household—while the majority expressed happiness, the youngest participant showcased a heightened attachment to Temi's presence and potential interactions. The grandparents, demonstrated increased engagement and enthusiasm, emphasizing the enduring impact of Temi on their daily lives.

In summary, the findings underscore the nuanced dynamics and evolving roles within the household as they interacted with Temi. The social robot proved to be a catalyst for increased connection, amusement, and exploration, presenting both positive and challenging aspects throughout the experiment.

5.3 Discussion

The initial interviews across the two households uncovered a spectrum of concerns, expectations, and perspectives regarding Temi's integration and how the robot would cherish or erode established values. Additionally, we discuss the affiliation and the boundaries that influence the use and interaction dynamic.

5.3.1 Values

Cherished Values - *connection, communication, control, safety, care* The main focus of the positive values lies in the desire for enhanced connection and communication. From the grandmother's perspective, the robot opened a new portal to interact with the granddaughters, and engage in their lives, transcending the barriers of physical distance. The robot extended her level of communication, where the robot became a beacon of care, safety, and control, significant values for someone whose role is to be a guardian. The grandmother views the robot as a primary means to maintain a visual and interactive connection. Her approach is influenced by a desire for closeness and involvement in their lives, a traditional aspect of the grandparent-grandchild relationship. All the participants recognized the robot's potential to connect and viewed it as a positive aspect of technology in supporting familial ties.

Threatened Values - *privacy, invasion, autonomy concerns* Conversely, with the integration of the robot in House 2, concerns were raised regarding value collision and erosion.

Value Collision: The concept of privacy took center stage, with apprehensions about the robots' potential to infringe upon personal space and moments, mainly by the teenager and the mother. Interestingly, these privacy concerns intersect with the grandmother's value of care. While her intention is to maintain a connection and look after her family, the method – using a remotely controlled robot – inadvertently clashes with the family's need for privacy. Privacy invasion and the fear of external control revealed diverse and sometimes conflicting attitudes toward integrating

a social robot into family life 5.2. Seelye et al.'s research corroborates these concerns, highlighting similar issues in the context of teleoperated, remote-controlled communication technologies used with older adults and their families [157]. We could observe a value collision between the existing values of the family and the implications of introducing a robot to their family dynamic. The robot's capabilities and the family's traditional values may not align seamlessly, leading to tension or discomfort. Therefore, the family's articulated need for control mechanisms, such as designated robot-free areas or scheduled connection times, emphasized the necessity for tailoring technology to support the natural dynamics and values of the household.

Figure 5.2: Desires and Concerns regarding value operationalization of each participant

Value Erosion: Over time, the robot's presence and potential overreach could diminish the family's sense of privacy and independence. This erosion might not be immediate or obvious but can manifest in subtle changes in the family's behavior, perceptions, and comfort in the robot's presence. Aside from the teenager and the mother, the grandmother also realized the potential intrusiveness of her control over the robot, which reflected concerns about eroding family members' autonomy and independence. This dual perspective highlights a common dilemma in modern technology use: the trade-off between connectivity and personal space. Additionally, this aligns with the concept that technology, if not thoughtfully developed, can diminish core values rather than enhance them [63].

5.3.2 Affiliation of the robot and boundaries

Following the introduction of Temi, auto-ethnographic observations unveiled a dynamic series of household interactions and responses. In House 2, the youngest daughter exhibited enthusiasm, curiosity, and eagerness for a personalized approach to Temi's interactions, displaying a higher

engagement level than other household members. The younger daughter attempted to humanize the robot by decorating it, suggesting a level of comfort and familiarity that transcends the robot's use. Conversely, the grandmother employed Temi to observe and engage with their granddaughters and other family members.

Affiliation with different participants varied based on the situation and was influenced by who controlled or interacted with the robot. For instance, when the grandmother directed Temi to play with her granddaughter, affiliation focused primarily on her. In contrast, when the youngest granddaughter in House 2 employed the "follow me" mode, the affiliation dynamically shifted toward her as if the granddaughter was holding the grandmother's hand and bringing her around the house.

Notably, the older adults were hesitant to use the robot independently, preferring to engage with it only when accompanied by a technologically proficient adult family member. This introduced a boundary in the robot's usage, potentially influencing the grandmothers' interactions with family members. However, it might be a matter of time for participants to acclimate to the device, gradually becoming more comfortable operating the robot with increased practice [157]. The assessment uncovered the potential for Temi to facilitate increased daily interactions between older adults and their families, presenting a unique avenue for communication beyond routine daily conversations. Research indicates that digital communication technologies have the potential to enhance social connectedness, fostering meaningful social interactions [81] [15]. These technologies can play a role in mitigating both loneliness and social isolation in later life [81] [15]. Additionally, the findings revealed that the presence of Temi may influence the older adults' sense of social connectedness, engaging them in the interactions and heightening their interest and enthusiasm for the possibilities. However, the engagements of the older adult may have been constrained by personal limits, such as the apprehension of causing inconvenience or intruding on the family's privacy. Additionally, the availability of certain family members might have been restricted by their own boundaries and concerns. In contrast, the youngest granddaughter exhibited no reservations in embracing the interactions, cherishing her time with her grandmother, and remaining indifferent to potential privacy issues. Her excitement and personalized interactions demonstrated the robot's potential to positively impact emotional well-being, allowing her to engage in activities of her liking, thereby fostering relationships with others [121].

5.3.3 Family, robots, and tomorrow: contextual considerations for social robots at home

Our exploration with Temi illuminated multifaceted challenges, including the delicate balance required for incorporating a social robot into daily life without disrupting established routines and cherished values. Perhaps the most crucial takeaway from our study is the need for tailored technological solutions in familial contexts that respect each other's values without collisions or erosion. This balance is more than a technical challenge; it's a human-centered balance where understanding and empathy are as crucial as technological innovations. As we observed, the introduction of

Temi could potentially impact core family values like autonomy and independence. To mitigate this, design solutions must be sensitive to each household's unique dynamics and family-centric. Design solutions must therefore be sensitive to the diverse dynamics of families, considering factors such as generational differences, privacy needs, and perhaps, robot-free zones, alert mechanisms during connections, and structured interaction schedules. As we introduce robots in homes in the future, these technologies must respect and reinforce core family values. Our study has highlighted the importance of considering multiple perspectives in developing and implementing social robots. Each family member interacts and perceives the robot differently, and these diverse viewpoints must be acknowledged and addressed in the design and implementation process. This approach ensures that the technology is functionally effective and emotionally and socially compatible with all the users. This includes ongoing dialogue with the users to understand evolving needs, the impact of technology on the family dynamic, and the family ethical standards.

In conclusion, our case study with the Temi robot revealed and showcased the subtle perspectives, concerns, and importance of a value-sensitive design approach. As we move forward, these findings will be instrumental in guiding the development of social robots and other similar technologies, ensuring that they uphold the values of multiple people and are tailored in a way that collisions between values are mitigated.

Chapter 6

Conclusions and Future Directions

This work emerges in the context of robots, older individuals, and value-sensitive design principles. While the development of robots has primarily focused on functionality and assistance, there is a growing recognition of the importance of designing robots that foster agency and align with the values of their users. The design of robots for older people should extend beyond mere assistance to consider the social and emotional dimensions of human-robot interaction.

The future of robotics in older adult care lies in creating robots that perform tasks and crafting robotic companions that understand and respect the values of older individuals. Robots designed through a value-sensitive lens can enhance older individuals' social fabric, providing companionship and assistance that aligns with their values. The field of robotics for older people should prioritize designing robots that go beyond functionality to embrace the values and agency of their users.

Through the first exploratory study (Chapter 3), we gathered valuable insights and information regarding older adults' experiences with values, how they used technology to operationalize them, or how they wished they could use it. More specifically, we approached 15 older adults through individual interviews.

The study shedded light on the experiences and perspectives of two distinct groups—those aging in place and individuals in care homes—revealing commonalities and disparities in their interactions with technology.

Social connections emerged as a foundational pillar of well-being for both groups. While technology is recognized as a potential facilitator for bridging gaps in social ties, there is a nuanced perspective that underscores the importance of authenticity and the "human side" in interactions.

Technology is viewed as having a potential role in altruistic endeavors, particularly in care homes where a hands-on approach to altruism is observed, driven by empathy and personal concerns about their future well-being. Participants express interest in using technology for philanthropic purposes, recognizing its efficiency and reach Freedom and agency manifest diversely, with aging in place individuals associating it with financial independence, personal beliefs, and health, while those in care homes intertwine it with social relations, personal autonomy, and the comforting notion of having a place to call home.

The desire to (re)discover new places and engage in lifelong learning underscores the multi-

faceted motivations of older adults.

Aging-in-place individuals express enthusiasm for technology-enabled travel, recognizing its cost-efficiency and ability to overcome physical barriers. In contrast, individuals in care homes may be more hesitant due to concerns about triggering negative memories and the sensory limitations of virtual exploration. Older adults in both living contexts acknowledge technology's role in facilitating lifelong learning. It is seen as a means to access new information, pursue interests, and stay connected.

Older adults perceive technology as a potential facilitator in manifesting their values, but this perception varies across living contexts. While there is recognition of technology's benefits, a pervasive skepticism exists, shaped by concerns about unfamiliarity, privacy invasion, and the potential impact on core values. Understanding these nuanced perspectives is crucial for designing technologies that align with older adults' diverse needs and values, ensuring inclusivity and enhancing their overall well-being.

In the second phase of our work, we applied the acquired knowledge and designed a set of 15 HRI scenarios. These scenarios were then presented to 6 older adults during individual co-design sessions (Chapter 4). Scenarios related to Social Ties, Life-long Learning and Freedom and Agency were the ones with the most overall acceptance. Traveling and (Re)Discovering scenarios, although received with general openness and enthusiasm, a yearning was expressed for the interpersonal aspects of these experiences. The Altruism scenarios were met with varied responses. While some were willing to help and receive help using robotics, concerns about willpower, pride, and past negative experiences with altruism tempered these positive inclinations. Negative perceptions, reluctance, and uncertainties about societal readiness were also evident.

Value-Sensitive Design (VSD) emerges as a powerful tool to alleviate these concerns. By crafting technology from the ground up with active participation from older adults, we proactively address suspicion and skepticism. This inclusive design approach not only puts end users at ease but also cultivates a heightened sense of purpose and alignment with the robotic system. Consequently, individuals feel more trusting and comfortable in their interactions with the technology.

We conducted the assessment of a live prototypical Human-Robot Interaction (HRI) scenario, involving the remote control of a Temi robot by older adults in their family's home, as detailed in Chapter 5. During this experiment, we observed a dual intention among the older adults in House 1. They aimed to use Temi to observe and engage with their granddaughters while also expressing concerns about potential intrusion into family privacy. Despite these reservations, participants acknowledged Temi's potential to foster connections and viewed it positively as technological support for familial ties.

In contrast, adults and children in House 2 exhibited diverse attitudes, showcasing a mix of unease and excitement about Temi's potential. Concerns about privacy invasion and external control were prominent, indicating varied and conflicting perspectives on integrating a social robot into family life. Addressing these challenges may involve implementing control mechanisms to ensure the comfort of all involved parties.

The presence of Temi appeared to enhance the older adults' sense of social connectedness, eliciting increased interest and enthusiasm for its possibilities despite their close proximity to family members. Addicionally, the interactions of the youngest granddaughter underscored the potential for emotional well-being, as she engaged in activities tailored to her liking.

The expected core values operationalized during this case study, mainly related to Social Ties, and Freedom and Agency, were verified. The primary tasks undertaken by the older participants involved conversing with their family members and playing with their granddaughter.

This study underscores the diversity in perspectives among older adults when examining identical core values and their practical implementation, mainly through technological means. It highlights the necessity for technological adaptability, especially in catering to the unique preferences and needs of older adults as end-users. The pivotal takeaway is the importance of tailoring robotic designs to align with the varied expectations of older adults, underlining its significance for ensuring the effective and successful integration of technology in this demographic.

6.1 Limitations

While the studies provide valuable insights into older adults' perspectives on technology and values, some limitations should be acknowledged.

The number of participants, in the interview phase (chapter 3) and co-design sessions (Chapter 4) was relatively small and even more in the live prototypical HRI scenario evaluation (Chapter 5). This may limit the generalizability of the findings to a broader population of older adults.

Relying on participants' self-reported experiences and perspectives introduces a potential for subjectivity and social desirability bias. Participants may shape their responses based on what they believe is socially acceptable, affecting the accuracy of the information provided. Despite our efforts in designing the interviews and analyzing the resulting data with this concern in mind, addressing this issue remains challenging and may not have a straightforward resolution. When considering the scenario evaluation (chapter 5) The initial excitement and engagement observed might be attributed to the novelty effect, where participants were intrigued by the new technology. Over time, this novelty effect could wear off, potentially impacting the sustained use and interest in the social robot.

Lastly, the studies offer a snapshot of older adults' perspectives at a specific moment. A more longitudinal approach could provide a more comprehensive understanding of how these perspectives evolve over time and in response to technological changes.

6.2 Future Prospects

We contend that the exploration of adaptable assistive robotics remains an area rich in potential but relatively underexplored. While we acknowledge the relevance of our current findings, there exists a scope for delving more profoundly into the values we've examined, bearing in mind the acknowledged limitations. Additionally, there is an opportunity to explore other values that, though

not as prominently emphasized, might significantly contribute to fostering an active, joyful, and independent aging experience.

A more comprehensive investigation into Human-Robot Interaction (HRI) scenarios involving older adults could involve the development of prototypes for experimental purposes, allowing for a more concrete understanding and conclusive insights. A protracted iterative process of prototyping and experimentation holds promise not only in conceptualizing truly adaptable robots but also in comprehending how these robots could evolve, particularly in response to the changing capacities of older adults.

Another pertinent avenue for research involves identifying interfaces that best assist older adults in operationalizing their values. Considering the diverse physical health conditions among older adults, it is crucial to explore adaptable interfaces tailored to specific tasks and individual needs.

Lastly, delving into the learning methods and approaches that most effectively facilitate older adults' understanding of new assistive technologies and robots is a valuable research pursuit. This exploration should aim to inform the creation of intuitive and easily mastered technologies, ensuring seamless integration into the lives of older adults.

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Appendix A

Understanding Older Adults' Core Values and the Impact of Technology - Informative Briefing

PROJECTO: Projeto participativo/co-criação para explorar e construir cenários tecnológicos para alcançar valores humanos
INVESTIGADOR RESPONSÁVEL: Tiago Guerreiro

Vimos desta forma convidá-la/o a participar no nosso estudo de investigação focado em explorar cenários relacionados com valores e objetivos dos idosos, relacionados com funcionalidades da robótica assistiva.

Antes de decidir, gostaríamos de lhe apresentar os detalhes desta investigação, a sua razão de ser, a sua utilidade potencial e as implicações da sua participação. Um membro da equipa da investigação irá acompanhá-lo na leitura deste folheto e responderá a quaisquer perguntas que queira fazer.

1 - Em que consiste o estudo? Este estudo tem como objectivo a recolha de informação relativa aos valores e objetivos dos participantes para que seja possivel o co-desenho de cenários relativos a tecnologia assistiva que operacionalize esses valores e objetivos. Este estudo tem como base diretrizes e principios descobertos num estudo anterior onde junto de pessoas idosas descortinamos possiveis objetivos e prioridades desta população.

2 - Tenho de participar neste estudo?
A participação no estudo é totalmente voluntária. Vamos descrever o estudo e apresentar o conteúdo deste folheto informativo, incluindo os detalhes da sua participação. Se concordar em participar, irá assinar um Formulário de Consentimento. Serão-lhe fornecidas cópias deste documento e do Formulário de Consentimento informado.

3 - E se eu desejar desistir do estudo?

É livre de desistir, em qualquer altura, sem ter que fornecer quaisquer razões ou explicações.

4 - O que terei de fazer no âmbito do estudo?

No âmbito do estudo, irá participar numa primeira sessão de ideação de cenários tecnológicos e, caso seja necessário, participar em grupo, numa segunda sessão de refleção sobre os cenário criados.

Cada sessão demorará um tempo máximo de 1 hora mas não tem um tempo mínimo obrigatório.

O objetivo da investigação é perceber como se relaciona com cada tema tecnológico. Não tem como objetivo avaliá-la/o a si, sendo que não existem respostas certas ou erradas. Trata-se apenas da sua opinião. Todas as recomendações e melhorias sugeridas permitirão fazer evoluir a investigação e são bem-vindas.

5 - Quais as desvantagens e riscos de participar?

Não estão previstos quaisquer riscos associados e a expectativa da equipa de investigação é de que as sessões em que participar sejam uma experiência agradável para os participantes.

6 - Quais os possíveis benefícios de participar?

De acordo com a nossa experiência, as pessoas gostam de participar em estudos que promovem a comunicação com cientistas. O seu envolvimento irá ajudar a desenvolver tecnologia que poderá ajudar outras pessoas no seu quotidiano.

7 - O que acontece quando o estudo terminar?

A análise dos dados terminará em julho. Os resultados do estudo serão publicados em conferências e revistas académicas. Se desejar saber detalhes sobre os resultados e implicações do estudo, fazer-lhe-emos chegar uma cópia do relatório do estudo, mas não antes de outubro.

8 - E se ocorrer algum problema?

Se tiver alguma preocupação sobre qualquer aspecto deste estudo, deve falar com o investigador responsável, Prof. Tiago Guerreiro, que fará o seu melhor para o elucidar e responder às suas dúvidas, por telefone, 965360737 ou e-mail, tjvg@di.fc.ul.pt. Caso esteja descontente ou queira apresentar uma queixa formal, pode fazê-lo contactando o Diretor da Faculdade de Ciências da Universidade de Lisboa [e-mail: direccao@fc.ul.pt].

9 - A minha informação será mantida confidencial?

Sim. Seguiremos todas as práticas éticas e legais e toda a informação sobre si será tratada de forma absolutamente confidencial. Para garantir a anonimidade, os registos pessoais estarão apenas disponíveis na sua integralidade, para o investigador responsável, e os membros da equipa de investigação apenas terão acesso aos dados que necessitarem de conhecer. Se os seus dados forem usados para publicações ou apresentações, serão totalmente anonimizados, sem qualquer referência, directa ou indirecta, à sua identidade. Se forem tiradas fotografias, e for nossa

intenção usá-las em alguma apresentação, será-lhe pedida autorização prévia. Se estiver disponível para que usemos fotografias ou vídeos para esse propósito, pedir-lhe-emos primeiro que assine autorizações específicas com esse objectivo.

10 - O estudo passou por um processo de revisão?

Sim. Com efeito, este estudo foi revisto pela Comissão de Ética de Ciências (https://ciencias.ulisboa.pt/pt/comissao-etica-ciencias). Esta comissão analisou a proposta de estudo, bem como todos os seus materiais e não levantou objeções do ponto de vista ético.

11 - Quem posso contactar relacionado com este estudo?

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Sinta-se à vontade para os contactar em qualquer matéria relacionada com este estudo. Muito

Obrigado. Obrigado por nos ter dedicado este seu tempo e por considerar participar neste estudo.

O Investigador Responsável

Appendix B

Understanding Older Adults' Core Values and the Impact of Technology - Informed consent

1. Confirmo que li e compreendi o folheto informativo associado ao projecto.
2. Foi-me dada a oportunidade de ler e considerar a informação apresentada, e fazer perguntas, as quais foram respondidas de forma satisfatória.
3. Compreendo que a minha participação é voluntária e que sou livre de desistir do estudo em qualquer altura, sem ter que dar quaisquer explicações e sem quaisquer consequências.
4. Compreendo que os dados recolhidos durante o estudo possam ser do conhecimento dos membros da equipa de investigação, sempre que necessário para o estudo. Autorizo que os membros da equipa tenham acesso a esses dados.
5. Compreendo que, caso esta investigação venha a ser publicada, todos os dados serão mantidos anónimos e nenhuma informação será identificável como sendo minha.
6. Gostaria que me fosse enviado o relatório final do estudo.
7. O meu endereço de e-mail é:
8. Gostaria de ser contactado para o endereço acima acerca de sessões ou estudos adicionais relacionados com este estudo.
9. Declaro que não comuniquei nenhuma razão potencial de qualquer natureza que constitua um eventual factor de risco para a minha saúde ou integridade física.
10. Declaro que participo neste estudo sem qualquer remuneração ou contrapartida, para além do ressarcimento das despesas em que tiver incorrido ou compensação simbólica pelo meu tempo.
11. Declaro que aceito que as minhas entrevistas sejam gravadas em áudio.

12. Declaro que tomo a minha decisão de forma inteiramente livre.

13. Concordo em participar neste estudo.

Appendix C

Understanding Older Adults' Core Values and the Impact of Technology - Interview Script

We discussed previously with elders, and we found that people state connections with family, friends, and neighbors or social networks in general as very relevant in their lives.

1. What is the role of social connections in your life? With whom?
2. From your experience, how frequently would you like to be in contact with people? Daily, Weekly? At what point would it become too much?
3. Which means do you use to communicate? Written letters/texts? Social activities? Phone calls? Videocalls?
4. Aside from the ones you mentioned, do you envision other means?

In a previous study, we found that one of the things people wished more was helping others. For example, people mentioned taking action through volunteering, helping family members, helping other elders at institutions, neighbors.

1. How do you define altruism in your life?
2. Do you have someone specific you would like to help?
3. What would you like to be helpful with?
4. Would you like technology to assist you in being an altruist and helping others?
5. To what extent would you feel comfortable (would be appropriate) using technology to be altruistic?
6. What tasks/situations you don't want help from technology to exert altruism?

A situation we found previously was that people wanted help to be freer and have more control over their lives/future. This can be a reality in many contexts.

1. Looking at yourself, what does it mean to be free in your life stage?
2. In what situations do you feel like you want to achieve more freedom/independence in your daily life?
3. Imagine that you can totally control the technology you are using to be freer. How would you feel depending on it to be freer?
4. In what way can technology help you to be freer?
5. What would be something related to your freedom that you would dislike technology helping you with?

We discussed previously with elders that some people value learning throughout their lives. This can be related to new knowledge, re-learn past knowledge, or additions to existing knowledge.

1. At this stage of life, what are your thoughts on learning?What have you learned recently? What does it bring to you? Can you apply that knowledge? Is it essential to apply that knowledge?
2. What do you think is more important to learn while being a retired person?
3. What format of learning do you think can bring more benefits to you? Through another person, a smartphone, a computer, a robot, classes, alone, in a group, text, video, through other elders, through younger people. . . ?
4. Do you feel you have more to teach or to learn at this point in your life?

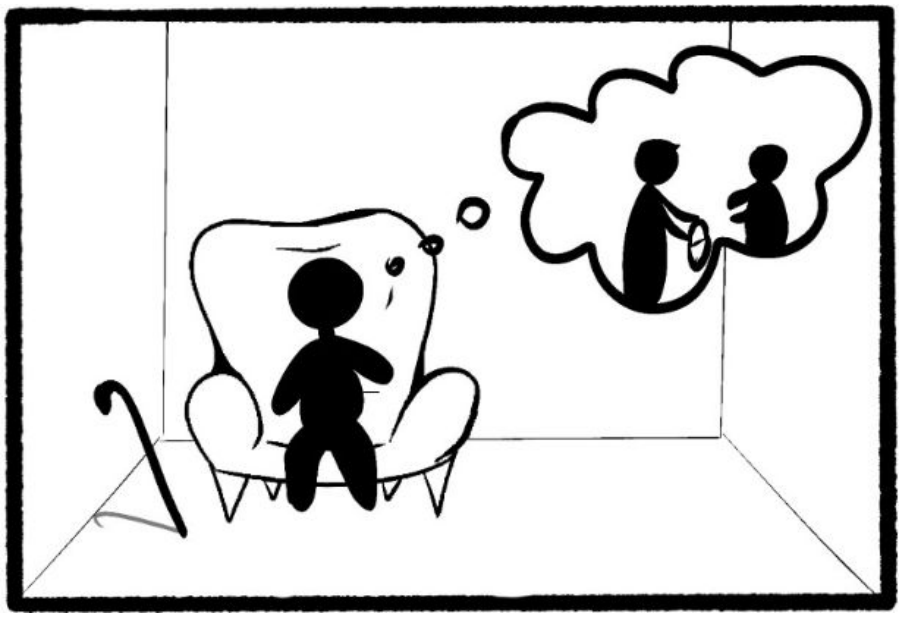
You might have traveled, lived abroad, or known places around this country or even around the globe throughout your life. In past interviews, we discovered that people like to remember past places, and some people might even want to revisit past places.

1. Are there places that you would like to visit or revisit? Which ones?
2. What brings you back to that place? What is more relevant to you? Emotions? People? Places? Experiences? Food? Smell?

Appendix D

Co-designing Value-Sensitive HRI Scenarios - Storyboards

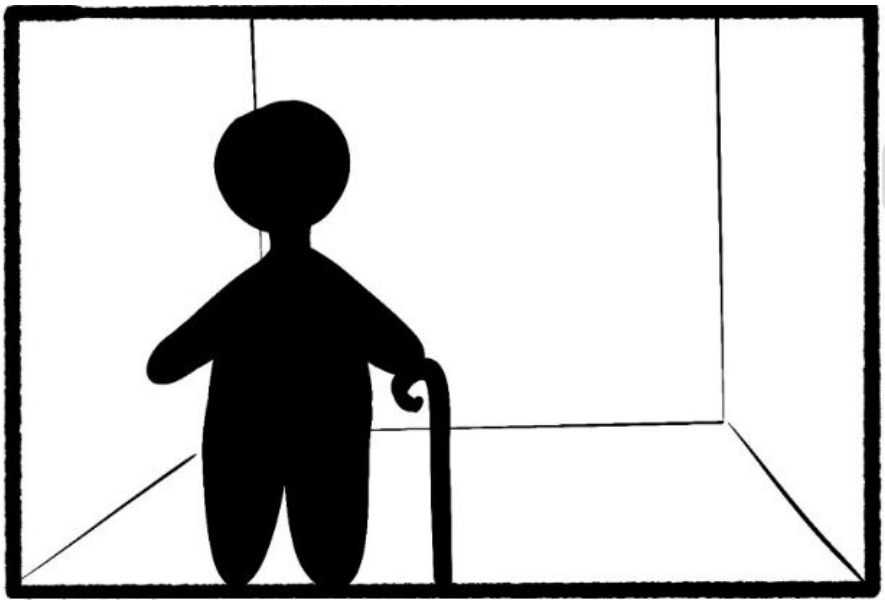
Cenário 1



João é um homem aposentado de 72 anos que mora sozinho. Ele guarda com carinho as suas memórias de quando era ativo na comunidade, especialmente quando se voluntariava para ajudar os mais necessitados.

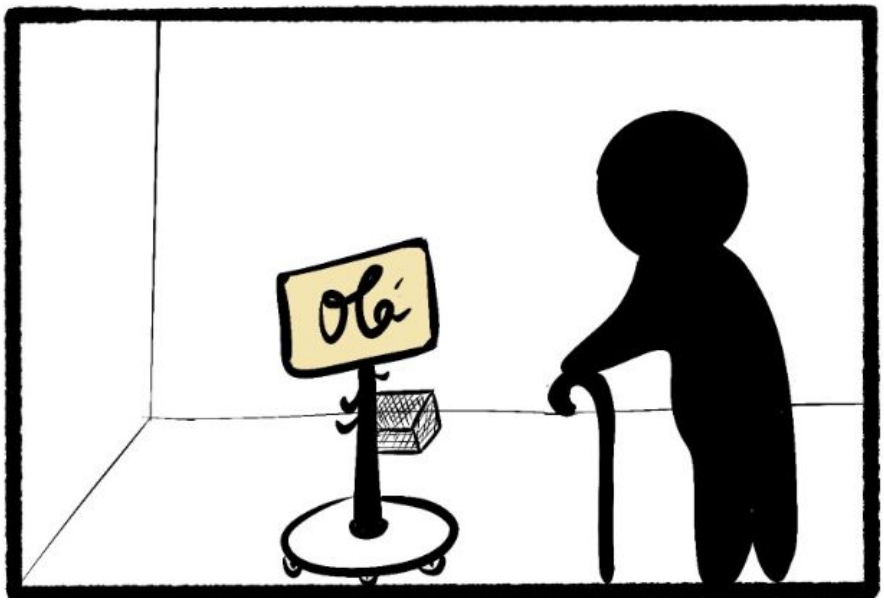
1

Cenário 1



João enfrenta desafios de mobilidade física que lhe dificultam sair de casa, não o permitindo atingir o seu desejo de se envolver no serviço comunitário.

Cenário 1



João descobre que a biblioteca pública local possui um robô que dá para programar e que foi criado para responder às necessidades da comunidade. Percebendo o potencial do robot para ajudar a comunidade, ele inscreve-se para assumir o controlo do robô durante alguns dias da semana, com o objetivo de usar mais uma vez a sua energia altruísta para o serviço comunitário.

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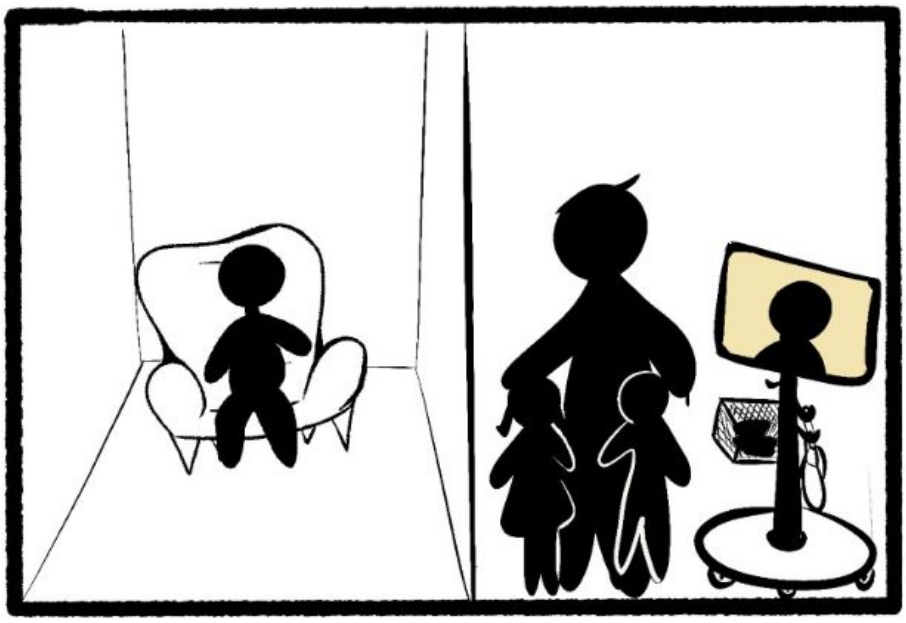
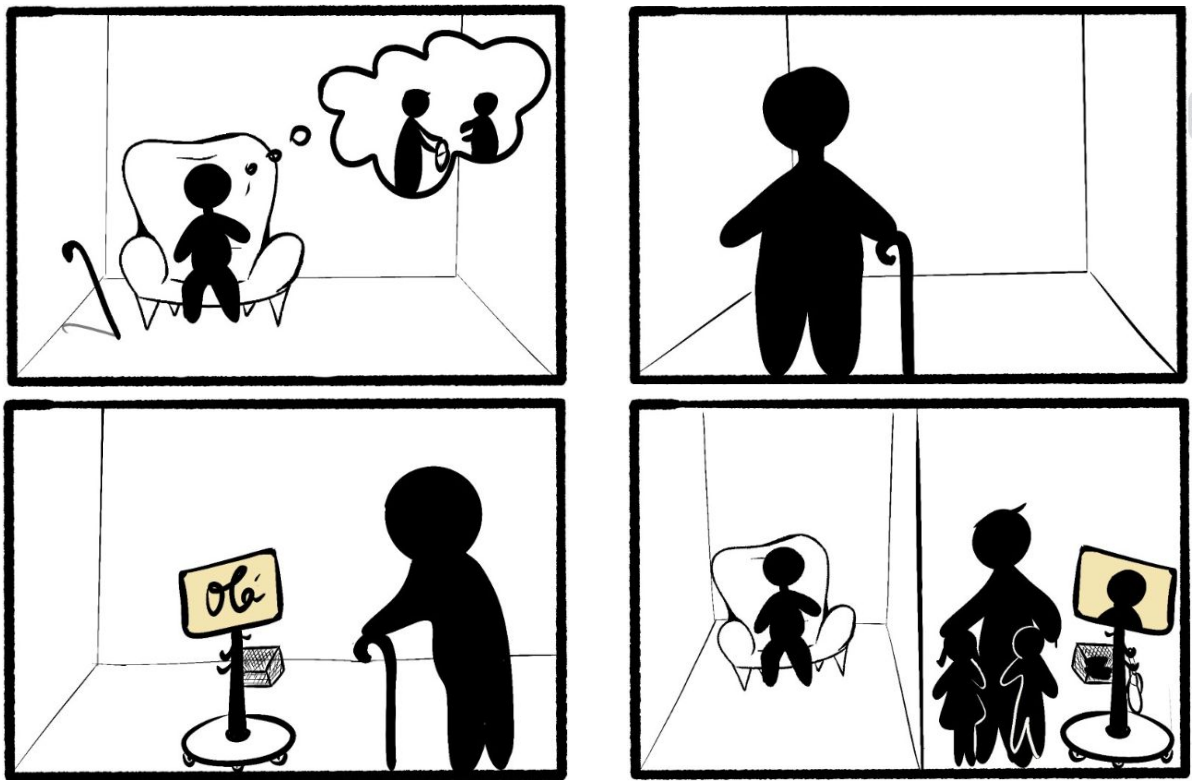
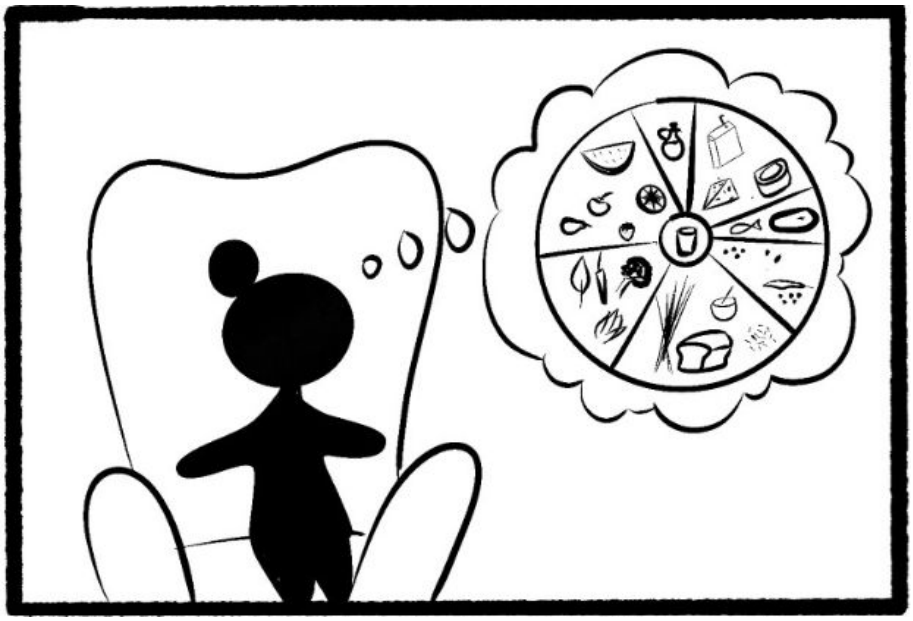


Agora, estando na sua casa e através do robot, João está novamente envolvido na sua comunidade. Ele usa o robô para entregar livros a pessoas que moram sozinhas em casa, ajudar a contar histórias on-line para crianças e até prestar ajuda em eventos locais. Apesar dos seus problemas físicos, o João contribui ativamente para o bem-estar da sua comunidade.

Cenário 1

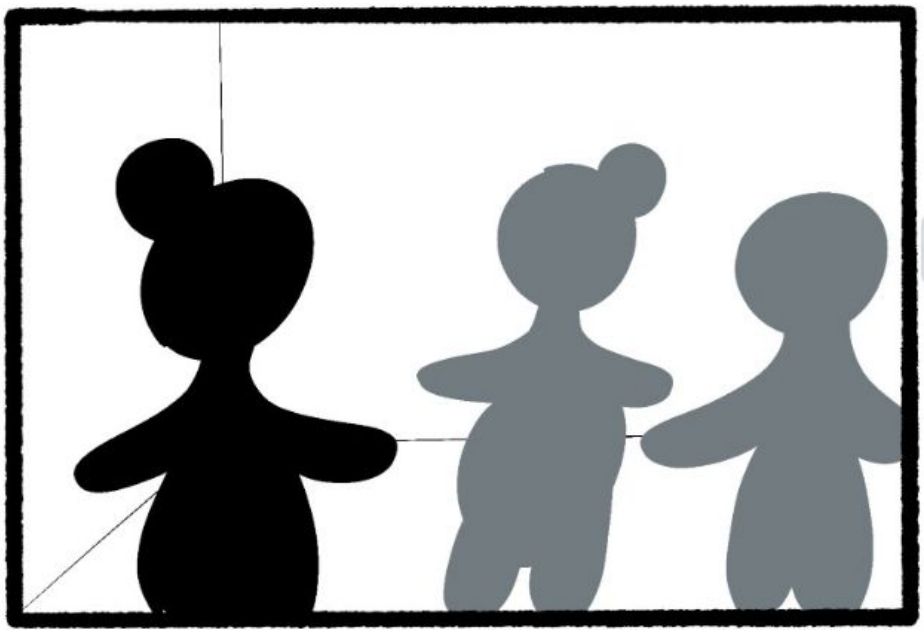


Cenário 2



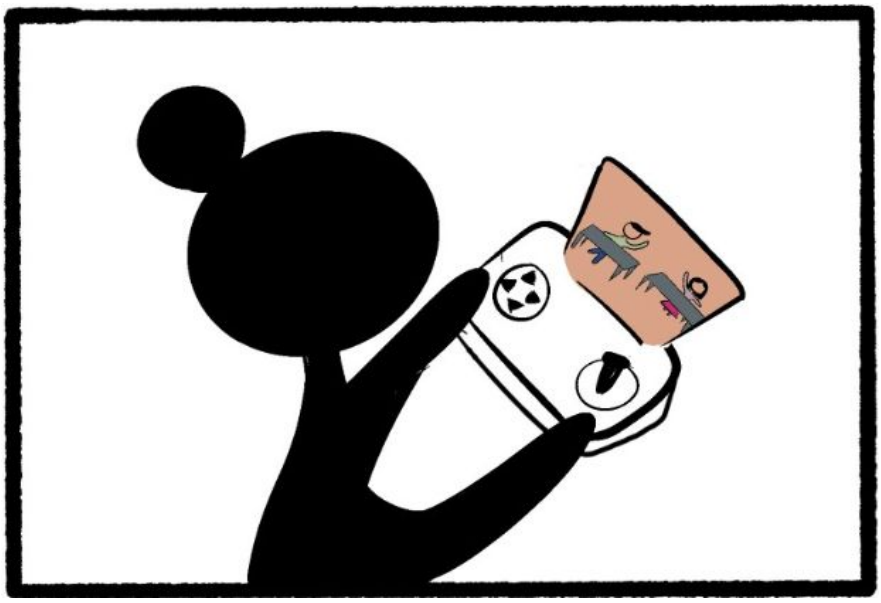
Cristina, uma nutricionista de 76 anos, vive numa casa de repouso. Durante a sua vida foi adquirindo conhecimentos sobre nutrição que está entusiasmada por partilhar com as gerações mais jovens.

Cenário 2



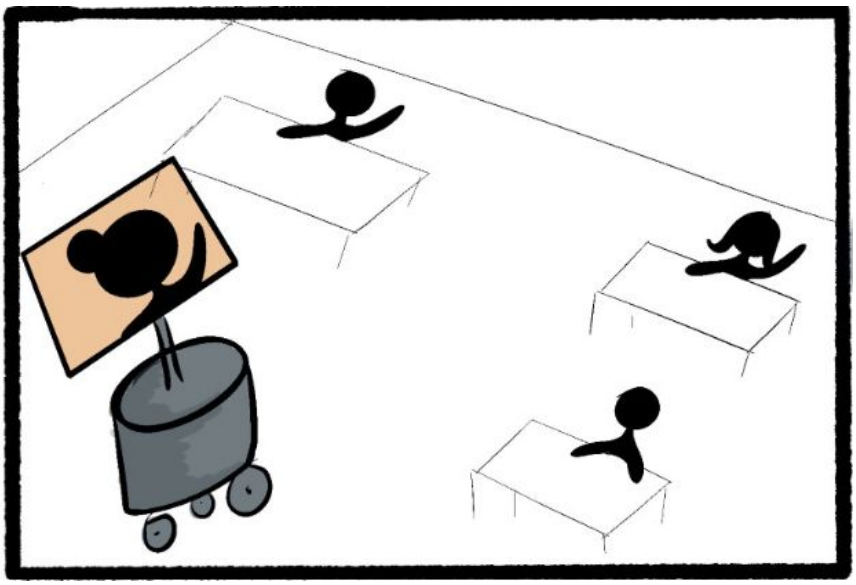
Como a Cristina só tem contacto com os colegas no lar de idosos, ela não consegue cumprir com o desejo de transmitir aos jovens o seu conhecimento relacionado com uma alimentação saudável. Ela quer partilhar a sua experiência nutricional com pessoas que podem beneficiar desse conhecimento.

Cenário 2



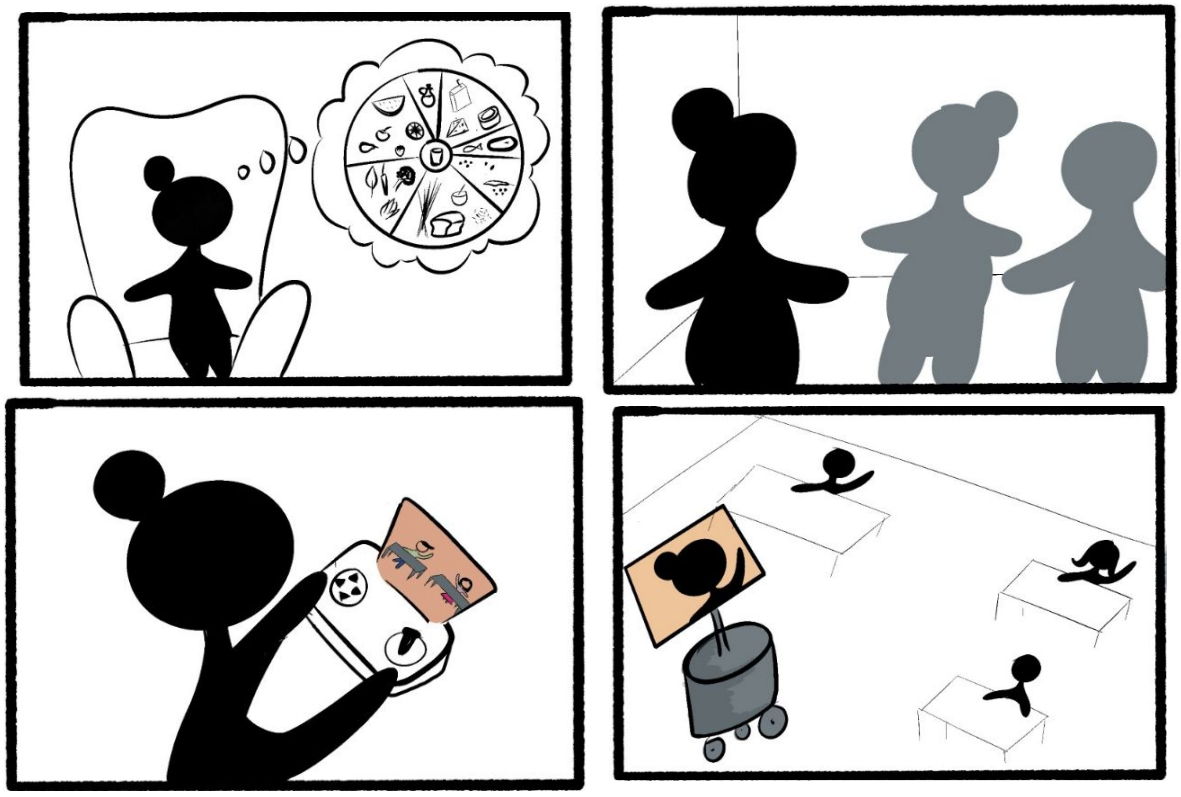
Sabendo da intenção de Cristina, o diretor do lar de idosos apresenta-lhe um robô de última geração. Este robô é controlado remotamente e pode interagir com os alunos de uma escola local à distância. Equipado com câmaras, microfones e altifalantes, o robô torna-se a forma como a Cristina partilha conhecimento nutricional.

Cenário 2

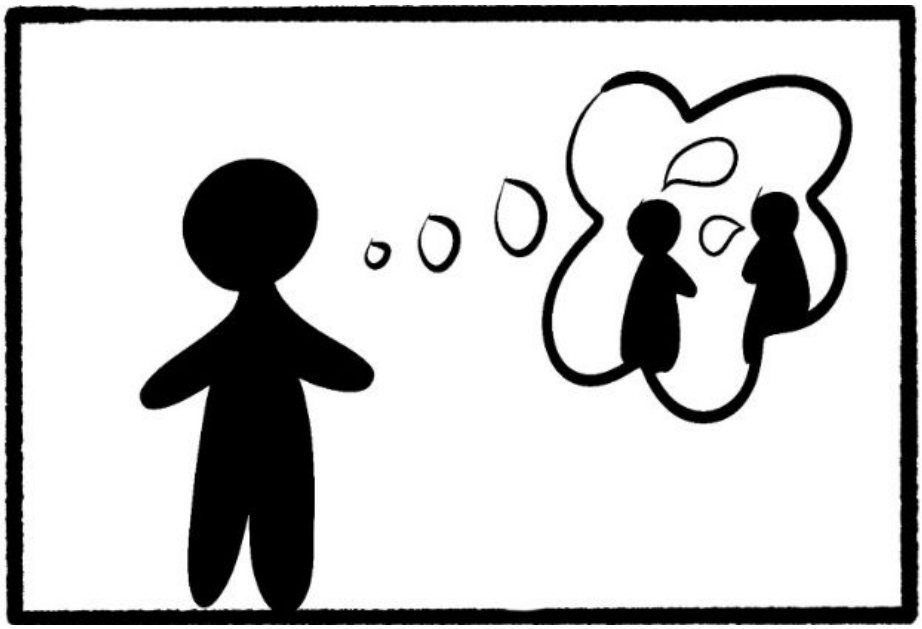


Tendo o robô como mensageiro, Cristina entra virtualmente nas salas de aula, falando sobre nutrição e o seu impacto na saúde. Cristina encontra um novo propósito através do robot e ensina os alunos sobre nutrição e alimentação saudável.

Cenário 2



Cenário 3



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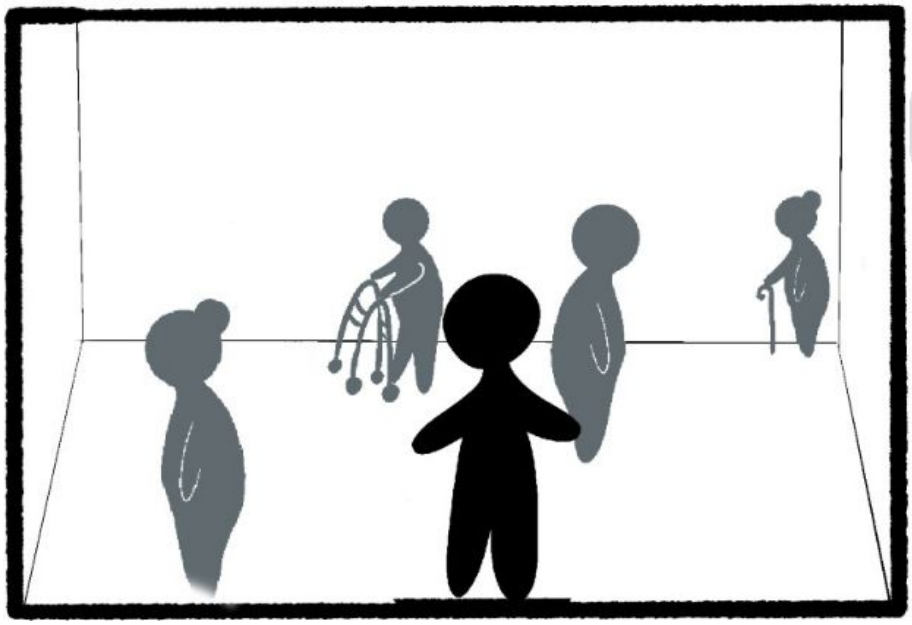
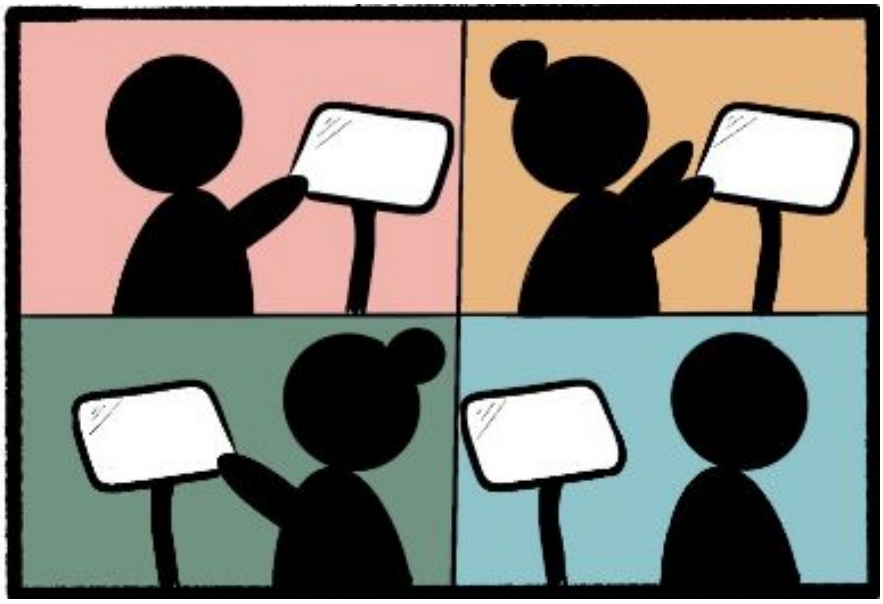
Júlio é um homem de 92 anos que reside numa casa de repouso. Ele adora interação social, desfrutando de conversas animadas e fazendo novas amizades.

Cenário 3



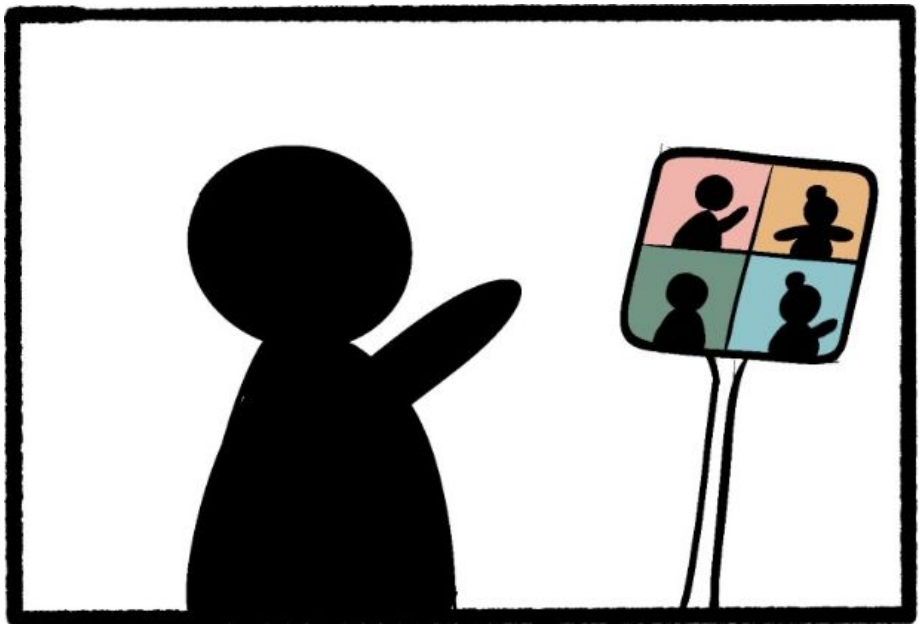
Como o Júlio está na casa de repouso, ele sente-se limitado a interações apenas com outros residentes e funcionários. Júlio começa a sentir-se emocionalmente preso. Ele sente falta da diversidade e da energia que costumava ter ao conhecer novas pessoas.

Cenário 3



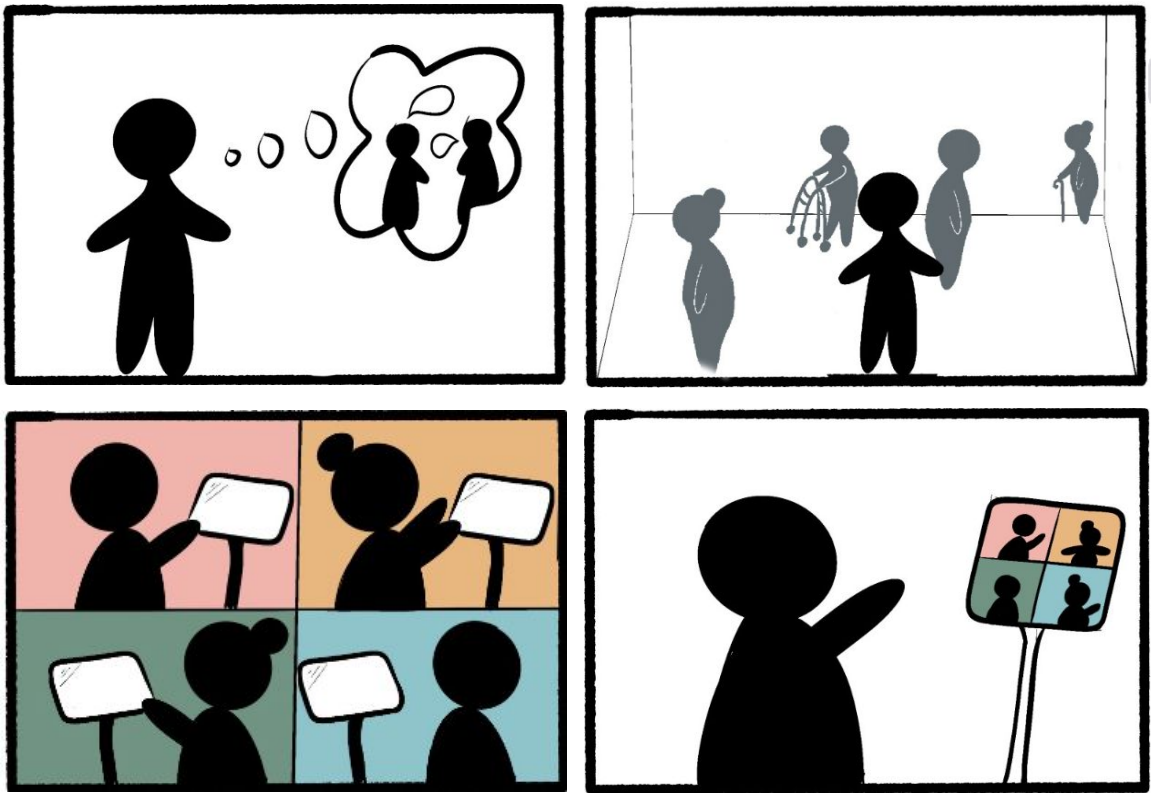
A casa de repouso investe num robô para socialização, capaz de se conectar com robôs noutras casas de repouso. Estes robôs são feitos para ajudar em encontros sociais, ligando residentes de diferentes casas de repouso para criarem amizades.

Cenário 3

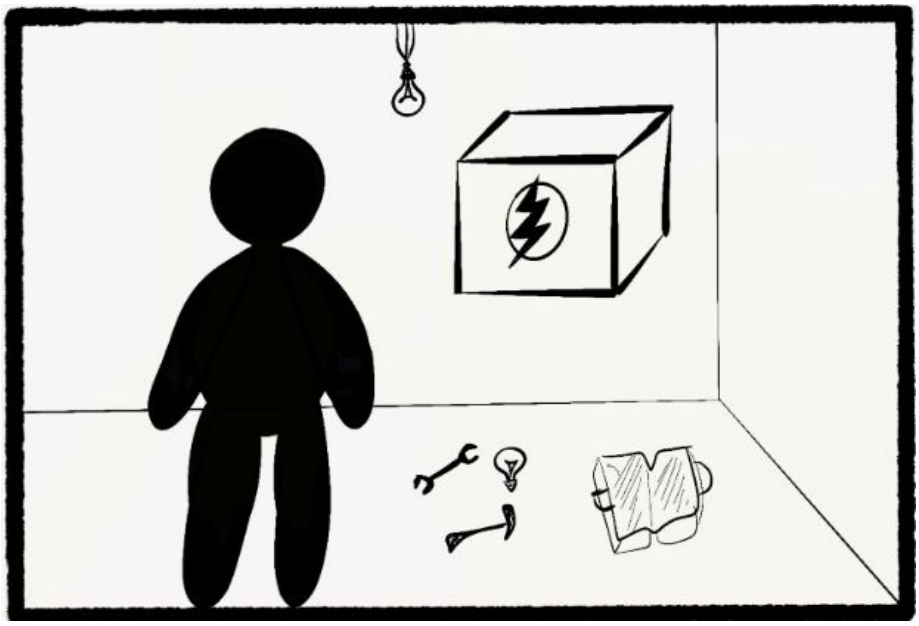


Com este novo robot, Júlio consegue alargar o seu círculo social. Ele participa ativamente em conversas remotas com residentes de outras casas de repouso. Isto alarga a sua rede social além daquela que mantém na instituição em que reside, trazendo de novo o seu entusiasmo pela vida sem ter de enfrentar os desafios emocionais e físicos de deixar o ambiente familiar.

Cenário 3



Cenário 4



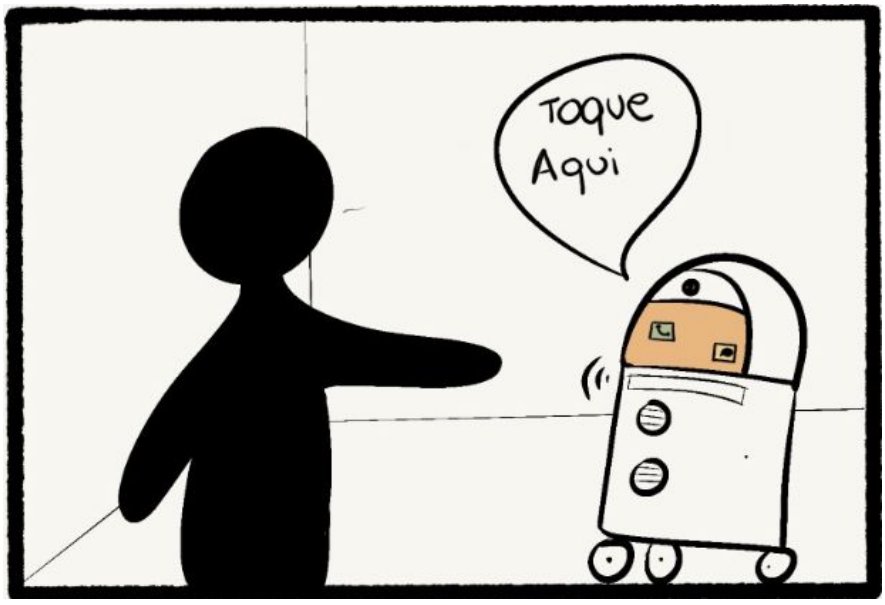
Pedro, 77 anos, mora com a esposa numa pequena casa suburbana. Eletricista aposentado, ele sempre foi prático e de trabalho manual, mas tem a ideia de que já “passou da idade” para novas aprendizagens, especialmente quando se trata de tecnologia moderna.

1

Cenário 4

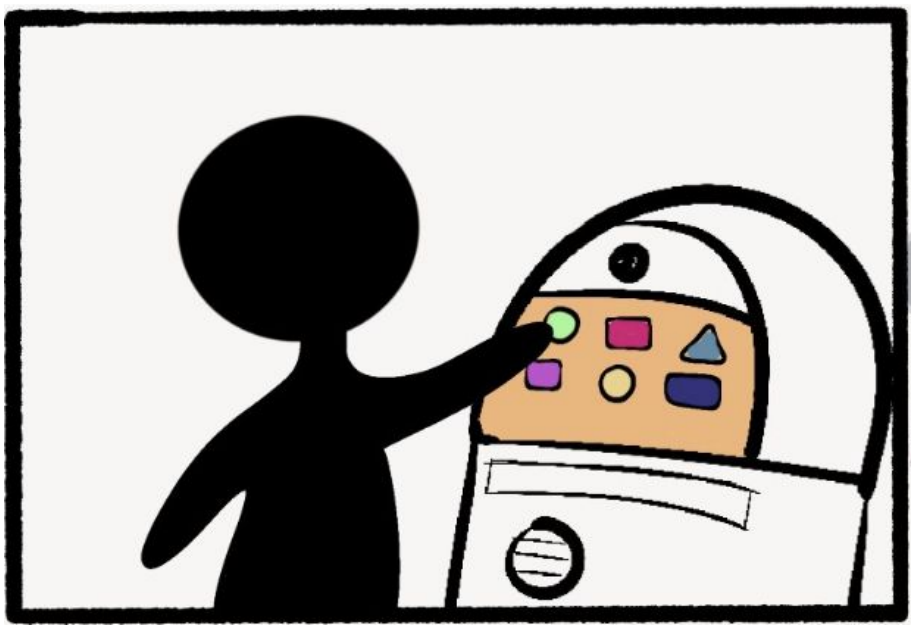
Pedro vê o mundo a evoluir ao seu redor, no que toca à tecnologia e vê como especialmente as gerações mais jovens navegam sem esforço no mundo digital. Pedro sente-se deixado para trás e irrelevante. Ele sente-se incerto em iniciar esta aprendizagem tecnológica, embora compreenda o potencial e vantagens da tecnologia.

Cenário 4



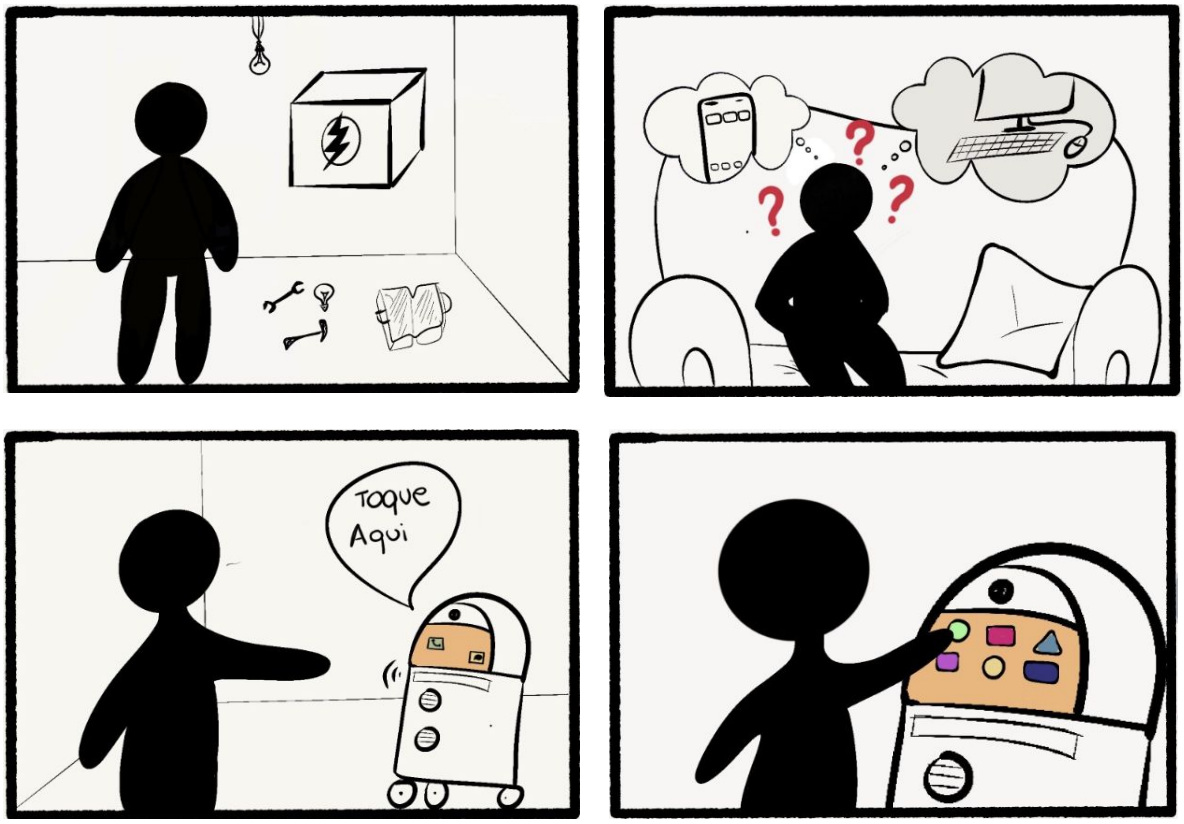
Reconhecendo a sua dificuldade com tecnologia, os seus filhos oferecem-lhe um robô criado para adultos mais velhos. Este robô explica tecnologia básica de uma maneira que não assusta, e também abre a porta para uma comunidade de pessoas com ideias parecidas. A plataforma oferece diversos assuntos para as pessoas aprenderem, que vão da história à arte moderna.

Cenário 4

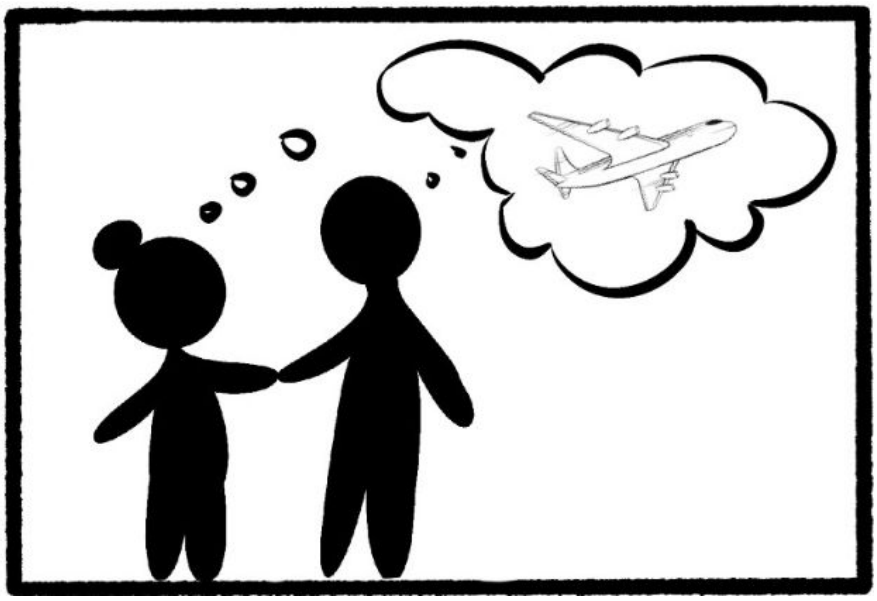


Curioso e guiado pelo robô, Pedro deixa de lado as limitações que colocou a si mesmo e passa a participar nas conversas virtuais sobre história e até faz um curso sobre “Arte”, assunto que sempre teve curiosidade, mas nunca explorou. Pedro torna-se num colaborador regular em discussões na comunidade, partilhando o seu novo conhecimento e décadas de experiência de vida.

Cenário 4



Cenário 5



Patrícia, uma mulher de 68 anos, aposentou-se recentemente ao lado do marido, Alexandre. Com uma paixão por explorar novas culturas e ver as maravilhas do mundo, eles sempre desejaram viajar muito.

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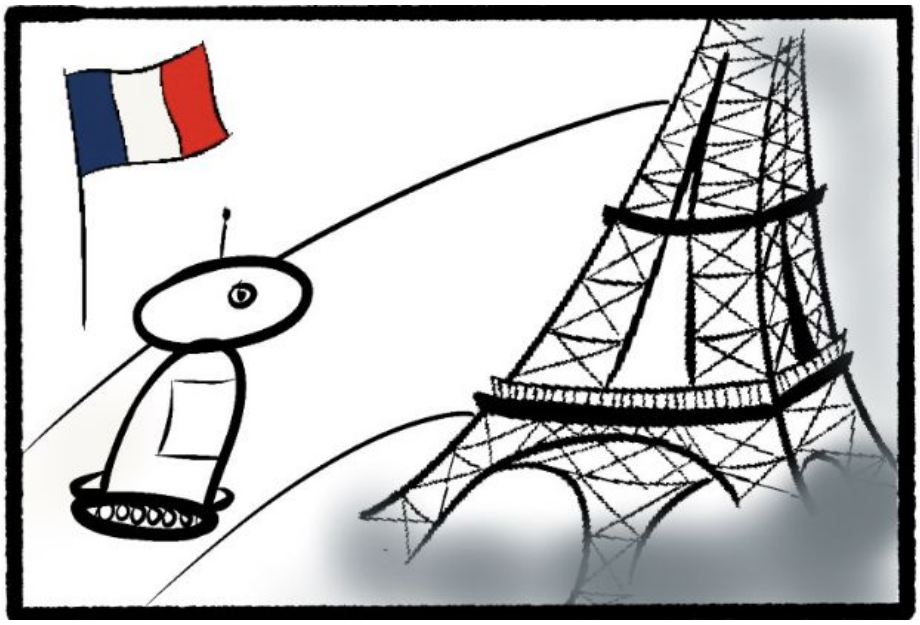
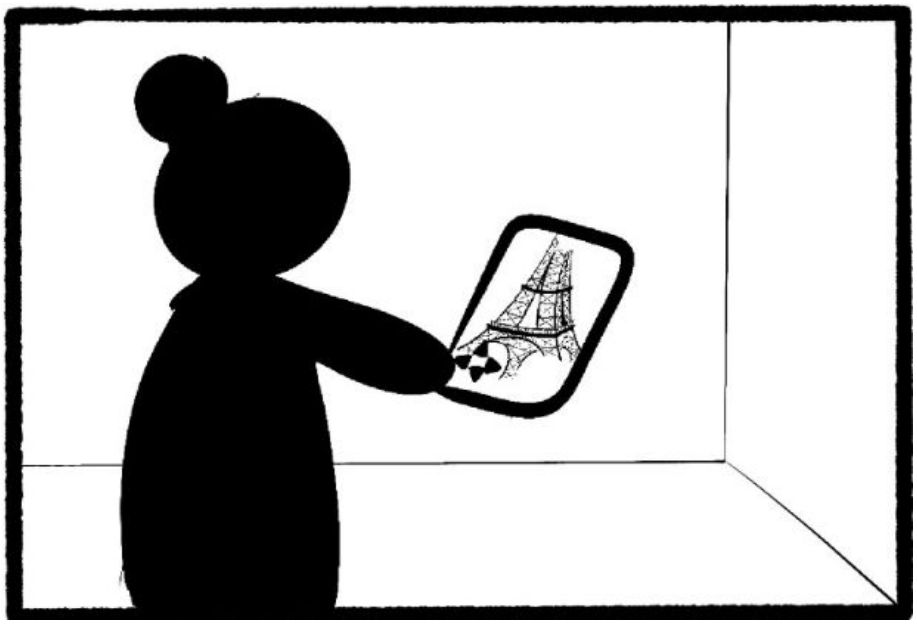
Cenário 5



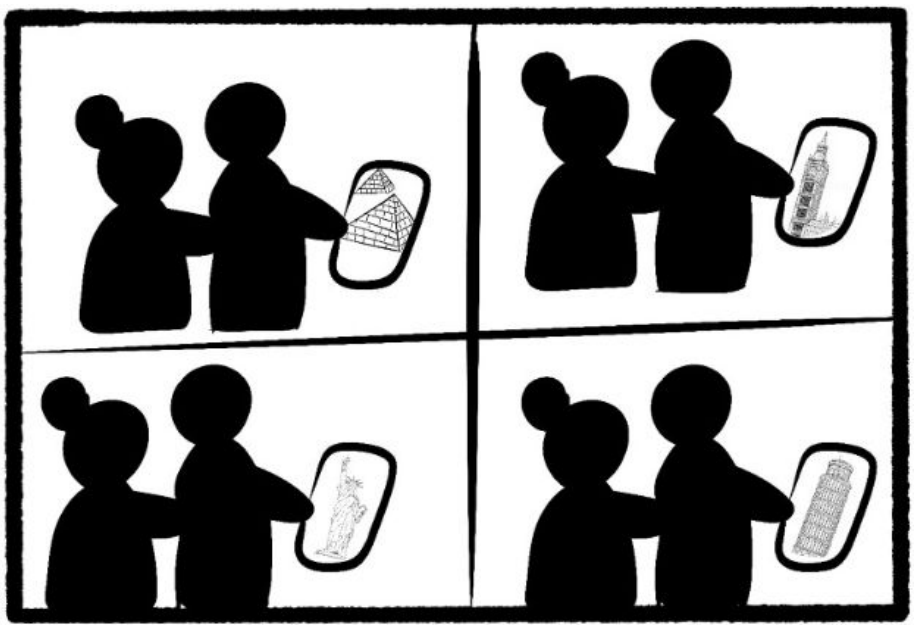
Patrícia descobre uma possibilidade curiosa: um serviço de robots que permite às pessoas controlar à distância robôs em diversas cidades no mundo. Estes robôs oferecem uma nova maneira de experimentar e explorar diferentes partes do mundo.

Cenário 5



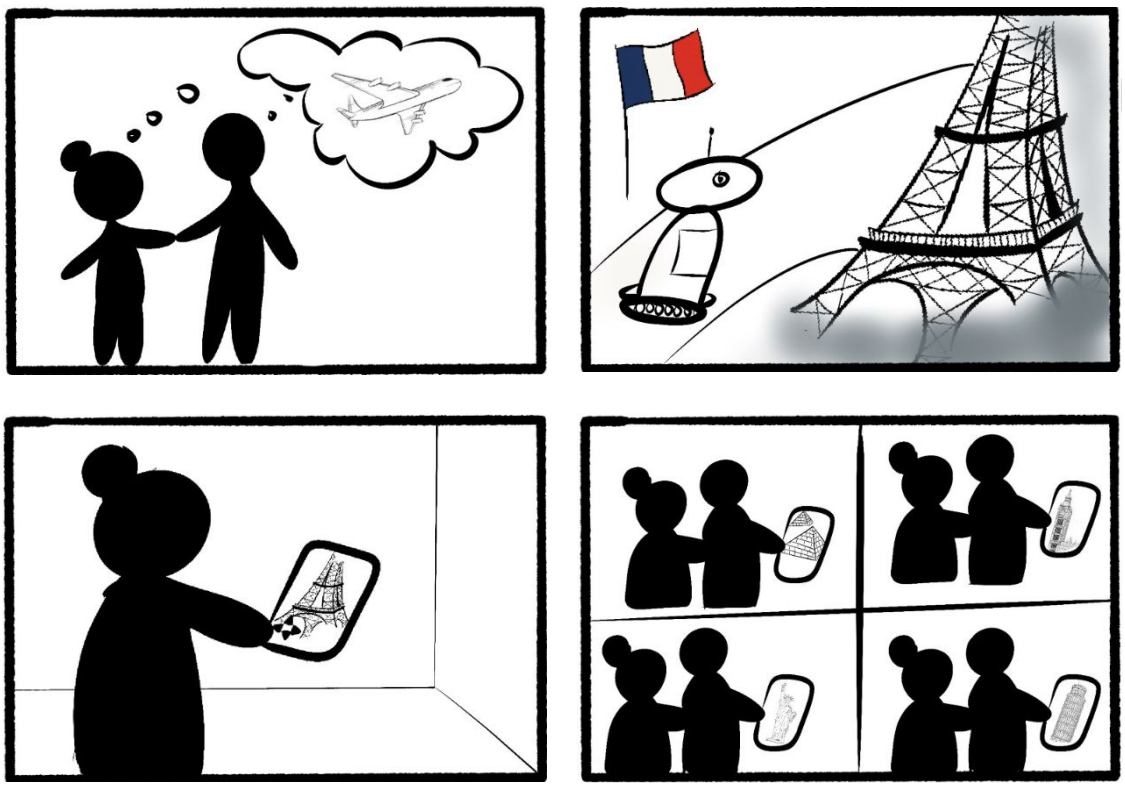
Curiosa e entusiasmada, Patrícia aluga um desses robôs. Com controlos fáceis de usar, ela passeia à distância pelas ruas de uma cidade estrangeira. Ela pode direcionar o robô para visitar locais específicos e até conversar com as pessoas locais, tudo isso enquanto experimenta vídeo e som em tempo real.

Cenário 5

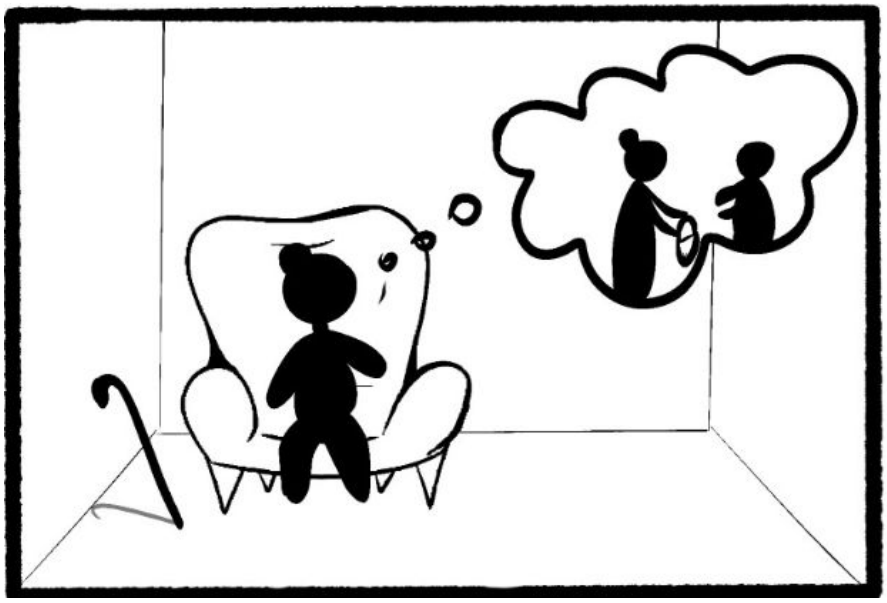


Patrícia e Alexandre consideram a experiência agradável e boa. Eles descobrem que as viagens através de robôs oferecem oportunidades únicas de exploração e aprendizagem, como poder falar com pessoas locais e visitas a sítios menos turísticos, o que seria mais difícil de fazer de outra forma.
Torna-se uma opção agradável que possibilita aventuras globais no conforto da sua casa.

Cenário 5



Cenário 6



Sara é uma senhora aposentada de 80 anos que mora sozinha. Ela trabalhou como diretora de um centro de caridade durante vários anos e relembra a sua carreira com grande orgulho. Neste ponto de sua vida, ela pondera como poderia continuar a fazer a diferença na vida de outras pessoas.

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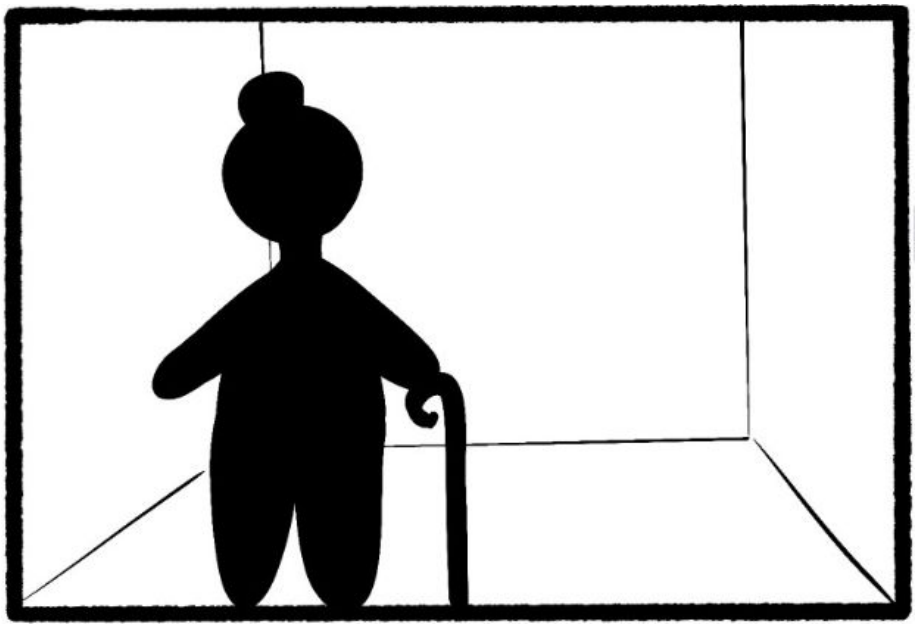
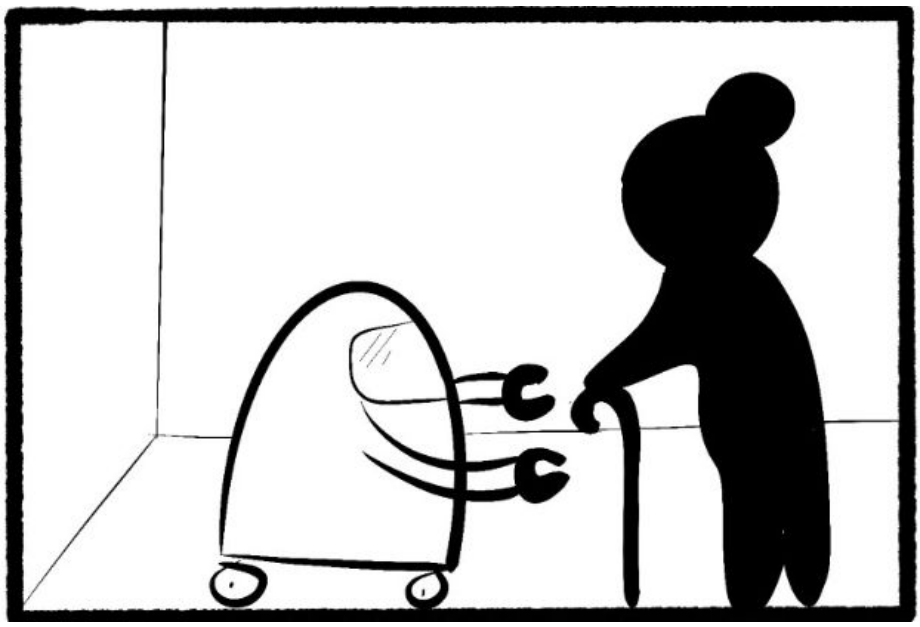
Cenário 6



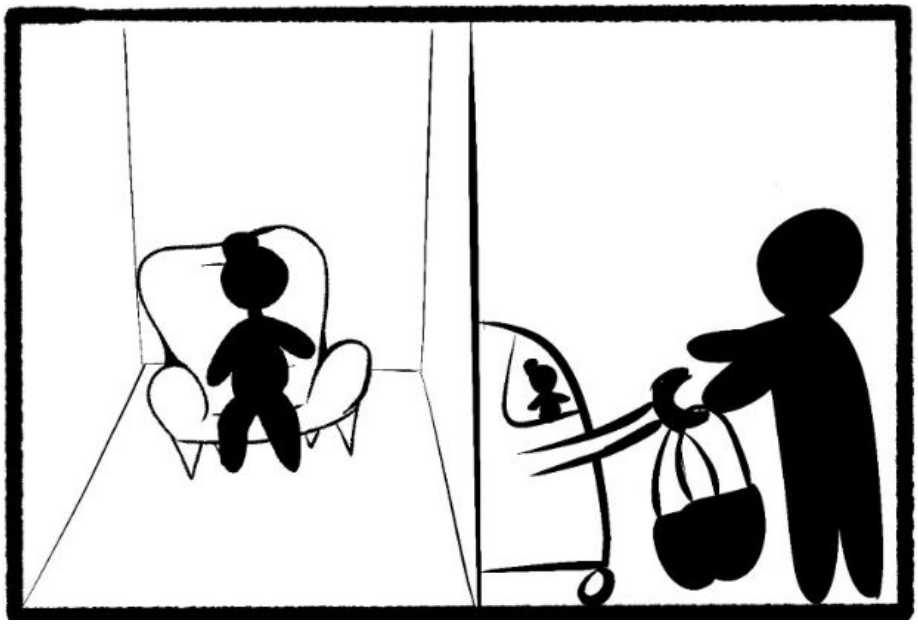
Sara sente falta dos dias em que contribuia ativamente na sua comunidade através de trabalhos de caridade e interacção social. No entanto, ela está limitada devido aos problemas físicos e falta de oportunidades sociais.

Cenário 6



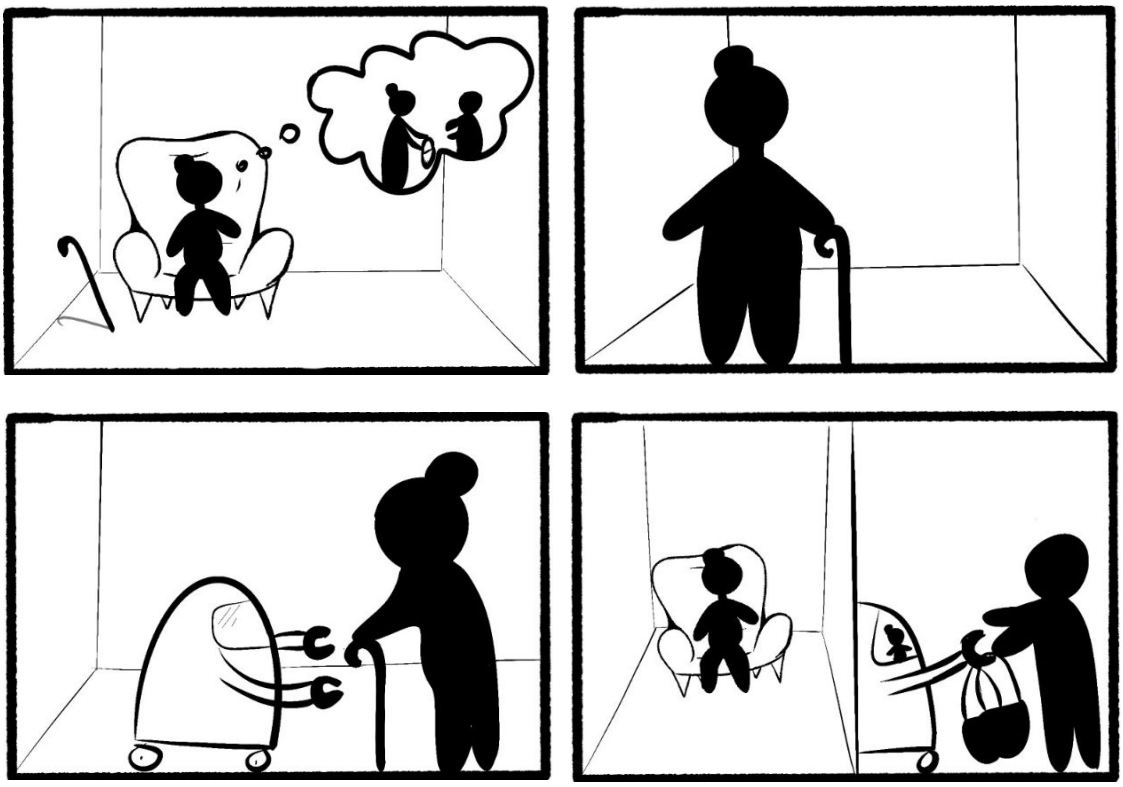
Para realizar o seu desejo de ajudar os outros, Sara investe num robô que pode controlar remotamente. Este robô está equipado com funcionalidades que lhe permitem realizar atos de caridade a partir de casa, como entregas de alimentos a pessoas carenciadas ou conversas à distância com membros isolados da comunidade.

Cenário 6

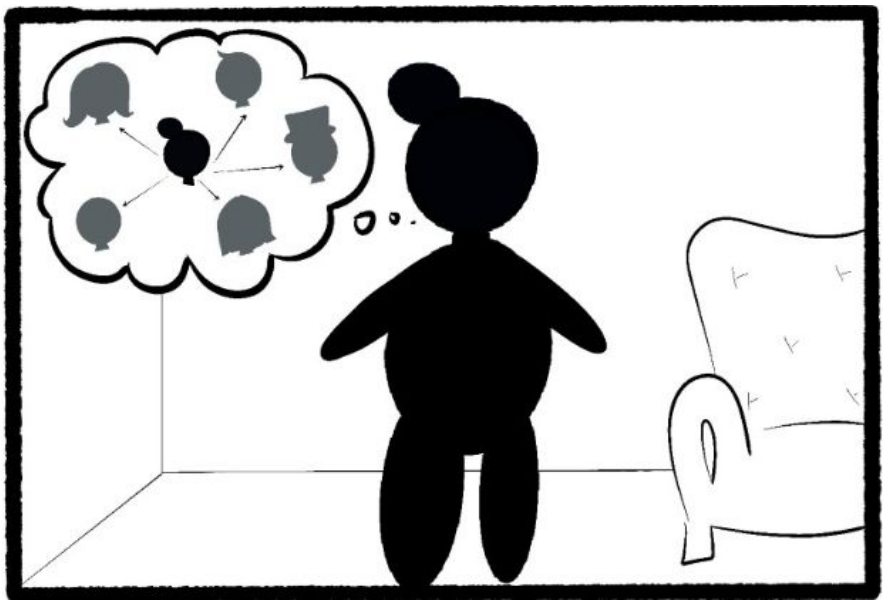


Sara usa o robô com sucesso para aumentar a sua presença altruísta na sua comunidade local. O robô entrega itens essenciais a famílias mais carenciadas, ajuda a limpar o bairro e participa em reuniões comunitárias para falar sobre as preocupações locais.

Cenário 6

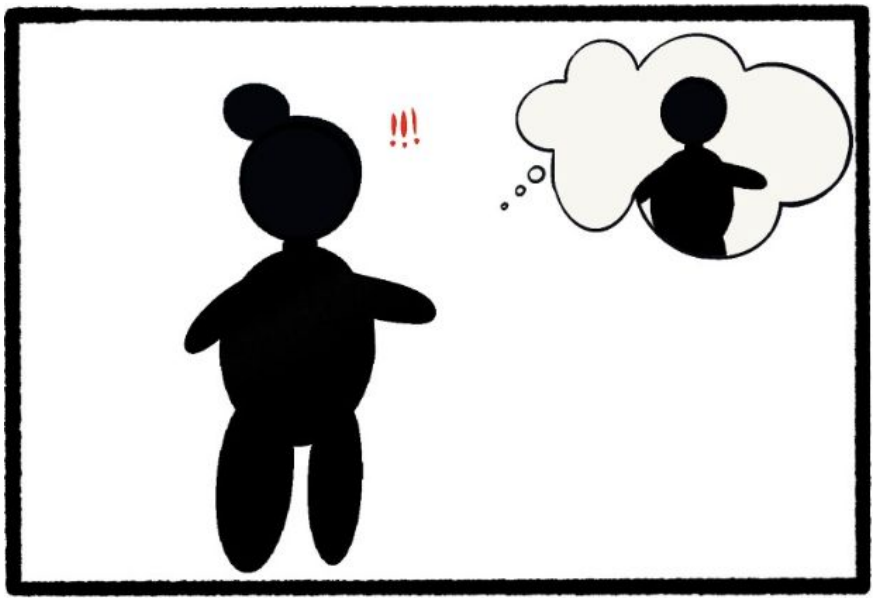


Cenário 7



Teresa é uma senhora de 86 anos que vive sozinha e valoriza a sua independência. Ela atribui grande importância às suas amizades, considerando-as uma parte essencial do seu bem-estar.

Cenário 7

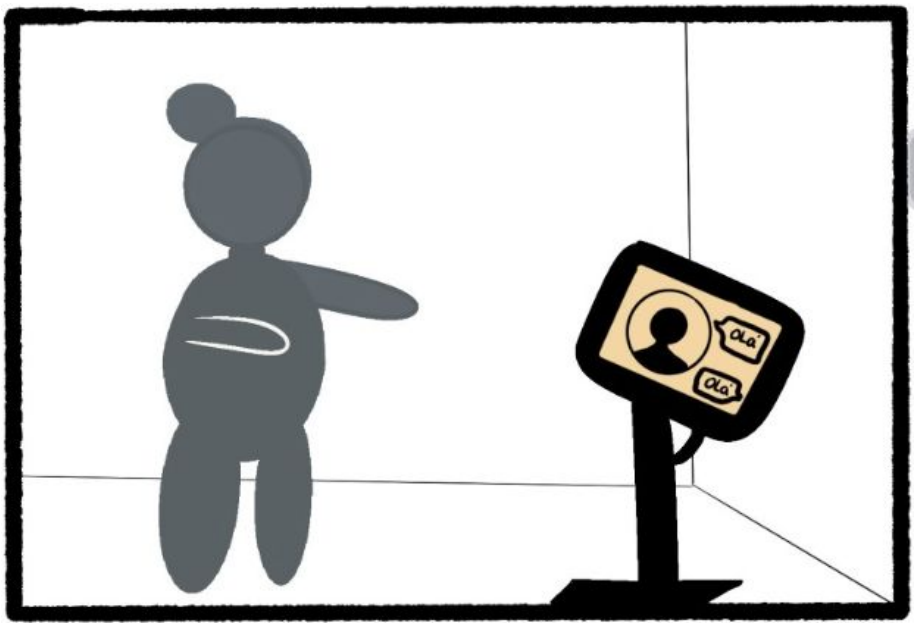


Apesar da Teresa se esforçar em manter as suas amizades, a sua memória fraca faz com que se esqueça de contactar os amigos. Por vezes, ela esquece-se de responder às mensagens dos amigos, um problema que a preocupa muito e que ela quer ver resolvido.

Cenário 7

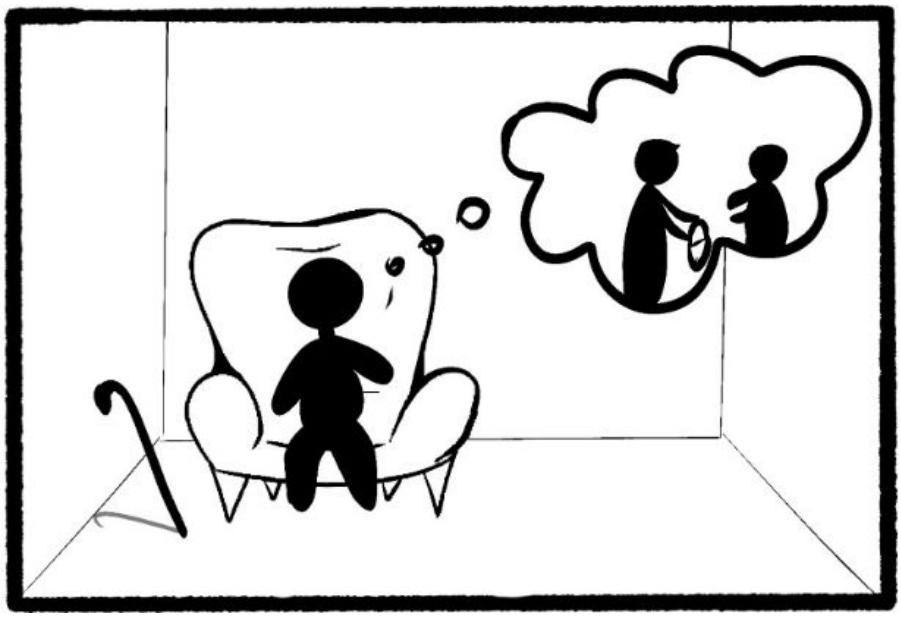
Para combater as falhas de memória, Teresa dá ordem a um robô para a lembrar sempre que se esquece. Este robô lembra-a para responder aos amigos. O robot permite-lhe enviar mensagens através de voz e vídeos diretamente de forma fácil.

Cenário 7



Graças ao robot, a Teresa desfruta agora de uma vida social mais completa, sem o stress de mensagens de amigos que ela se esqueceu de responder. Ela consegue manter contacto com o seu círculo de amigos facilmente.

Cenário 1



João é um homem aposentado de 72 anos que mora sozinho. Ele guarda com carinho as suas memórias de quando era ativo na comunidade, especialmente quando se voluntariava para ajudar os mais necessitados.

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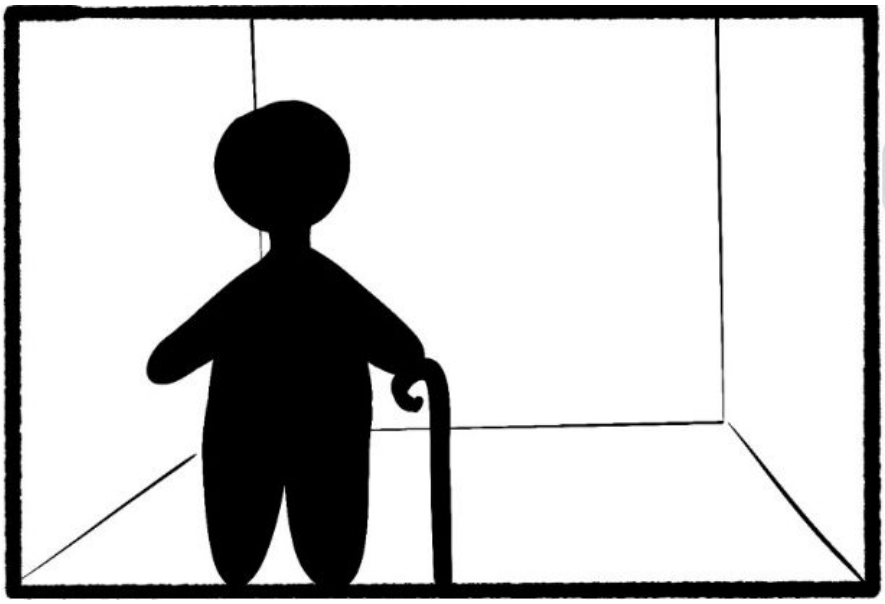
Cenário 1



João enfrenta desafios de mobilidade física que lhe dificultam sair de casa, não o permitindo atingir o seu desejo de se envolver no serviço comunitário.

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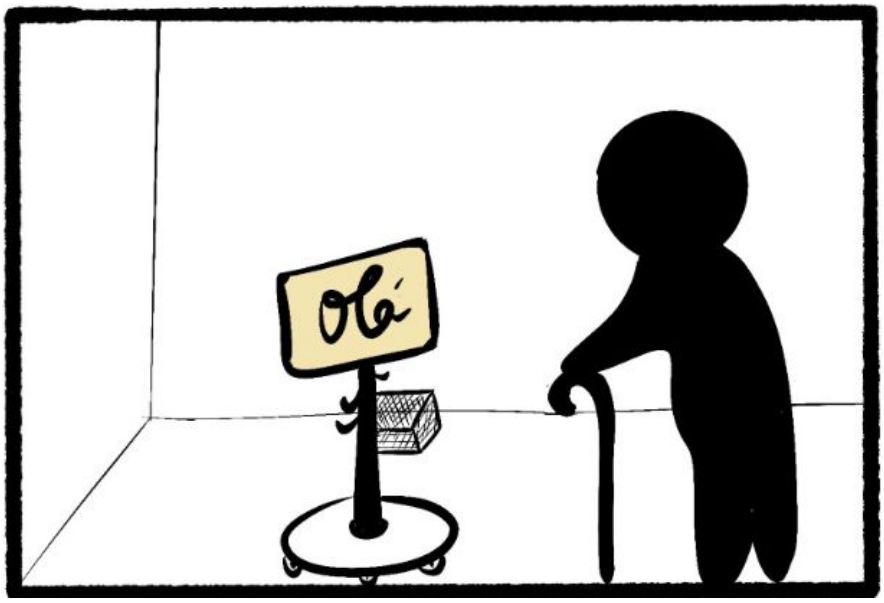

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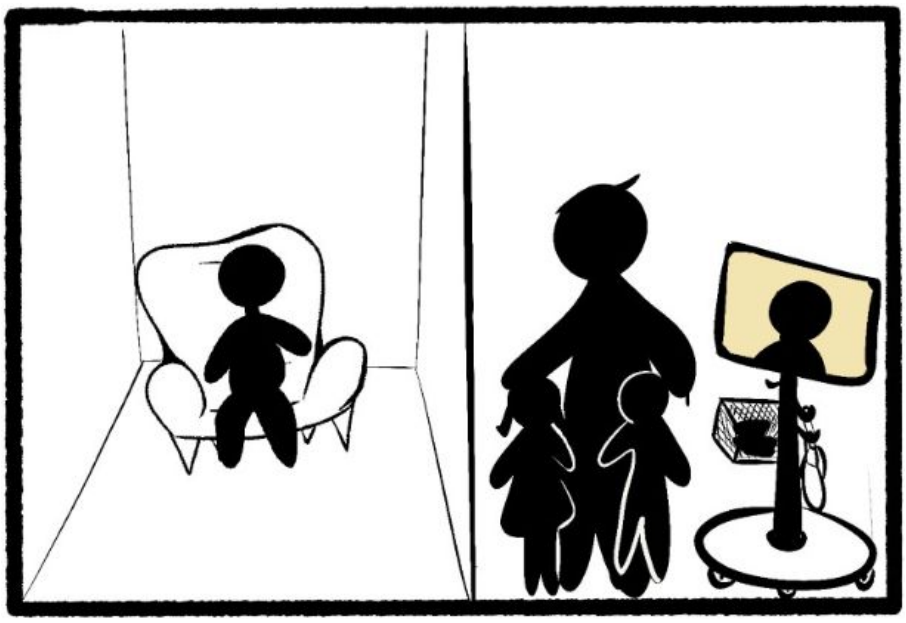

Agora, estando na sua casa e através do robot, João está novamente envolvido na sua comunidade. Ele usa o robô para entregar livros a pessoas que moram sozinhas em casa, ajudar a contar histórias on-line para crianças e até prestar ajuda em eventos locais. Apesar dos seus problemas físicos, o João contribui ativamente para o bem-estar da sua comunidade.

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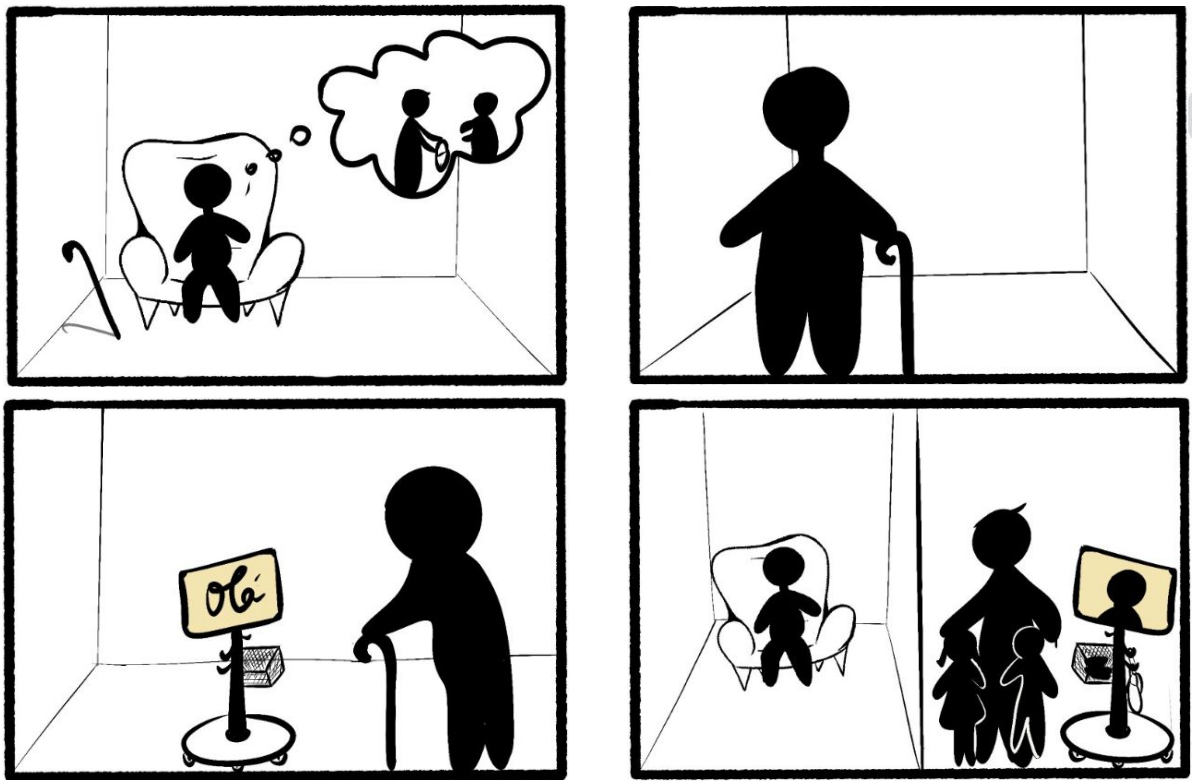
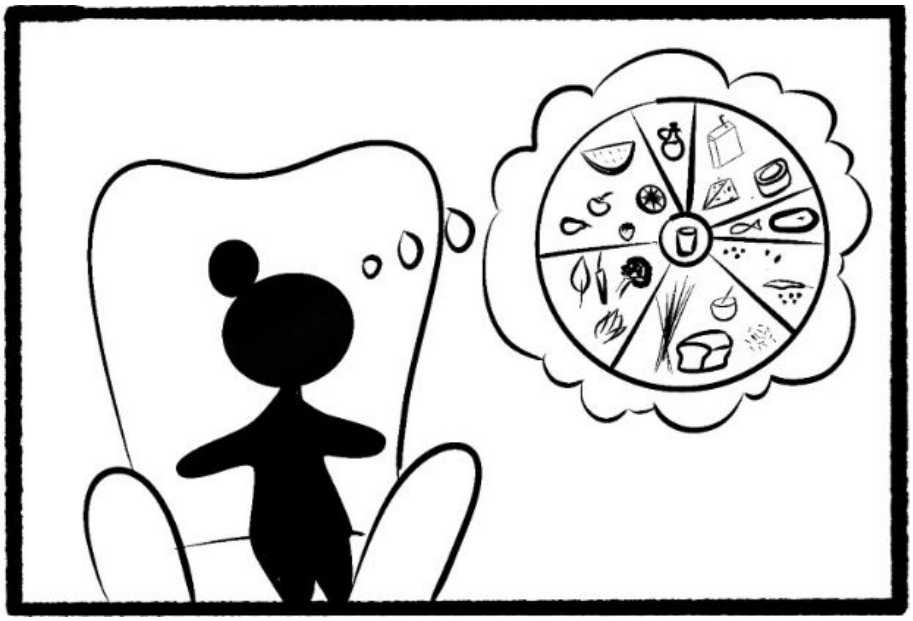
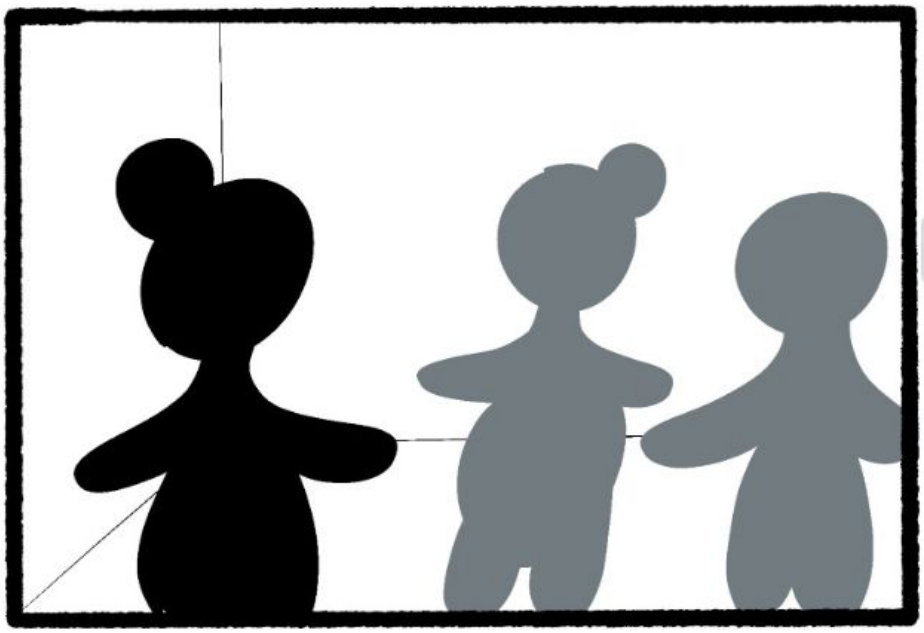


Cenário 2



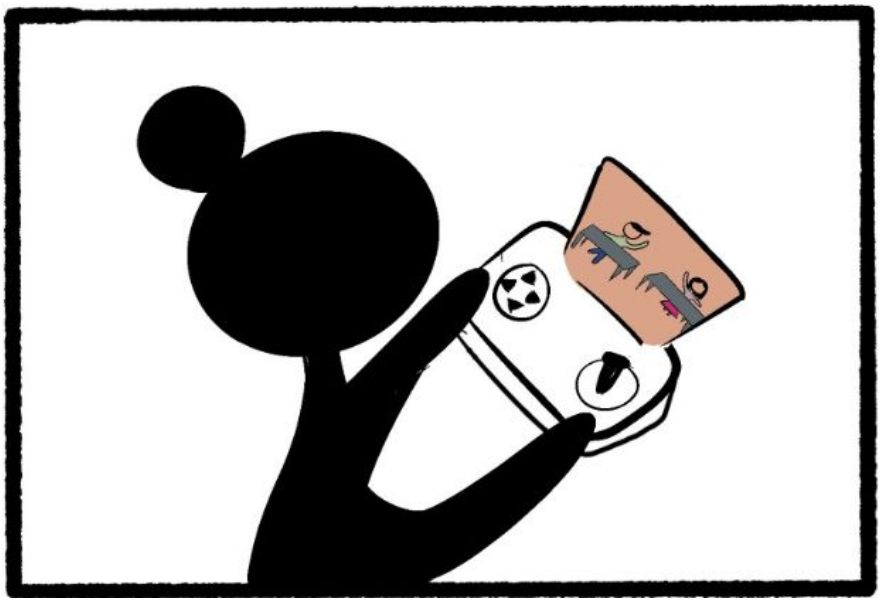
Cristina, uma nutricionista de 76 anos, vive numa casa de repouso. Durante a sua vida foi adquirindo conhecimentos sobre nutrição que está entusiasmada por partilhar com as gerações mais jovens.

Cenário 2



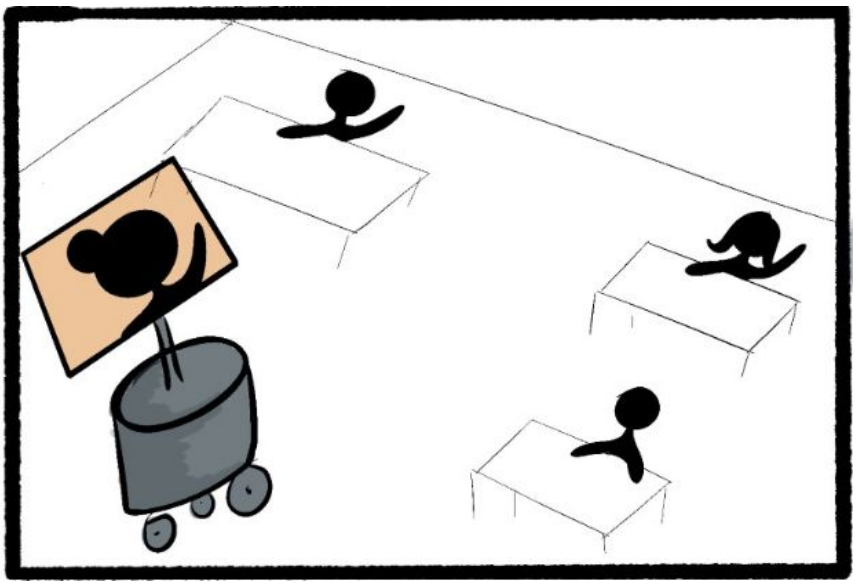
Como a Cristina só tem contacto com os colegas no lar de idosos, ela não consegue cumprir com o desejo de transmitir aos jovens o seu conhecimento relacionado com uma alimentação saudável. Ela quer partilhar a sua experiência nutricional com pessoas que podem beneficiar desse conhecimento.

Cenário 2



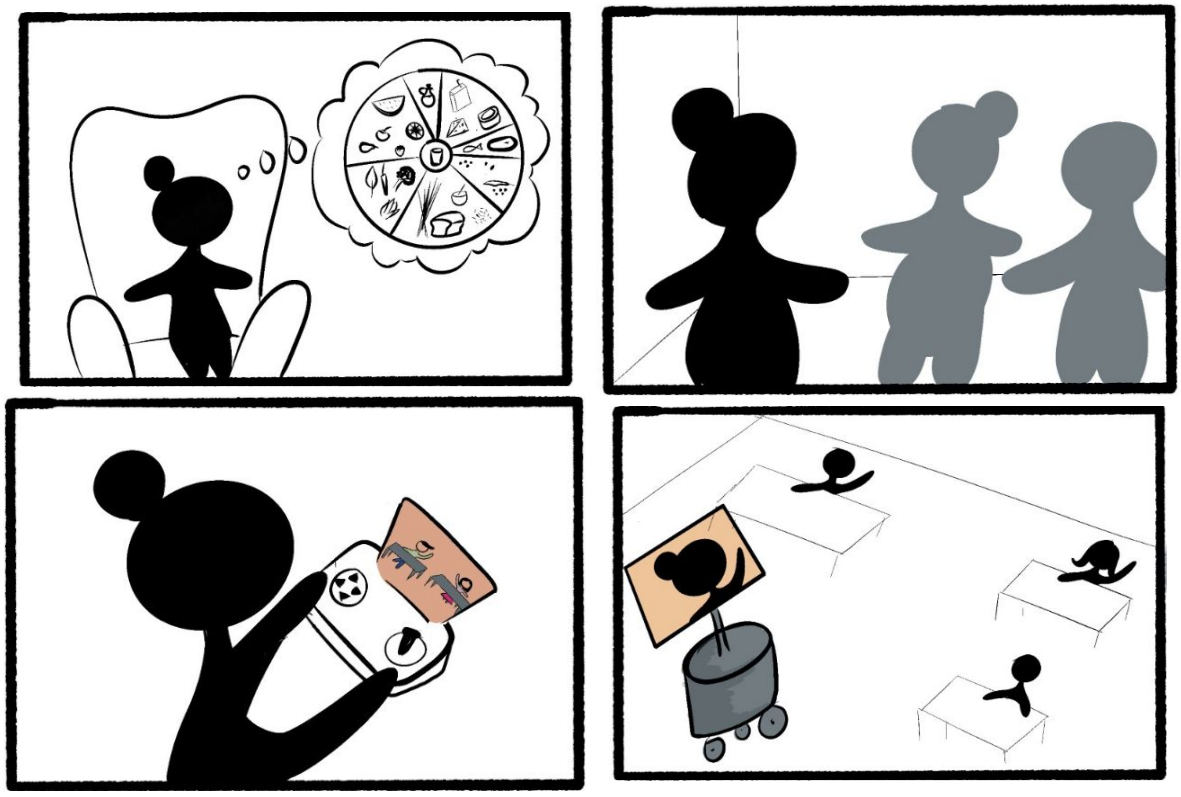
Sabendo da intenção de Cristina, o diretor do lar de idosos apresenta-lhe um robô de última geração. Este robô é controlado remotamente e pode interagir com os alunos de uma escola local à distância. Equipado com câmaras, microfones e altifalantes, o robô torna-se a forma como a Cristina partilha conhecimento nutricional.

Cenário 2

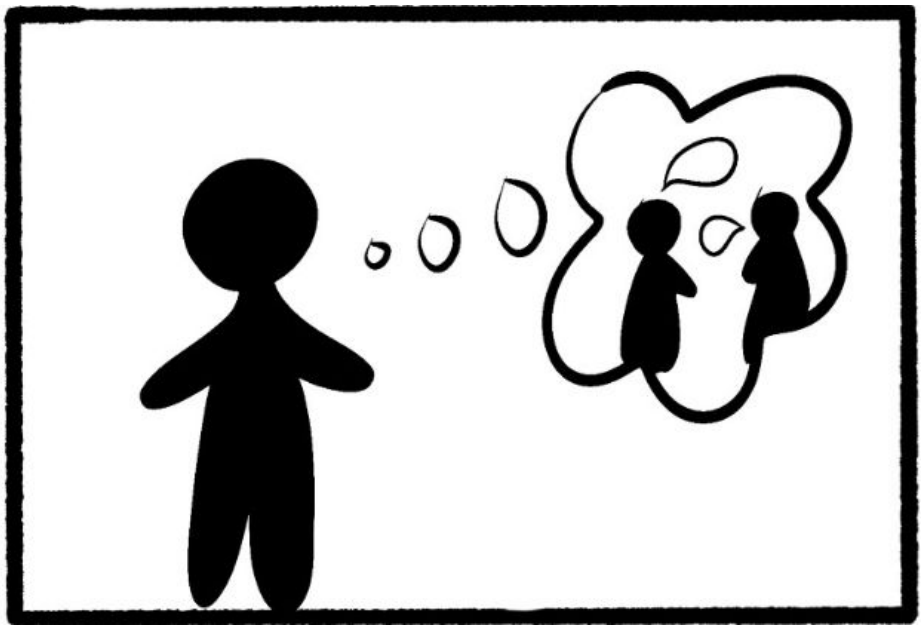


Tendo o robô como mensageiro, Cristina entra virtualmente nas salas de aula, falando sobre nutrição e o seu impacto na saúde. Cristina encontra um novo propósito através do robot e ensina os alunos sobre nutrição e alimentação saudável.

Cenário 2



Cenário 3



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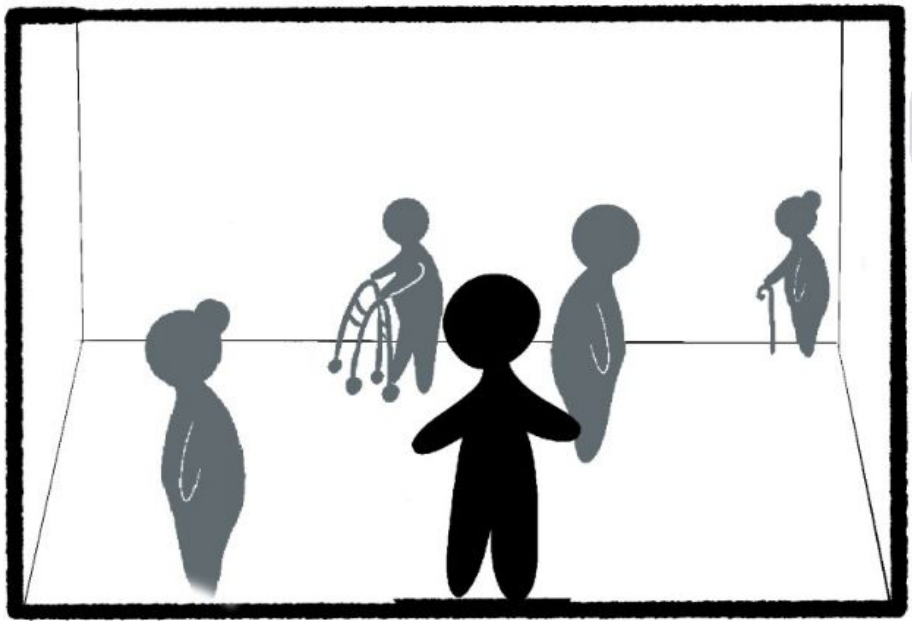
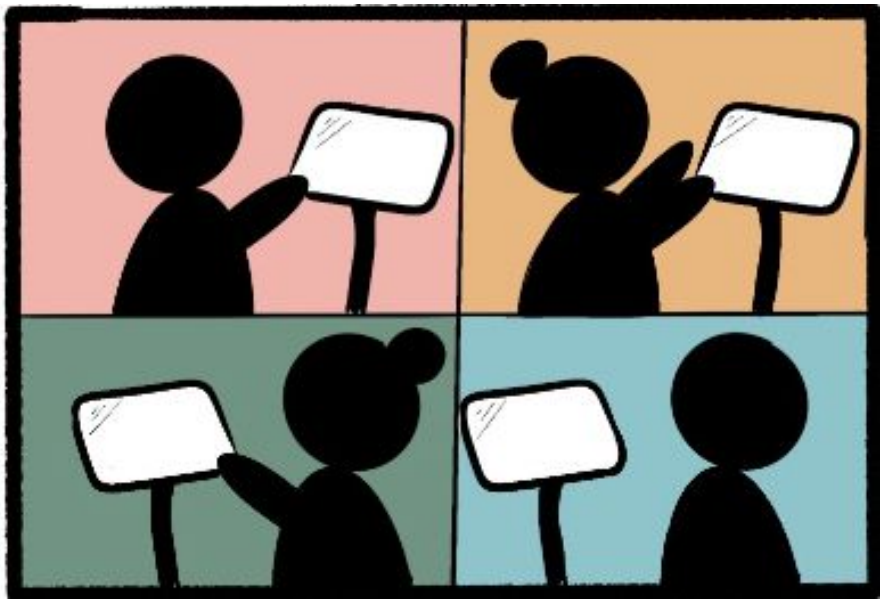
Júlio é um homem de 92 anos que reside numa casa de repouso. Ele adora interação social, desfrutando de conversas animadas e fazendo novas amizades.

Cenário 3



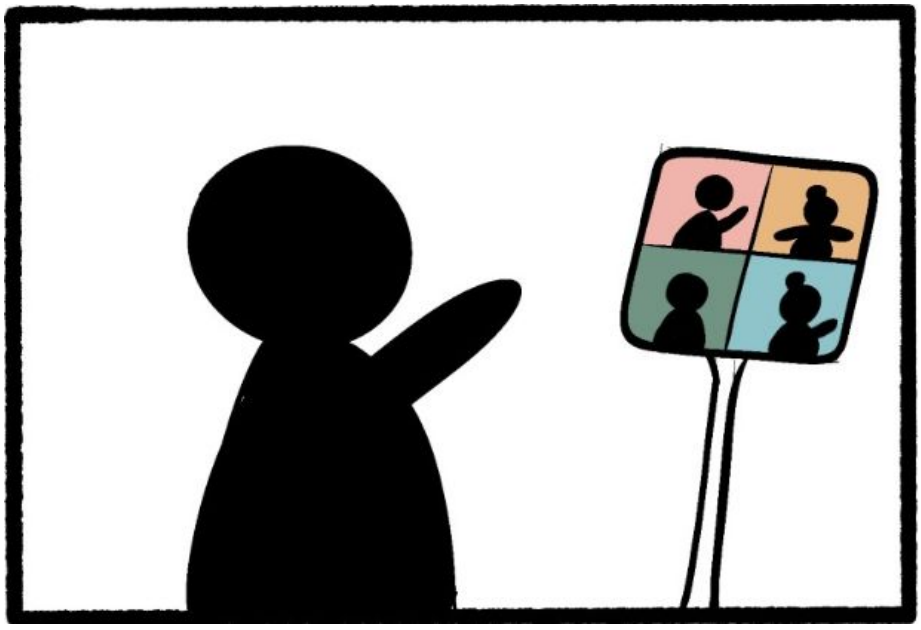
Como o Júlio está na casa de repouso, ele sente-se limitado a interações apenas com outros residentes e funcionários. Júlio começa a sentir-se emocionalmente preso. Ele sente falta da diversidade e da energia que costumava ter ao conhecer novas pessoas.

Cenário 3



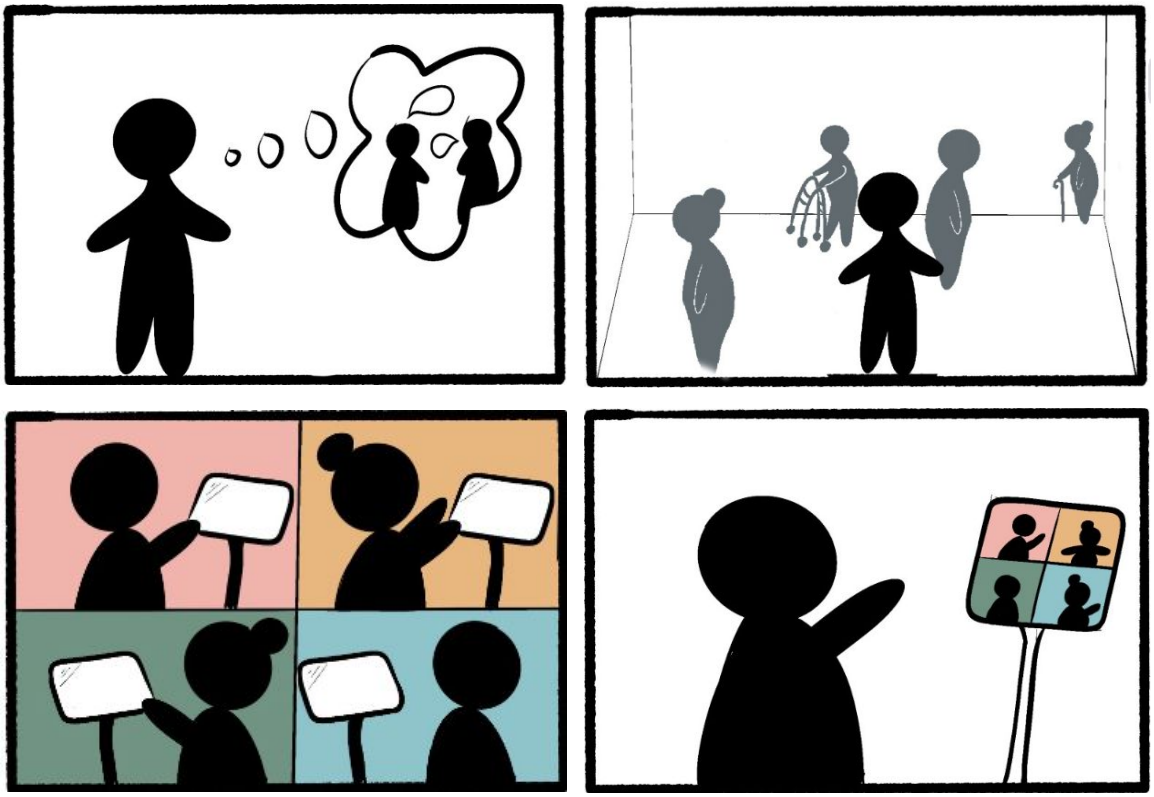
A casa de repouso investe num robô para socialização, capaz de se conectar com robôs noutras casas de repouso. Estes robôs são feitos para ajudar em encontros sociais, ligando residentes de diferentes casas de repouso para criarem amizades.

Cenário 3

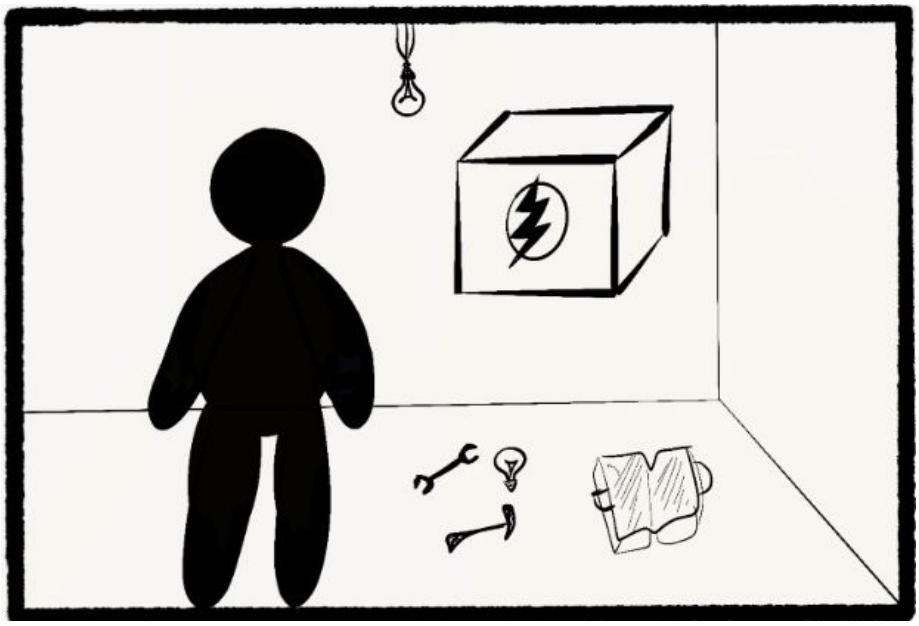


Com este novo robot, Júlio consegue alargar o seu círculo social. Ele participa ativamente em conversas remotas com residentes de outras casas de repouso. Isto alarga a sua rede social além daquela que mantém na instituição em que reside, trazendo de novo o seu entusiasmo pela vida sem ter de enfrentar os desafios emocionais e físicos de deixar o ambiente familiar.

Cenário 3



Cenário 4



Pedro, 77 anos, mora com a esposa numa pequena casa suburbana. Eletricista aposentado, ele sempre foi prático e de trabalho manual, mas tem a ideia de que já “passou da idade” para novas aprendizagens, especialmente quando se trata de tecnologia moderna.

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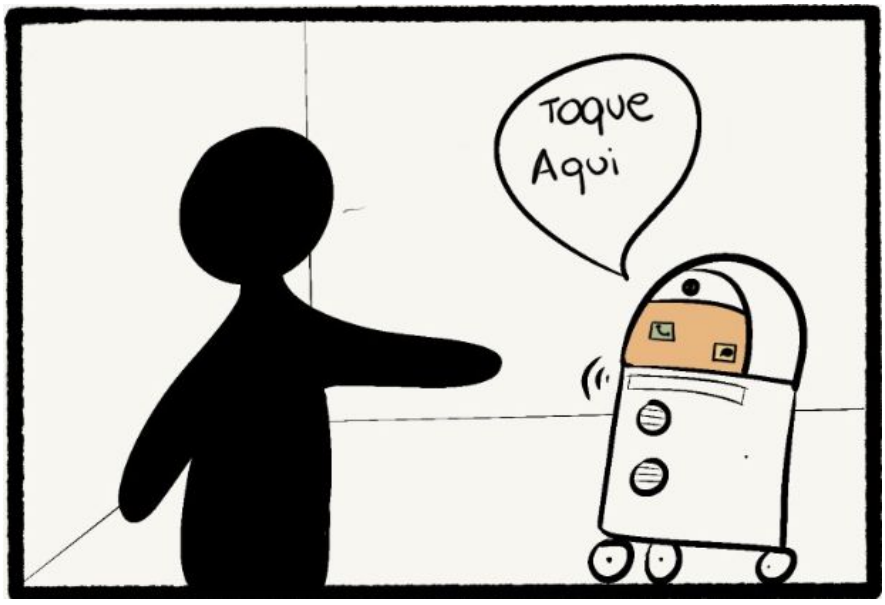
Cenário 4

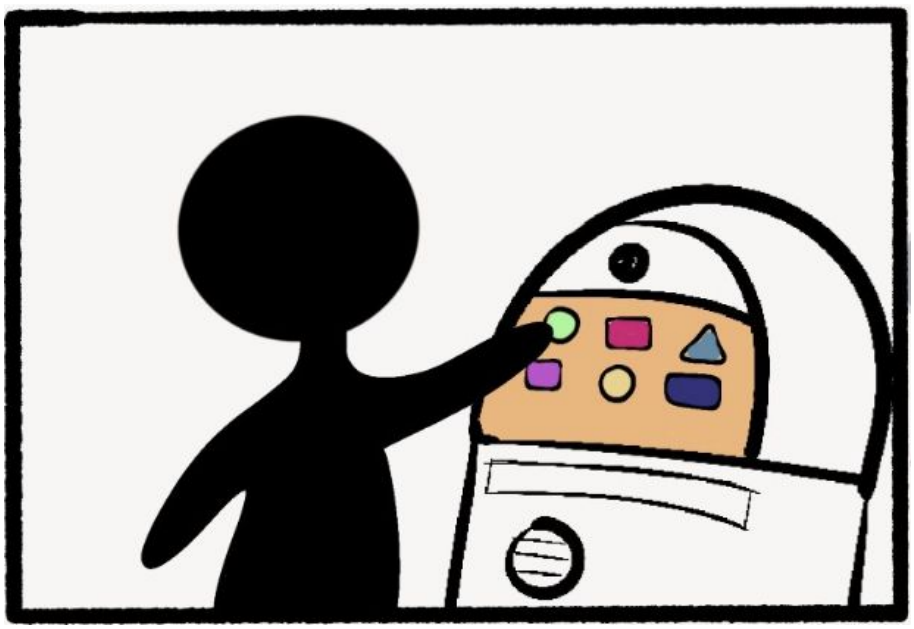
Pedro vê o mundo a evoluir ao seu redor, no que toca à tecnologia e vê como especialmente as gerações mais jovens navegam sem esforço no mundo digital. Pedro sente-se deixado para trás e irrelevante. Ele sente-se incerto em iniciar esta aprendizagem tecnológica, embora compreenda o potencial e vantagens da tecnologia.

Cenário 4



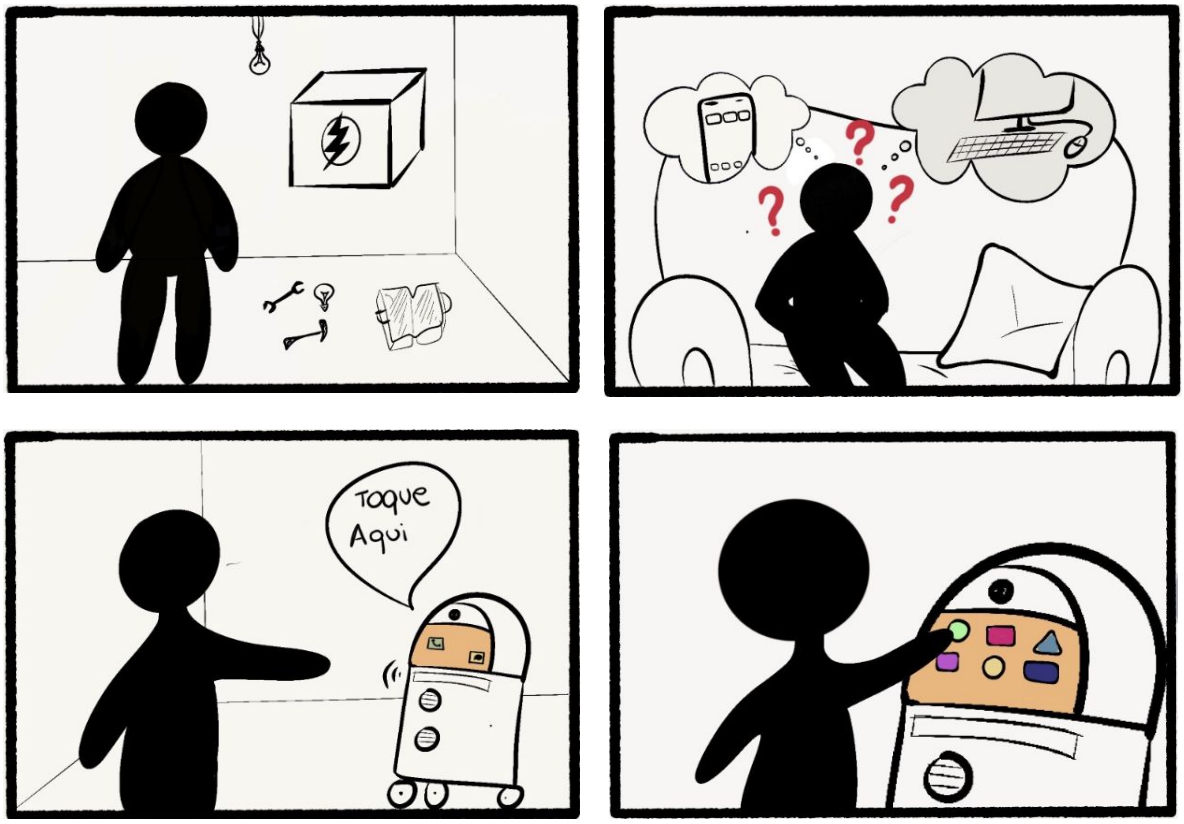
Reconhecendo a sua dificuldade com tecnologia, os seus filhos oferecem-lhe um robô criado para adultos mais velhos. Este robô explica tecnologia básica de uma maneira que não assusta, e também abre a porta para uma comunidade de pessoas com ideias parecidas. A plataforma oferece diversos assuntos para as pessoas aprenderem, que vão da história à arte moderna.

Cenário 4

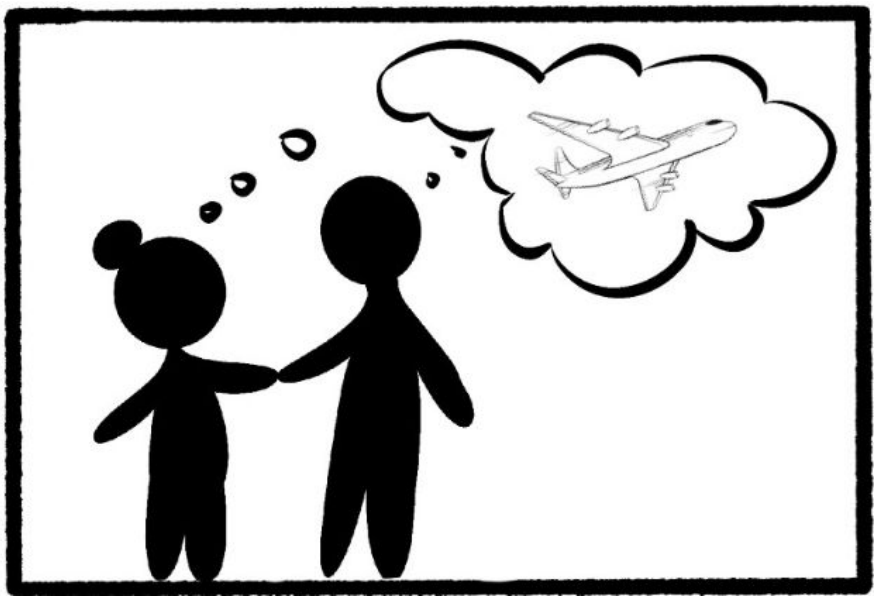


Curioso e guiado pelo robô, Pedro deixa de lado as limitações que colocou a si mesmo e passa a participar nas conversas virtuais sobre história e até faz um curso sobre “Arte”, assunto que sempre teve curiosidade, mas nunca explorou. Pedro torna-se num colaborador regular em discussões na comunidade, partilhando o seu novo conhecimento e décadas de experiência de vida.

Cenário 4



Cenário 5



Patrícia, uma mulher de 68 anos, aposentou-se recentemente ao lado do marido, Alexandre. Com uma paixão por explorar novas culturas e ver as maravilhas do mundo, eles sempre desejaram viajar muito.

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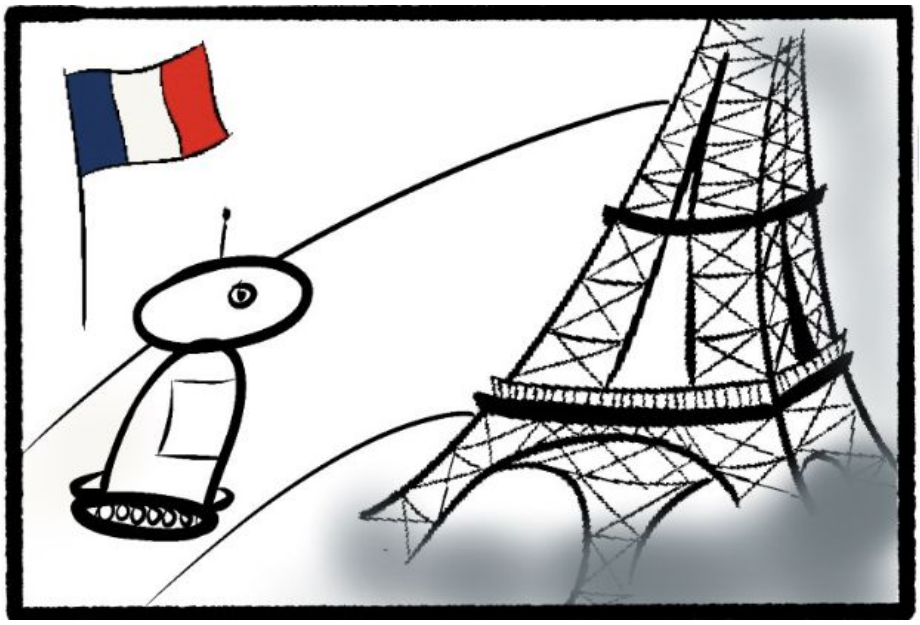
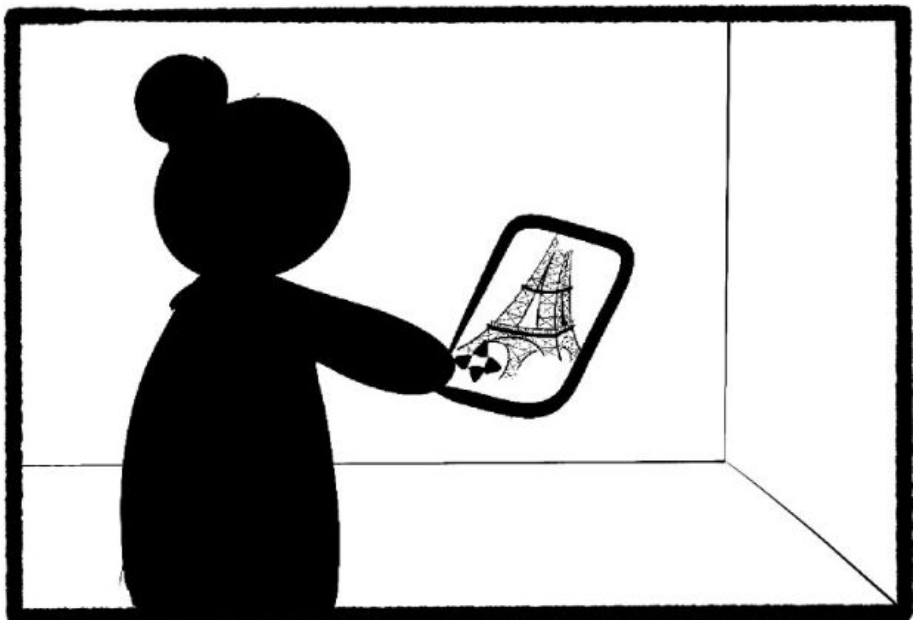
Cenário 5



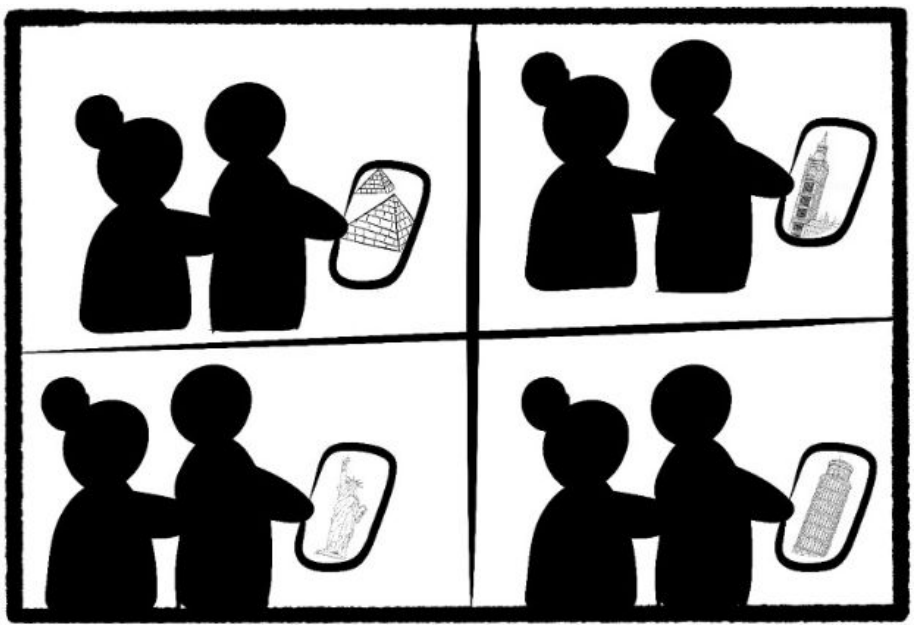
Patrícia descobre uma possibilidade curiosa: um serviço de robots que permite às pessoas controlar à distância robôs em diversas cidades no mundo. Estes robôs oferecem uma nova maneira de experimentar e explorar diferentes partes do mundo.

Cenário 5



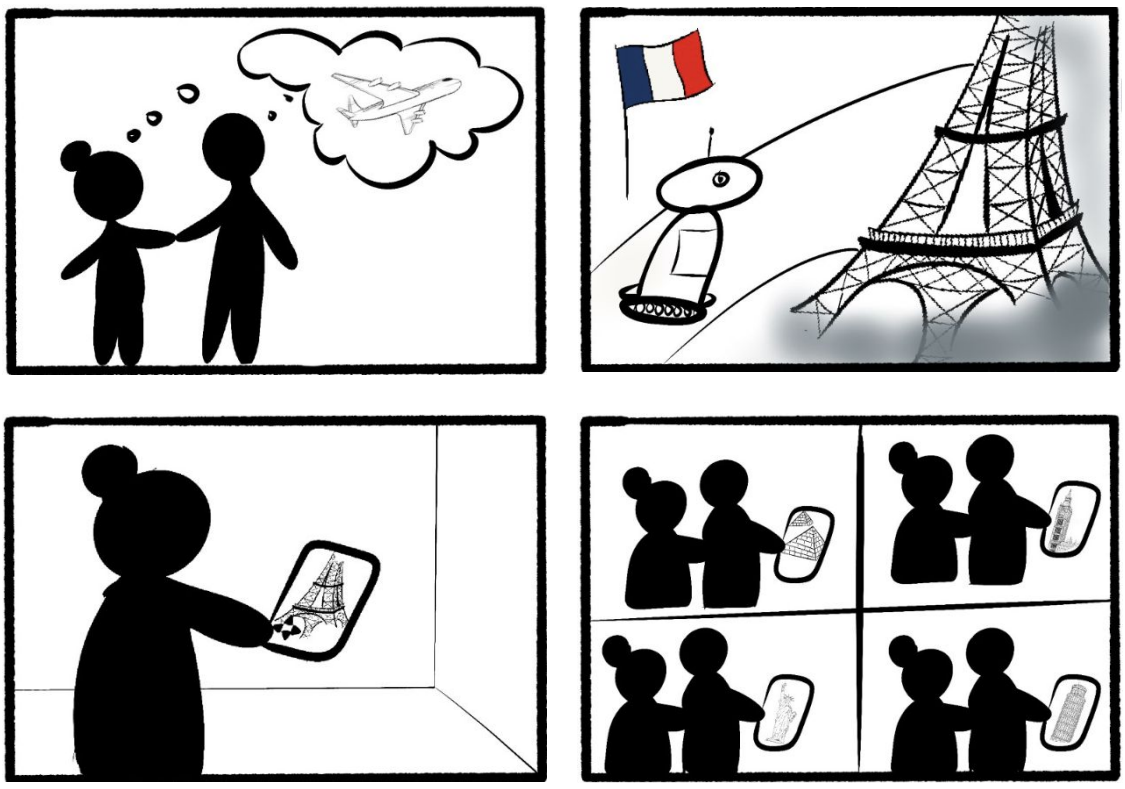
Curiosa e entusiasmada, Patrícia aluga um desses robôs. Com controlos fáceis de usar, ela passeia à distância pelas ruas de uma cidade estrangeira. Ela pode direcionar o robô para visitar locais específicos e até conversar com as pessoas locais, tudo isso enquanto experimenta vídeo e som em tempo real.

Cenário 5

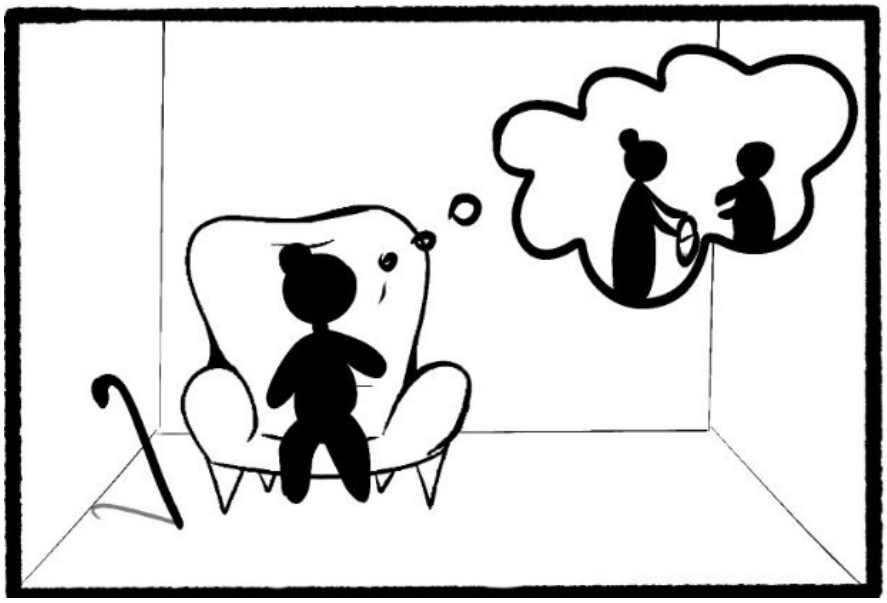


Patrícia e Alexandre consideram a experiência agradável e boa. Eles descobrem que as viagens através de robôs oferecem oportunidades únicas de exploração e aprendizagem, como poder falar com pessoas locais e visitas a sítios menos turísticos, o que seria mais difícil de fazer de outra forma.
Torna-se uma opção agradável que possibilita aventuras globais no conforto da sua casa.

Cenário 5



Cenário 6



Sara é uma senhora aposentada de 80 anos que mora sozinha. Ela trabalhou como diretora de um centro de caridade durante vários anos e relembra a sua carreira com grande orgulho. Neste ponto de sua vida, ela pondera como poderia continuar a fazer a diferença na vida de outras pessoas.

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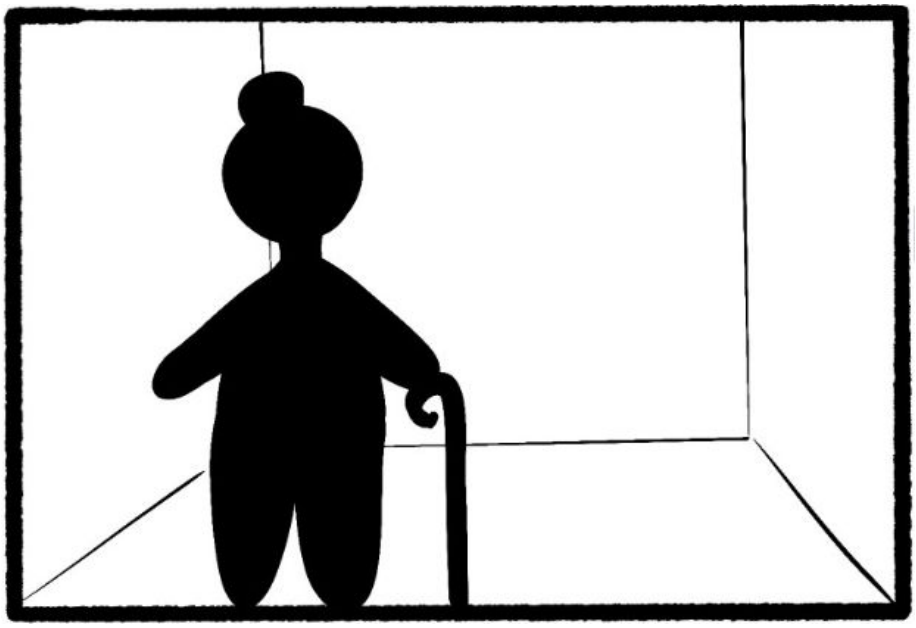
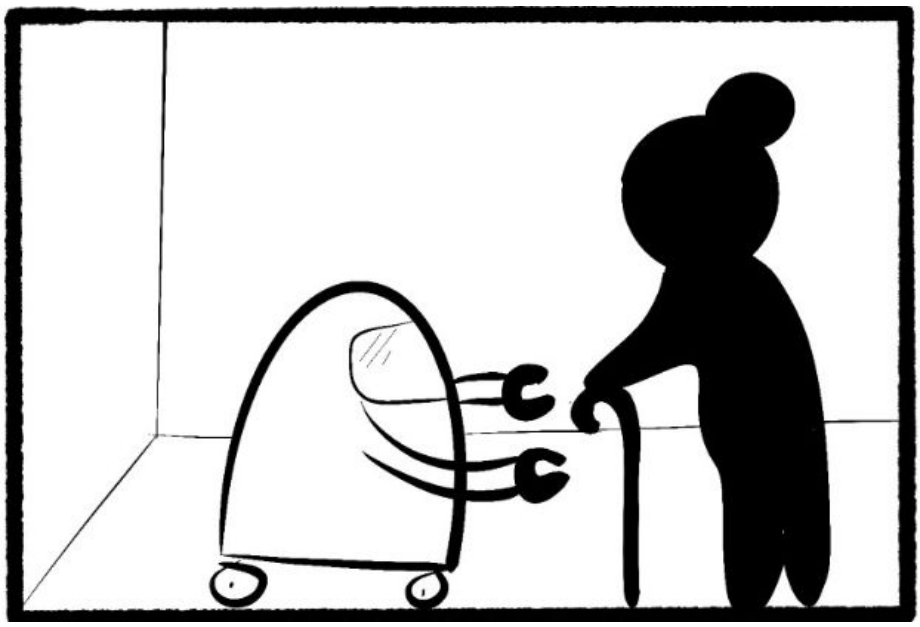
Cenário 6



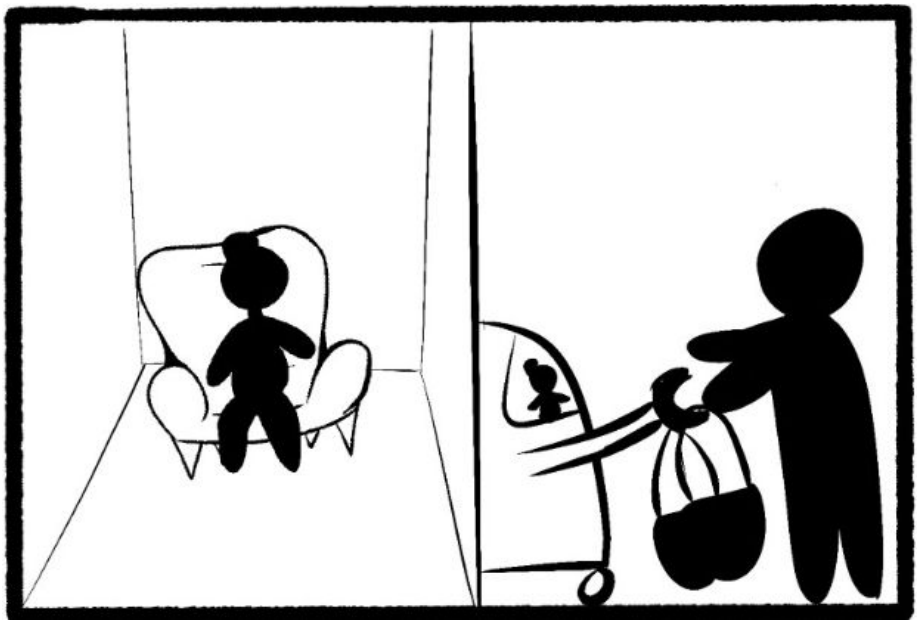
Sara sente falta dos dias em que contribuia ativamente na sua comunidade através de trabalhos de caridade e interacção social. No entanto, ela está limitada devido aos problemas físicos e falta de oportunidades sociais.

Cenário 6



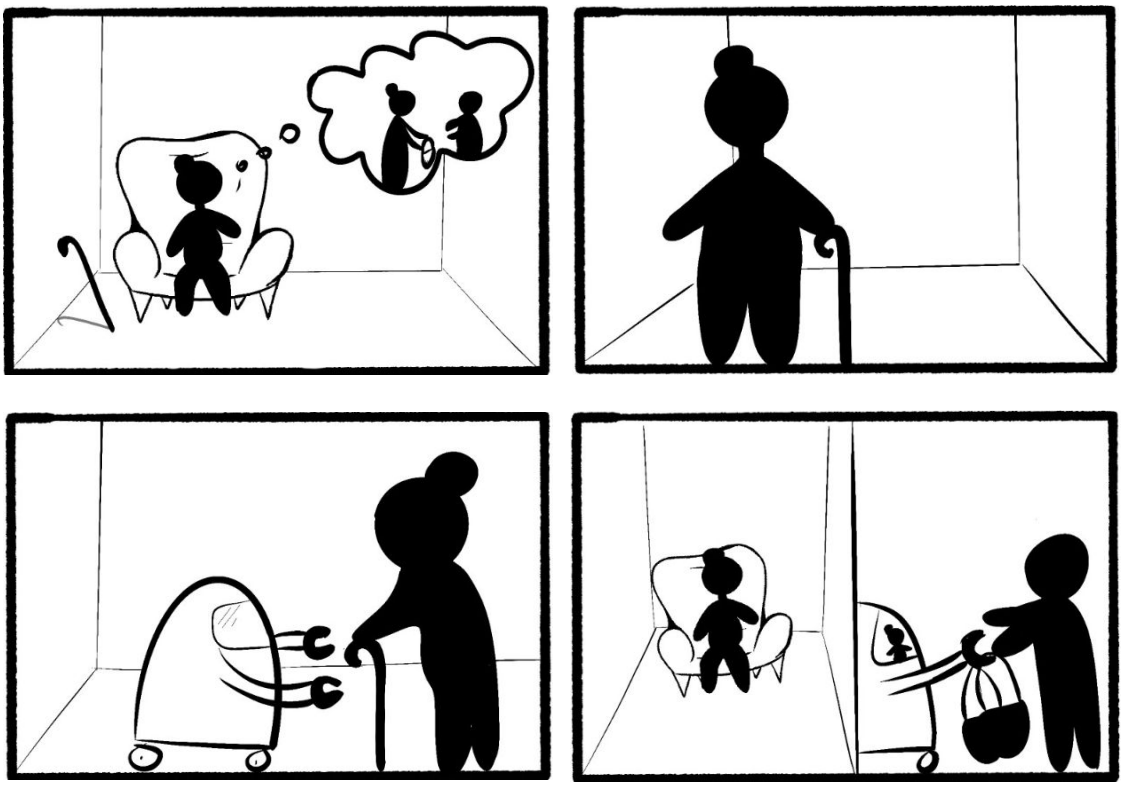
Para realizar o seu desejo de ajudar os outros, Sara investe num robô que pode controlar remotamente. Este robô está equipado com funcionalidades que lhe permitem realizar atos de caridade a partir de casa, como entregas de alimentos a pessoas carenciadas ou conversas à distância com membros isolados da comunidade.

Cenário 6

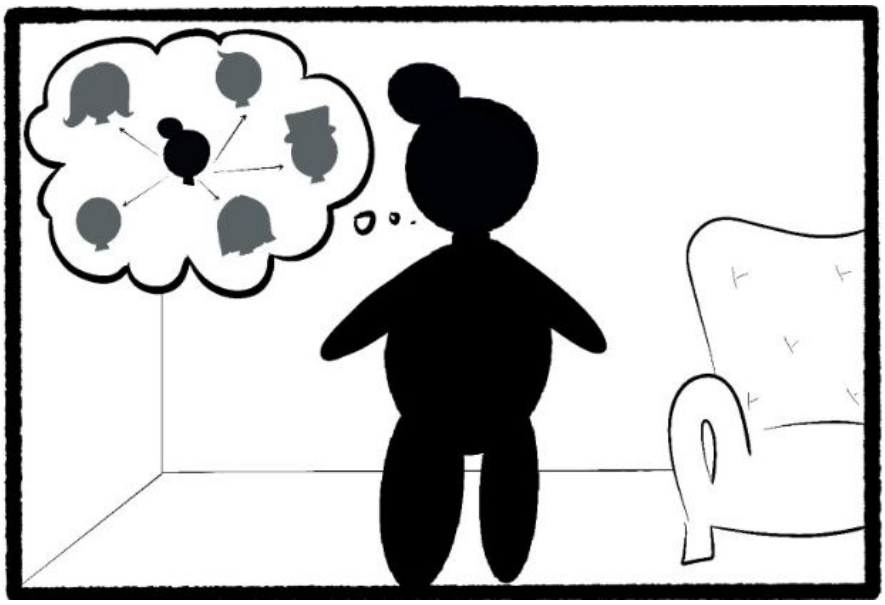


Sara usa o robô com sucesso para aumentar a sua presença altruísta na sua comunidade local. O robô entrega itens essenciais a famílias mais carenciadas, ajuda a limpar o bairro e participa em reuniões comunitárias para falar sobre as preocupações locais.

Cenário 6

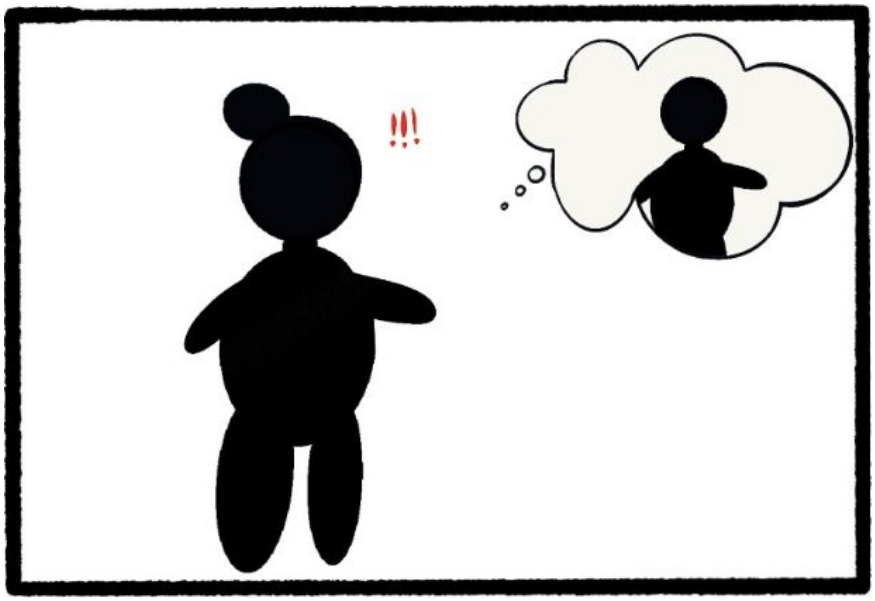


Cenário 7



Teresa é uma senhora de 86 anos que vive sozinha e valoriza a sua independência. Ela atribui grande importância às suas amizades, considerando-as uma parte essencial do seu bem-estar.

Cenário 7

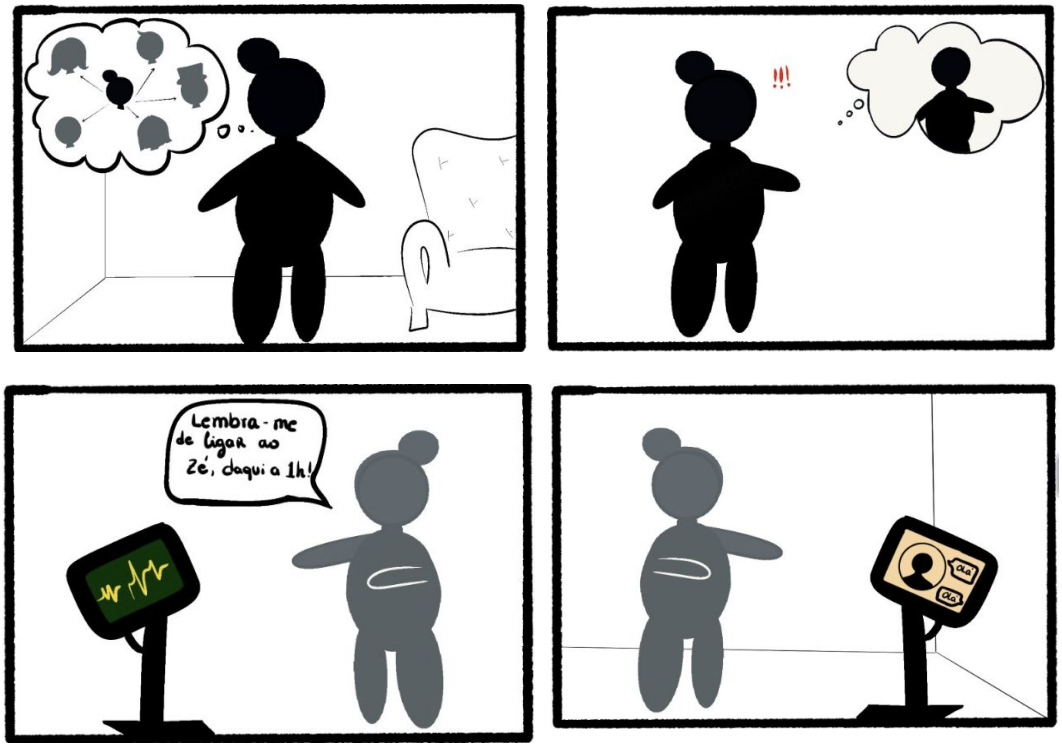


Apesar da Teresa se esforçar em manter as suas amizades, a sua memória fraca faz com que se esqueça de contactar os amigos. Por vezes, ela esquece-se de responder às mensagens dos amigos, um problema que a preocupa muito e que ela quer ver resolvido.

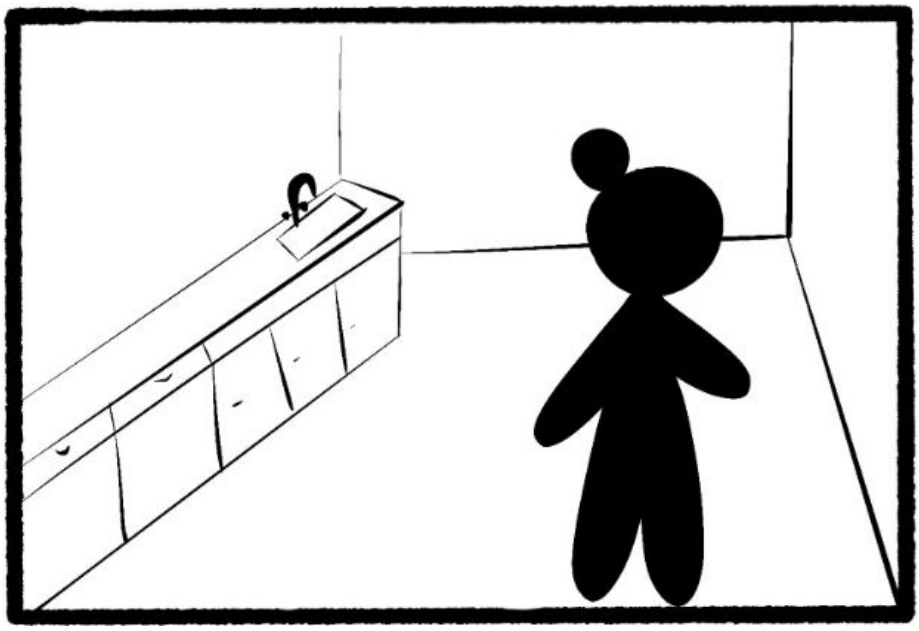
Cenário 7

Para combater as falhas de memória, Teresa dá ordem a um robô para a lembrar sempre que se esquece. Este robô lembra-a para responder aos amigos. O robot permite-lhe enviar mensagens através de voz e vídeos diretamente de forma fácil.

Cenário 7



Cenário 8



Inês é uma mulher de 75 anos que vive sozinha no seu apartamento. Ela é extremamente independente e sempre se orgulhou da sua capacidade de gerir a sua vida de forma autónoma.

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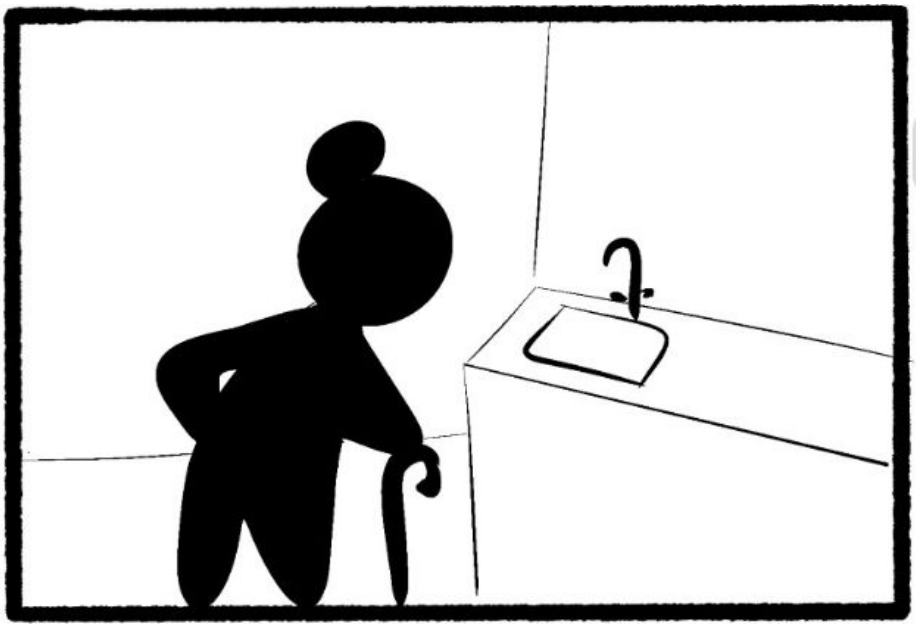
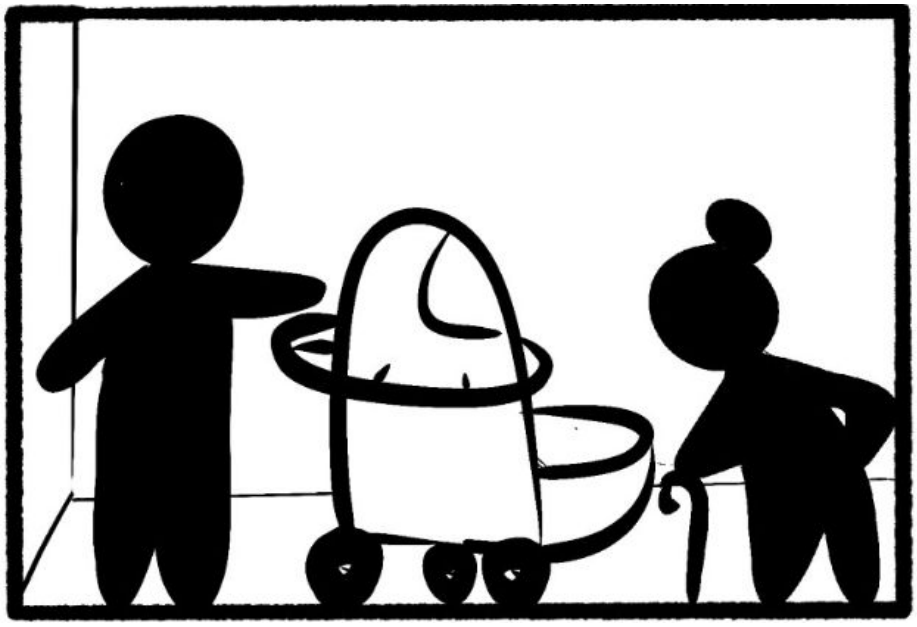
Cenário 8



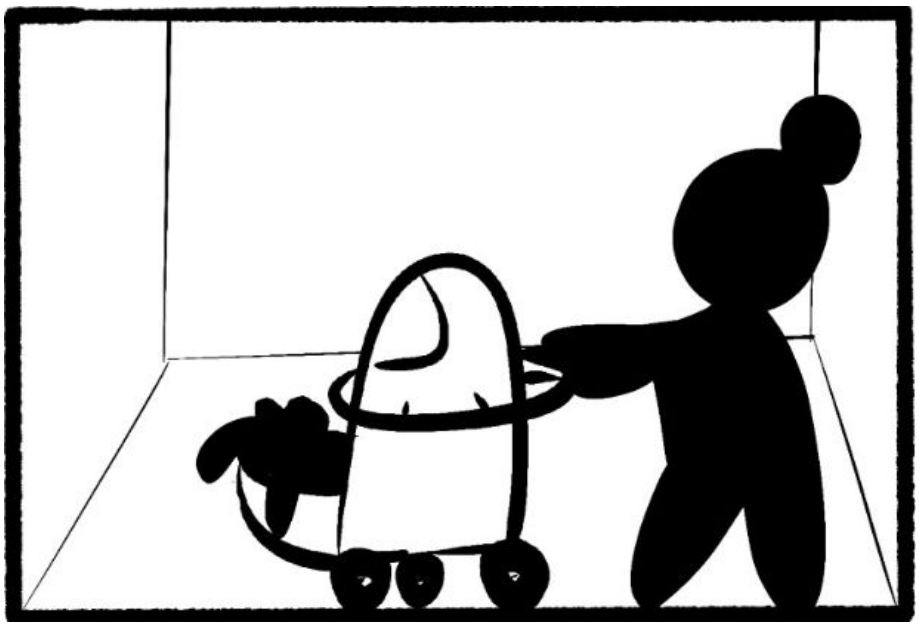
Inês sente-se cada vez menos capaz a cada dia que passa. Ela tem dores nas costas, nas articulações e ciática. Embora a sua independência seja muito importante, ela reconhece dificuldades em realizar certas tarefas, como cozinhar, limpar e caminhar. Ela começa a ponderar sobre as opções disponíveis para ajudá-la a manter o seu estilo de vida.

Cenário 8



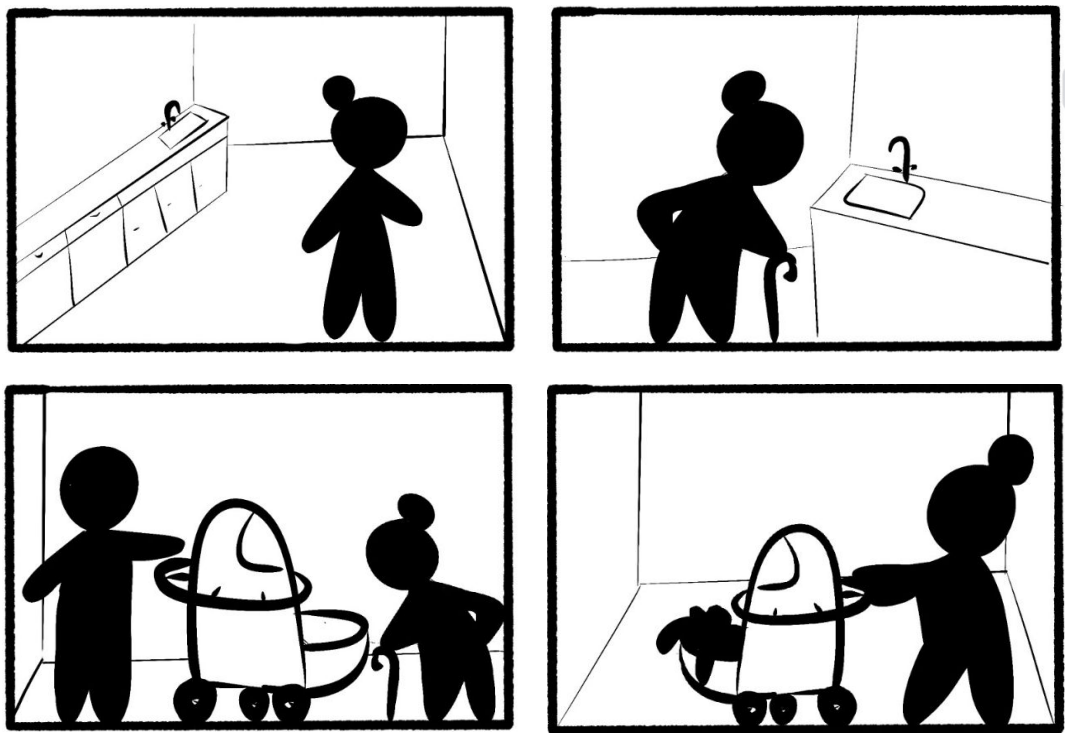
O seu filho, Pedro, investiga maneiras de ajudar a mãe e descobre tecnologias feitas de propósito para auxiliar pessoas com problemas físicos. Ele encontra um robô que pode fornecer ajuda prática, respeitando a independência de Inês.

Cenário 8

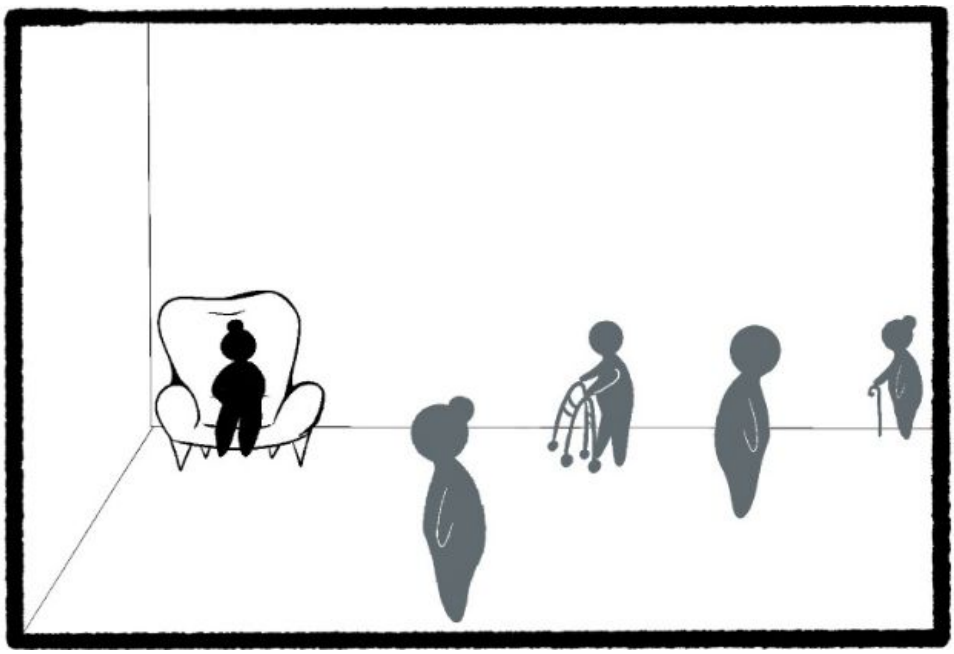


Com a assistência do robô, Inês continua a viver de forma independente. O robô ajuda nos movimentos, ajuda a gerir a rotina diária e transporta objetos mais pesados em vez da Inês.

Cenário 8



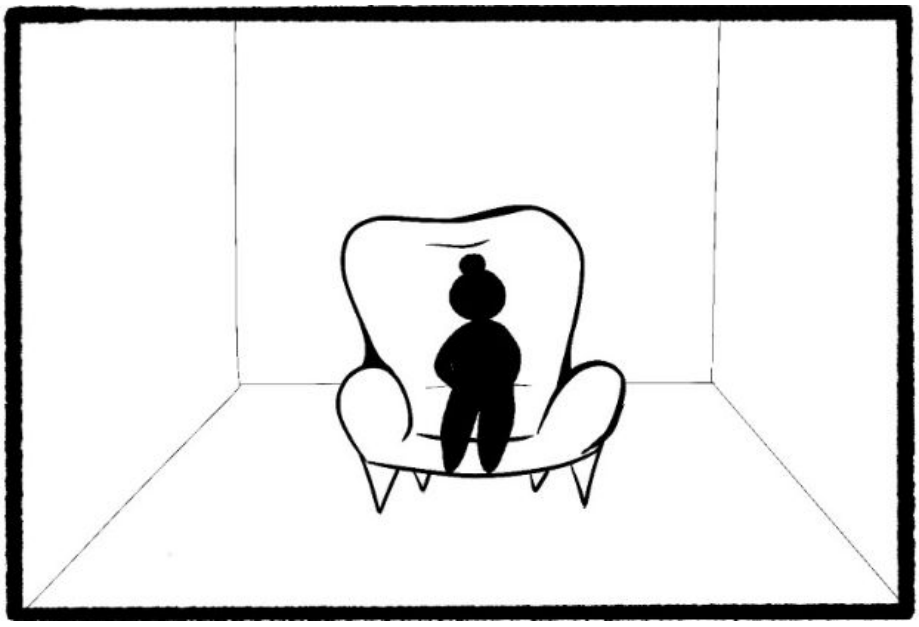
Cenário 9



1

Célia é uma mulher de 84 anos que mora numa casa de repouso, onde muitos moradores têm numa rotina que oferece pouca emoção ou aprendizagem.

Cenário 9

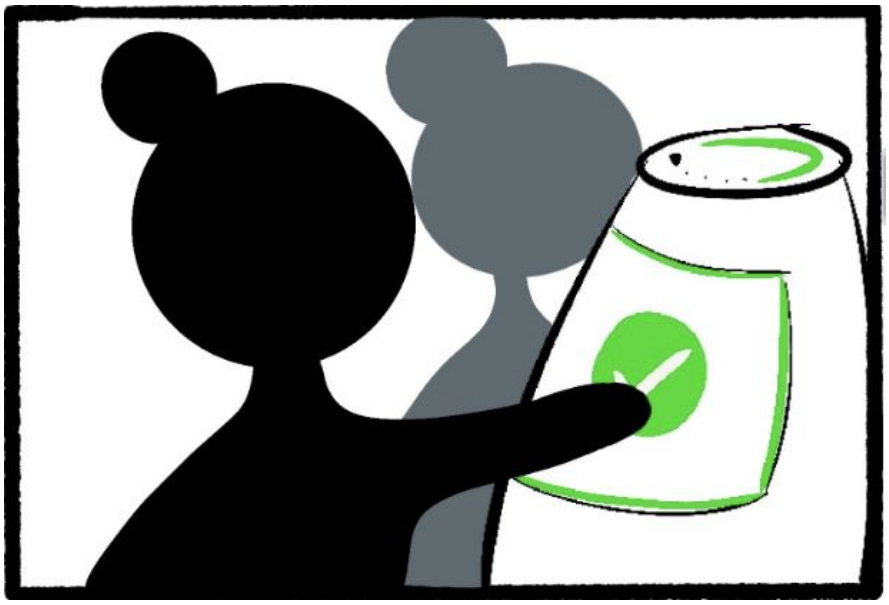


Célia sente-se resignada com a sua situação e acredita que os seus dias de aprendizagem ficaram para trás. Ela expressa que “esperar pela morte” é tudo o que lhe resta fazer agora.

Cenário 9

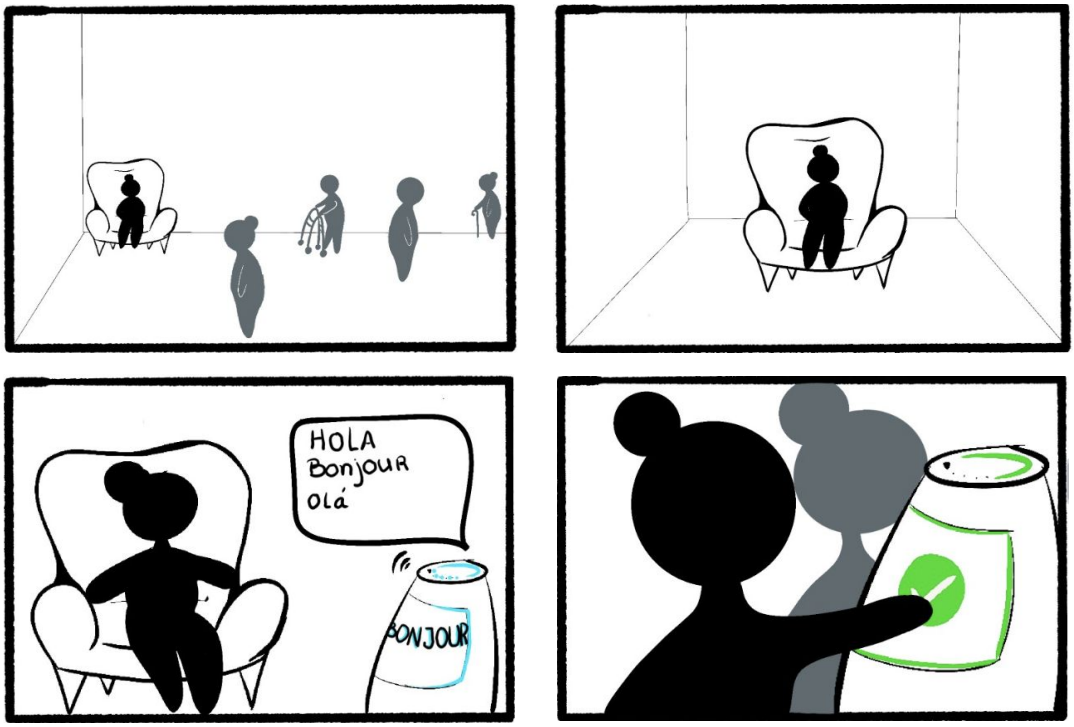
A casa de repouso onde ela mora introduziu recentemente um Robô que anda pela instituição e ensina coisas novas às pessoas da instituição, como canções, saudações noutras línguas, curiosidades sobre história e acontecimentos atuais que acontecem no mundo todo.

Cenário 9

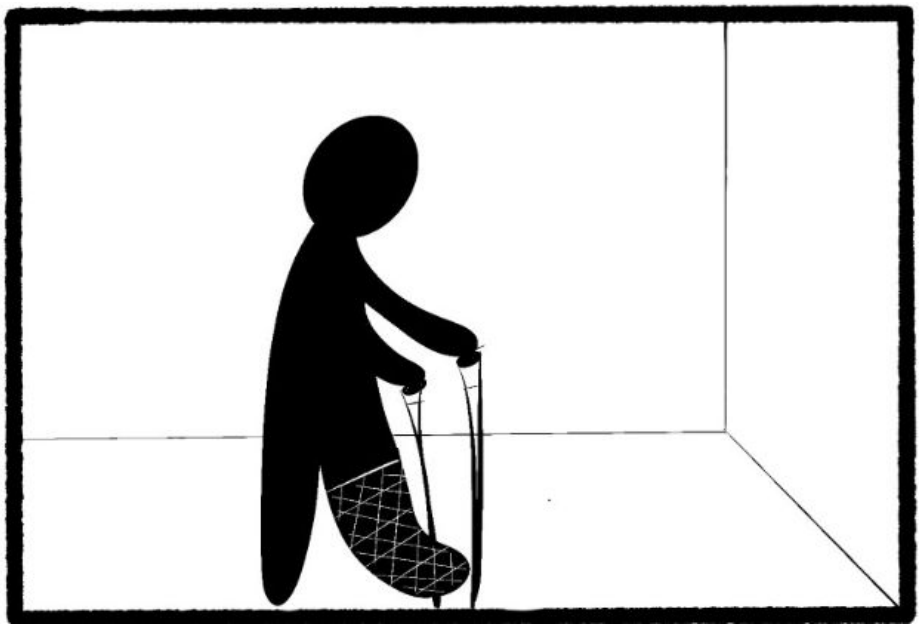


Célia fica mais ativa com o robô e procura-o na instituição para aprender mais sobre outras culturas e línguas e desenvolver a sua capacidade cerebral. Ela usa esse novo conhecimento para interagir com outras pessoas na casa de repouso e se integrar mais na comunidade.

Cenário 9



Cenário 10



Luís, um homem de 76 anos, vive numa cidade movimentada com a família. No ano passado, ele sofreu uma queda que fez com que magoasse a perna. Isto fez com que a sua autoconfiança ficasse afectada e limitando a sua mobilidade.

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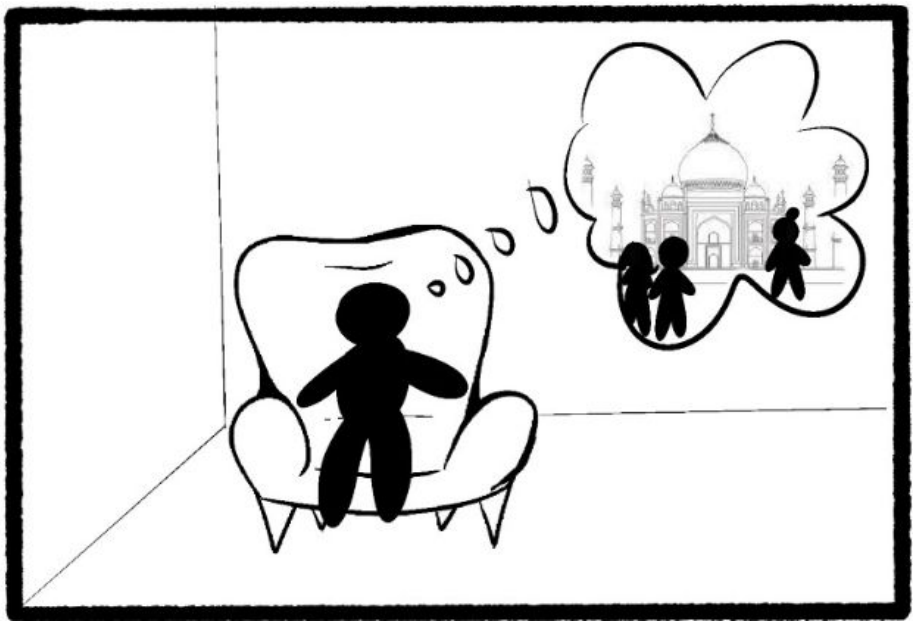
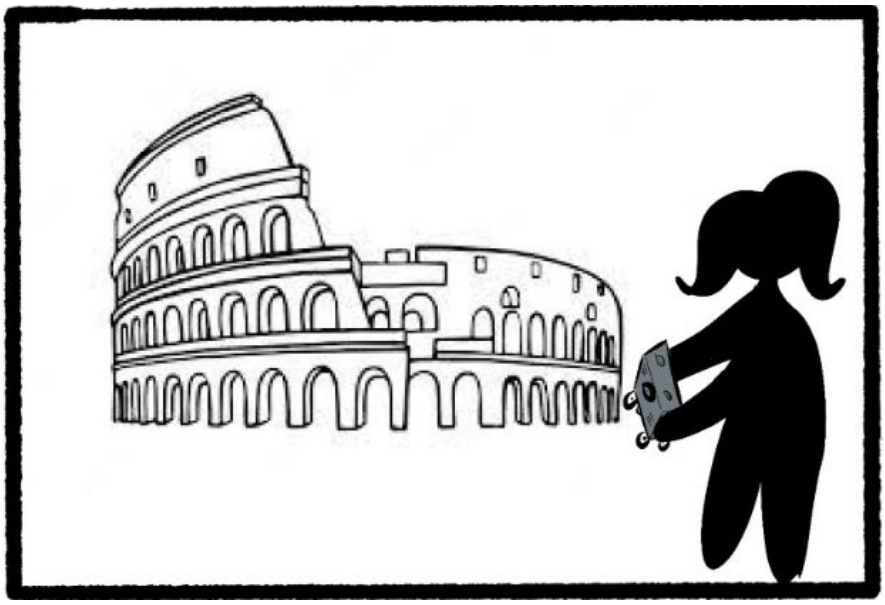
Cenário 10



Luís fica com medo de se juntar à família nas viagens aventureiras após a queda. Ele teme que outra queda possa resultar numa lesão mais grave. Assim, ele não vai nas viagens com a família e sente-se isolado.

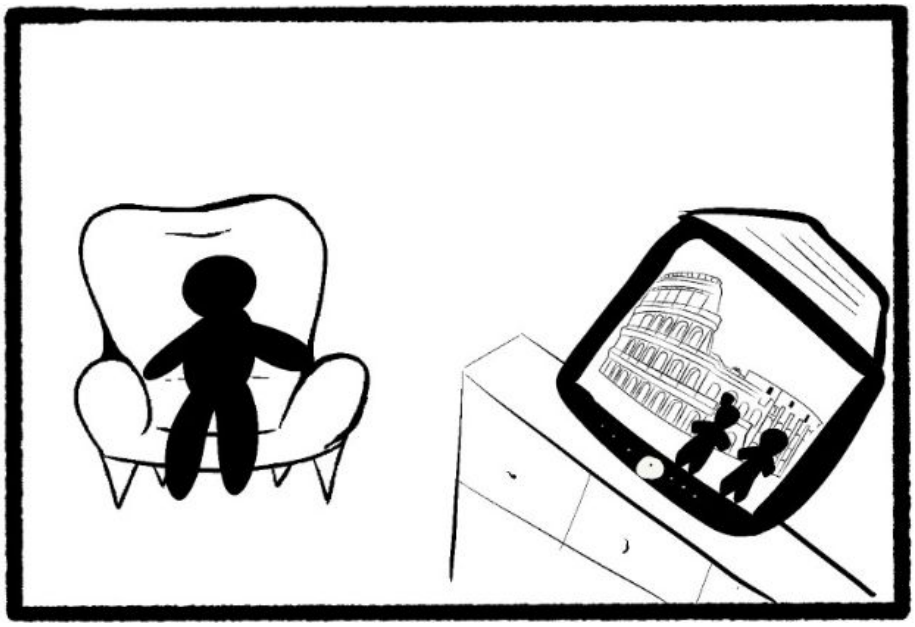
Cenário 10



3

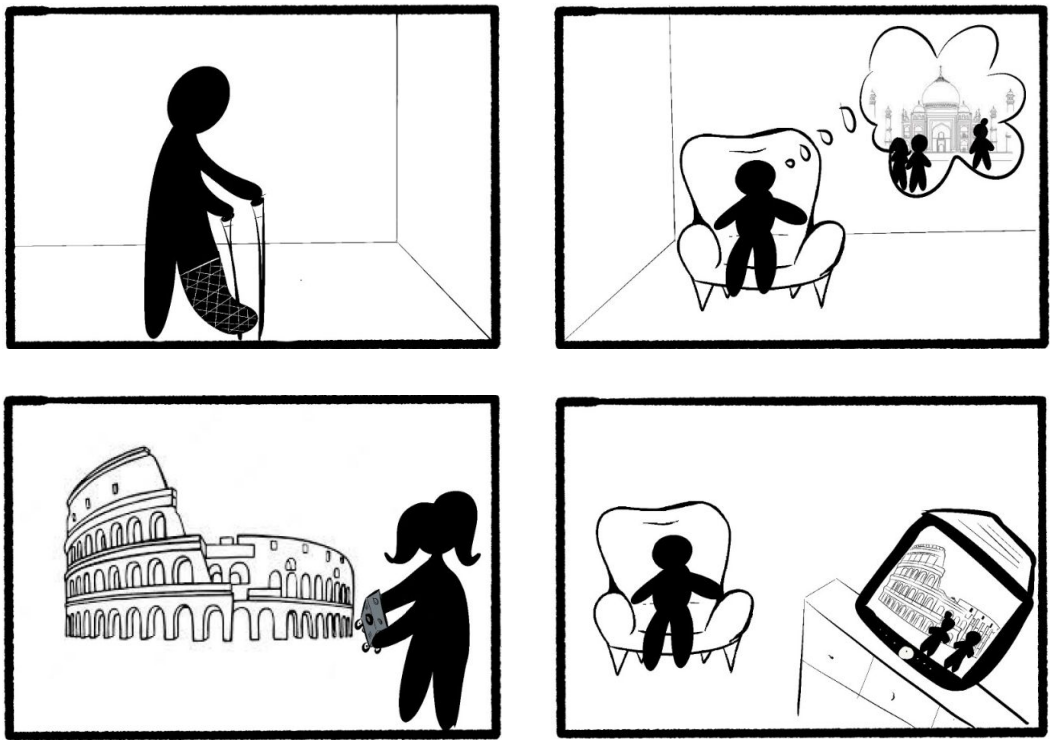
Reconhecendo seu desejo de fazer parte das suas viagens a família apresenta um robô equipado com câmeras em todo o redor e microfones. Este pequeno robô foi criado para viagens e pode ser transportado facilmente. A neta de Luís assume a responsabilidade de transportar o robô e escolher atividades que incluam aspetos que interessam a Luís, como a história e arte. O robô também possui um ‘Modo Exploração’ que permite ao Luís comandar o robot para explorar áreas ou atrações específicas, dando-lhe uma sensação de controle e aventura.

Cenário 10

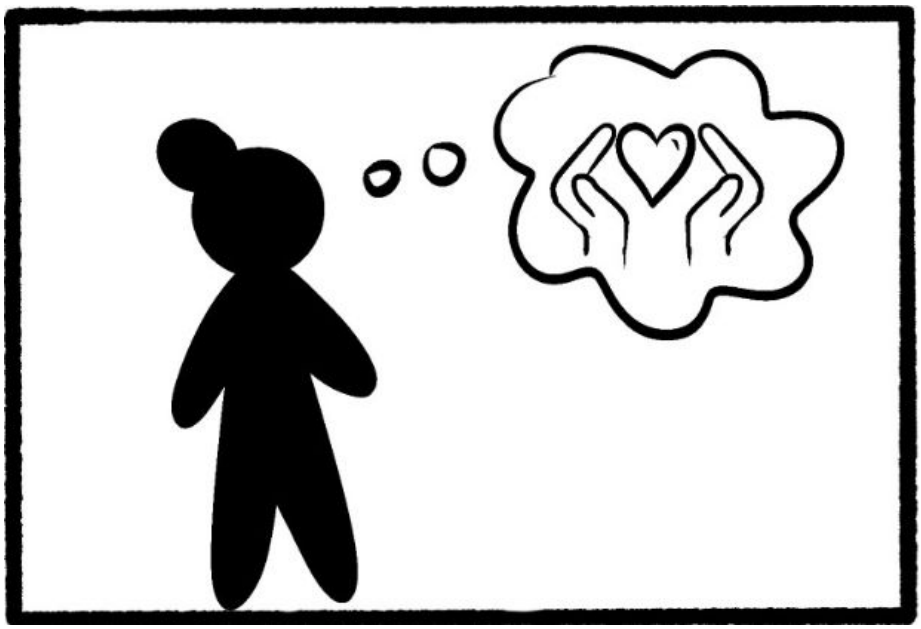


No conforto e segurança de sua casa, Luís agora viaja à distância com sua família. Ele não apenas participa nas atividades familiares, mas também ganha conhecimento sobre diferentes culturas, arte e história. Ele usa esse conhecimento para iniciar conversas com os seus familiares e amigos, fortalecendo os laços e facilitando uma aprendizagem para as duas partes.

Cenário 10



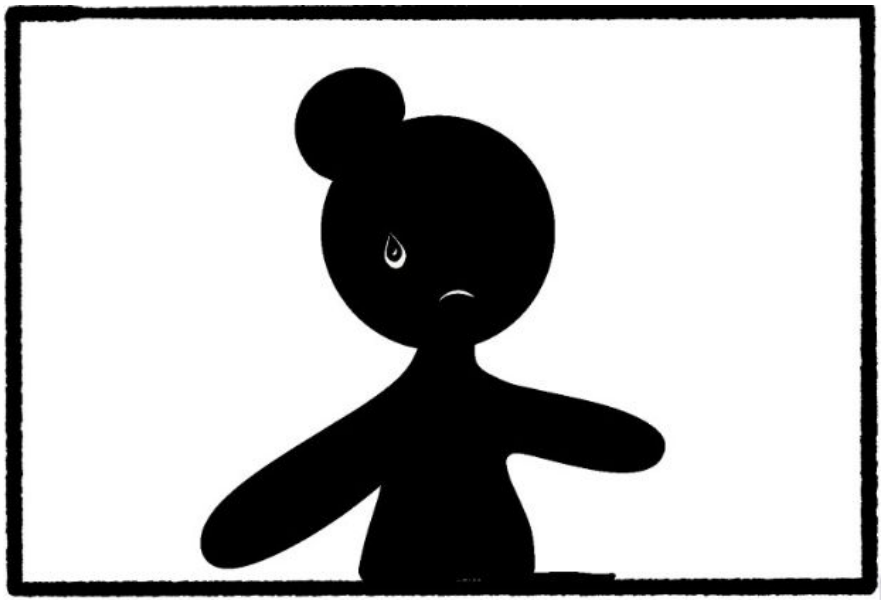
Cenário 11



1

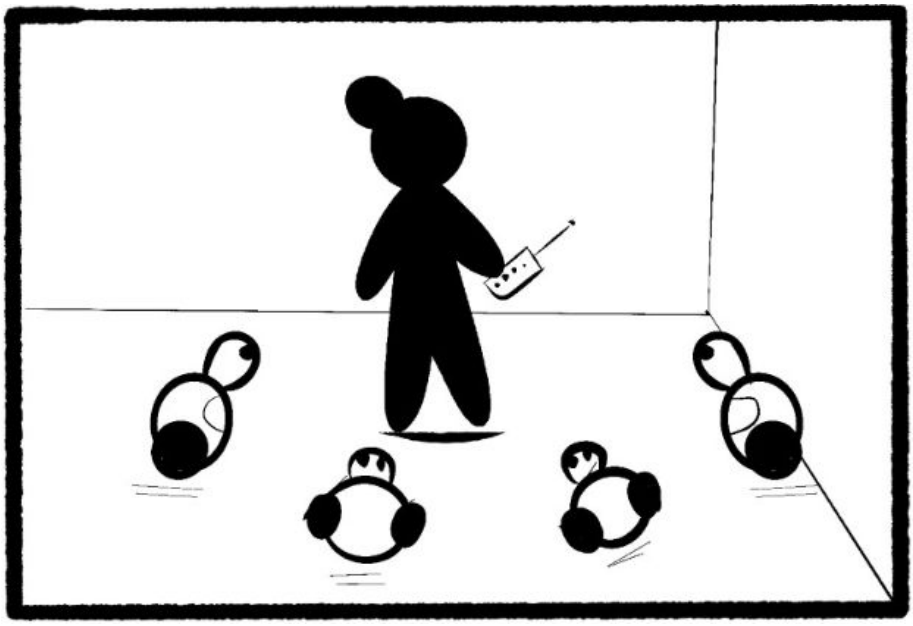
Mia é residente num lar de idosos e por causa das regras de saúde e segurança, não pode sair do estabelecimento. Ela é apaixonada por atividades de caridade, desde voluntariado em centros de abrigo até organização de eventos comunitários. A Mia deseja continuar essas atividades enquanto vive num ambiente confinado.

Cenário 11



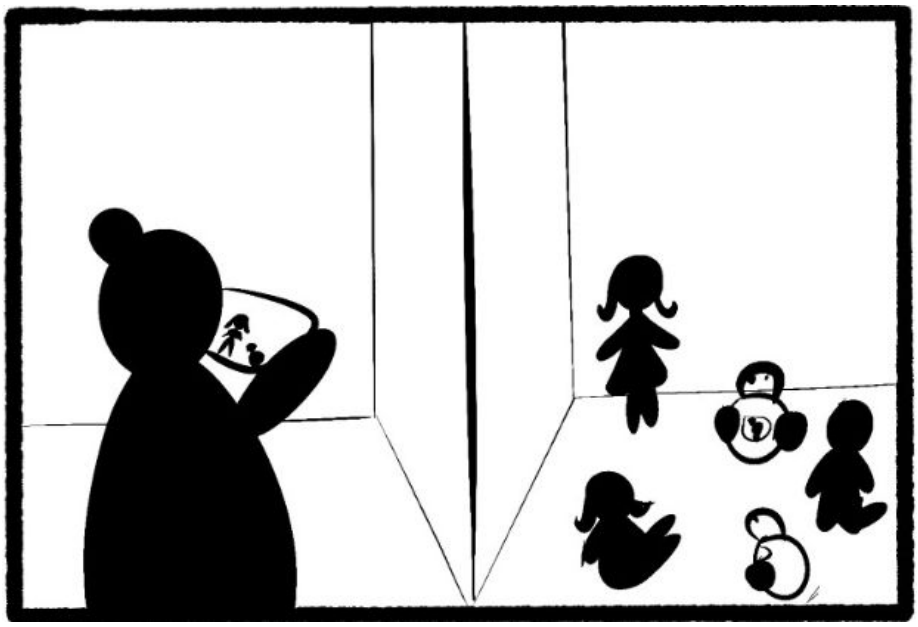
Mia está interessada em ajudar instituições de caridade locais, mas não pode participar fisicamente devido às suas atuais condições de vida na casa de repouso. Esta situação deixa-a insatisfeita e a querer encontrar uma forma de continuar as suas intenções de ajudar os outros.

Cenário 11



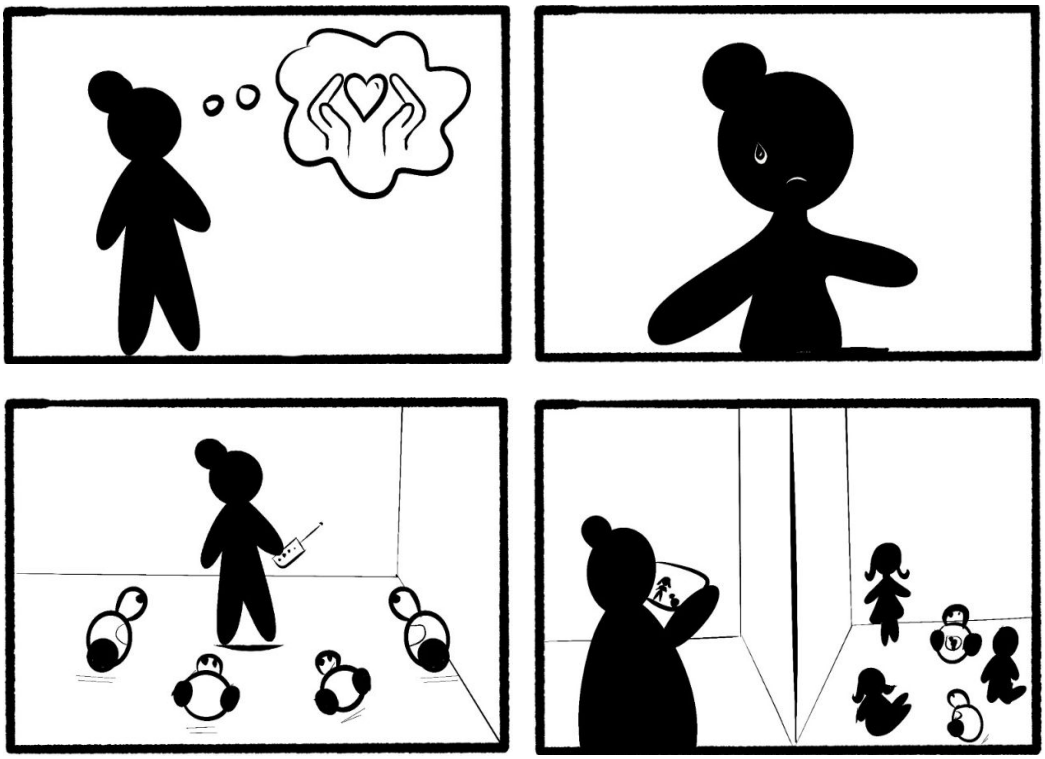
Ao descobrir que a sua casa de repouso possui vários robôs criados para auxiliar em diversas tarefas, Mia propõe uma forma de usar essas máquinas. Ela sugere programar os robots para atividades de ajuda comunitária, como a participação em eventos de caridade locais ou a participação em brincadeiras interativas num orfanato.

Cenário 11



O lar de idosos apoia a sua iniciativa e os robôs são enviados para o orfanato. Através de um vídeo em tempo real, Mia pode observar as crianças a interagir com os robôs e guiá-los em diversas atividades divertidas, contar histórias e jogos de aprendizagem. Isto permite-lhe contribuir para a comunidade, mesmo dentro dos limites do seu atual lar de idosos.

Cenário 11

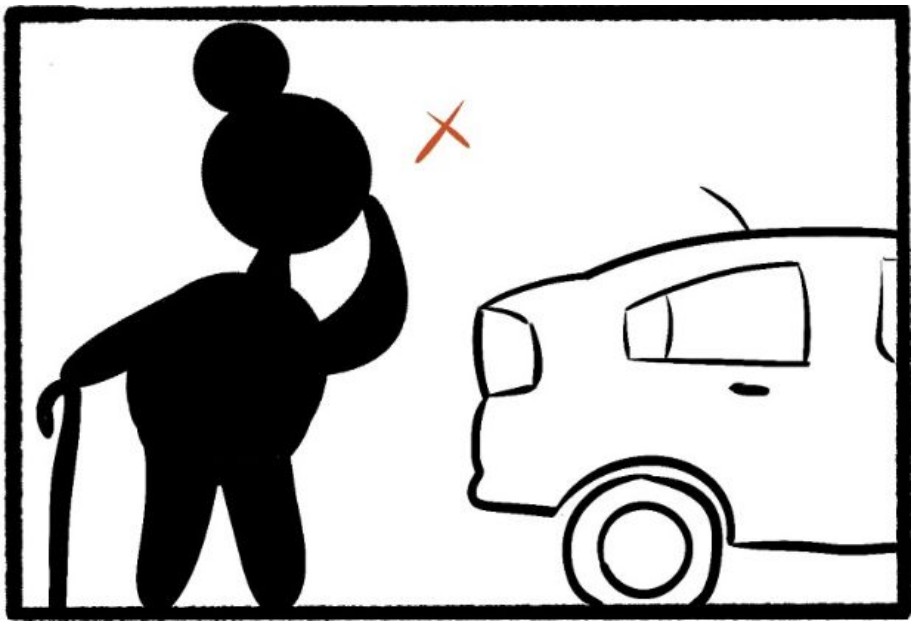


Cenário 12

1

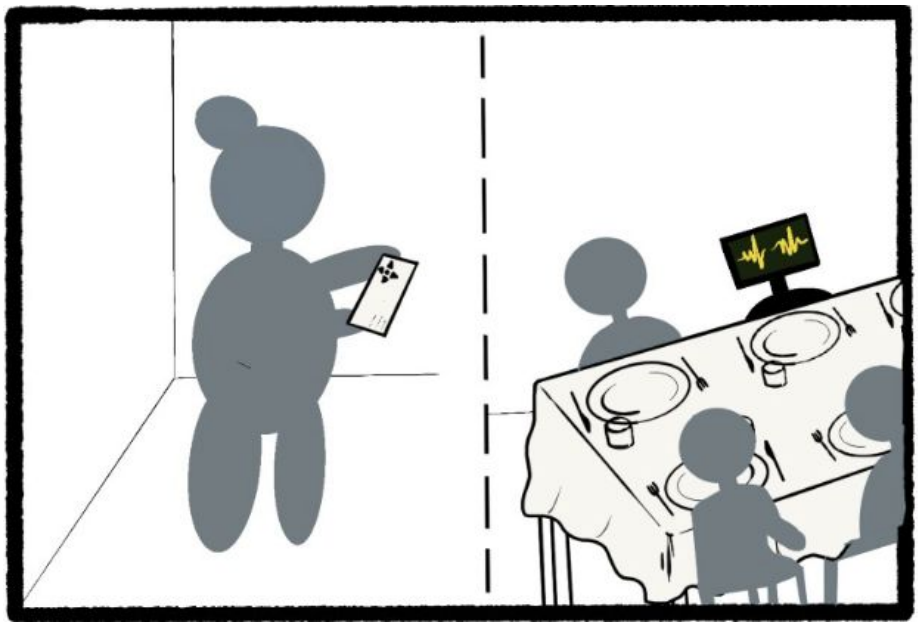
Amélia é uma senhora de 90 anos que coloca a família acima de tudo. Ao viver sozinha na sua casa, ela muitas vezes fala na distância que a separa dos filhos e dos netos.

Cenário 12



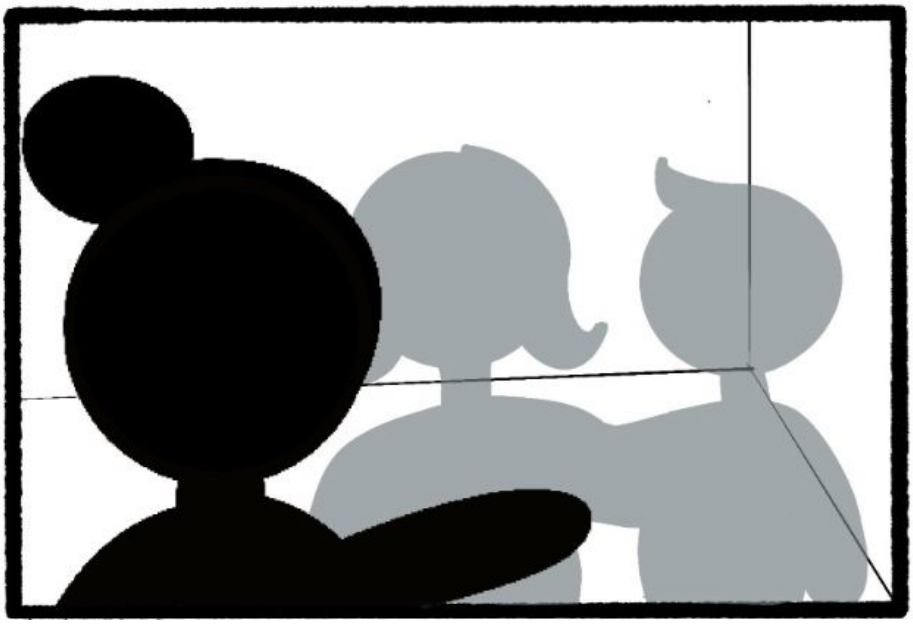
Mais do que qualquer outra coisa, Amélia deseja poder estar presente na vida da sua família – ver o dia-a-dia dos filhos e ver os netos crescer. Infelizmente, a sua condição de saúde impede-a de viajar para os visitar, deixando-a com uma sensação de falta de conexão e isolamento.

Cenário 12



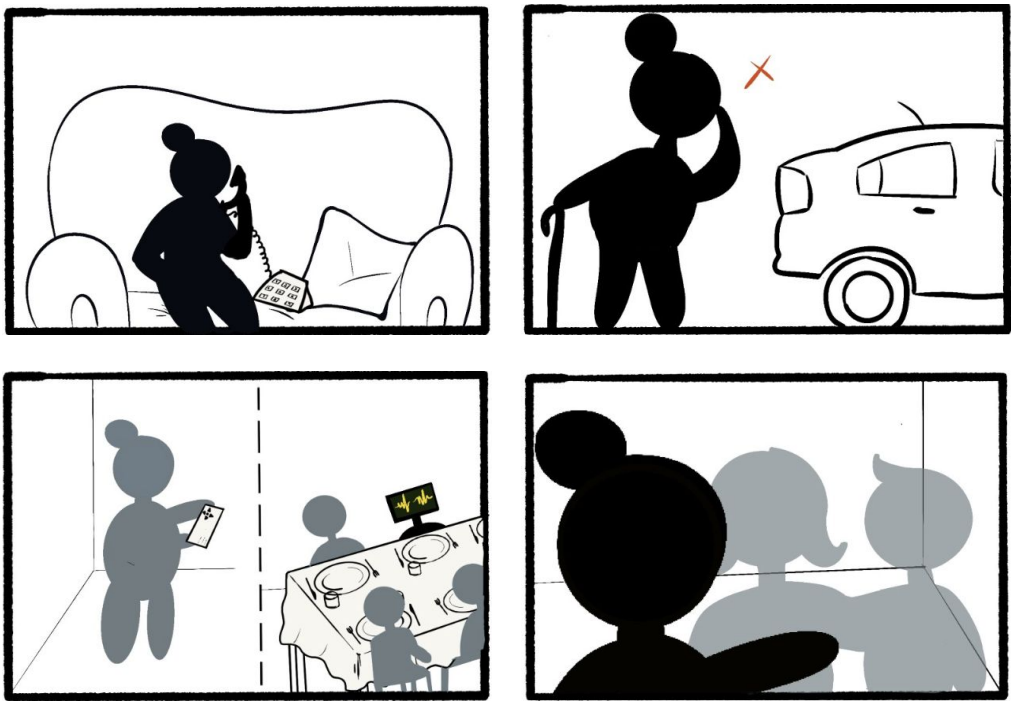
Amélias não quer deixar que a distância a impeça de visitar a família, por isso adota um robô para ir visitar a família no seu lugar. Este robô pode deslocar-se até à casa da sua família e filmar as atividades com os filhos e netos. Como está equipado com câmaras e sensores, a Amélia consegue vivenciar estas interações como se estivesse fisicamente presente.

Cenário 12

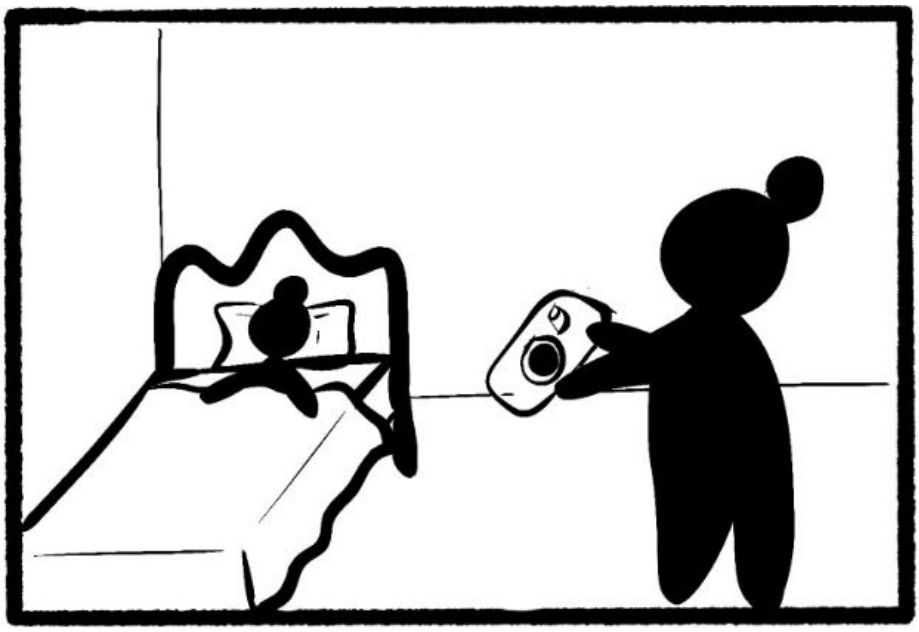


Sem sair de casa, Amélia pode agora participar à distância na vida da sua família. Ela observa através dos olhos do robô enquanto os netos brincam, ouve através dos seus ouvidos enquanto os filhos a atualizam sobre as suas vidas e até fala através do seu microfone para partilhar o seu amor e sabedoria com a família.

Cenário 12



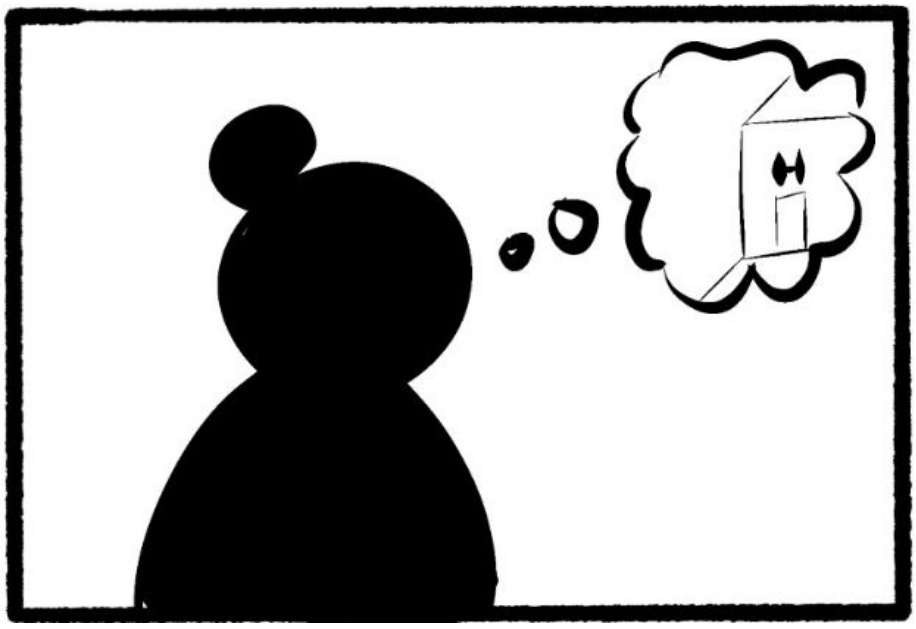
Cenário 13



1

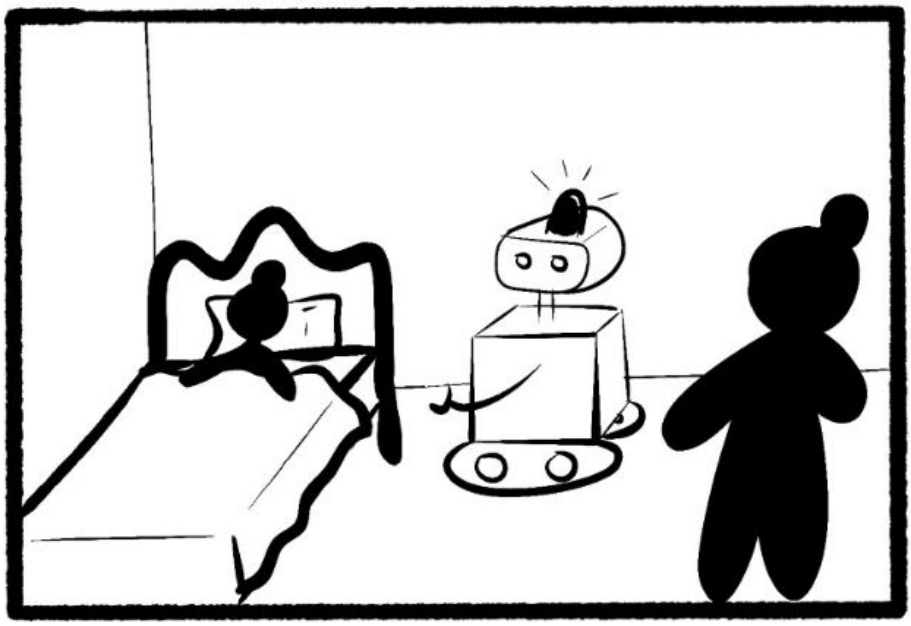
Aida é uma mulher de 70 anos que vive na sua casa. Ela é a principal cuidadora da mãe, que tem 95 anos e também vive com ela

Cenário 13



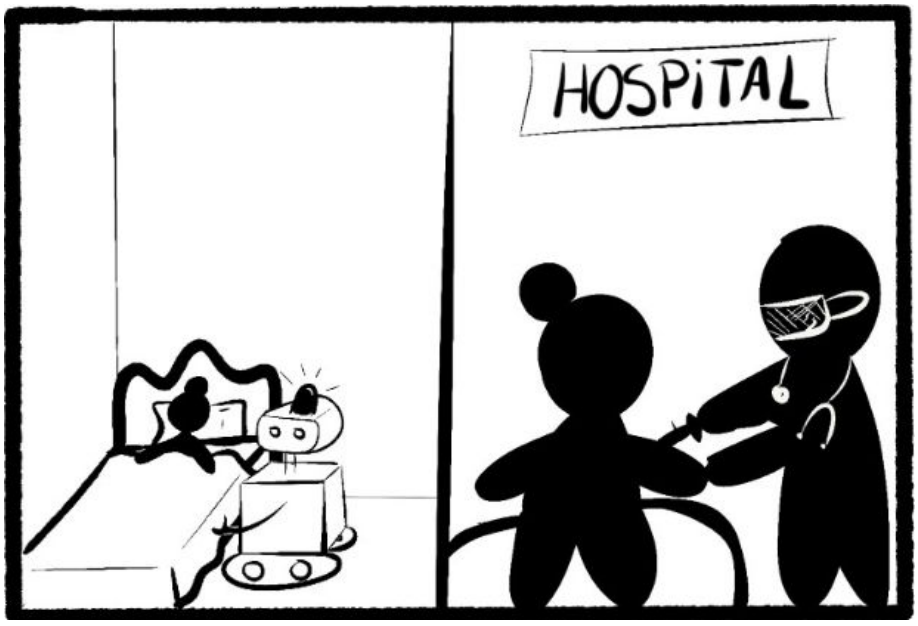
Embora Aida se dedique aos cuidados da mãe, as responsabilidades são muito grandes. Muitas vezes, ela não consegue afastar-se das suas funções de cuidadora por curtos períodos, como consultas médicas ou para cuidar do seu bem-estar mental.

Cenário 13



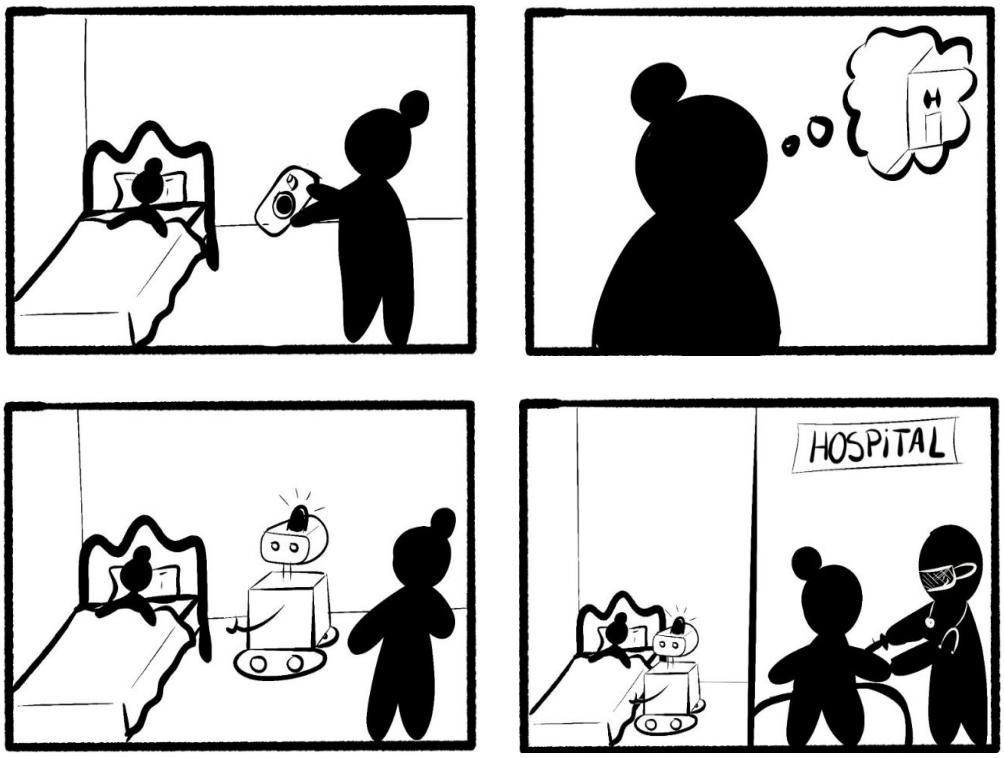
Ao conhecer um robô cuidador para situações como a sua, Aida decide experimentá-lo. O robô está equipado com uma câmara em tempo real e um sistema de alerta de emergência, podendo também realizar tarefas simples, como buscar objetos ou lembrar dos medicamentos.

Cenário 13

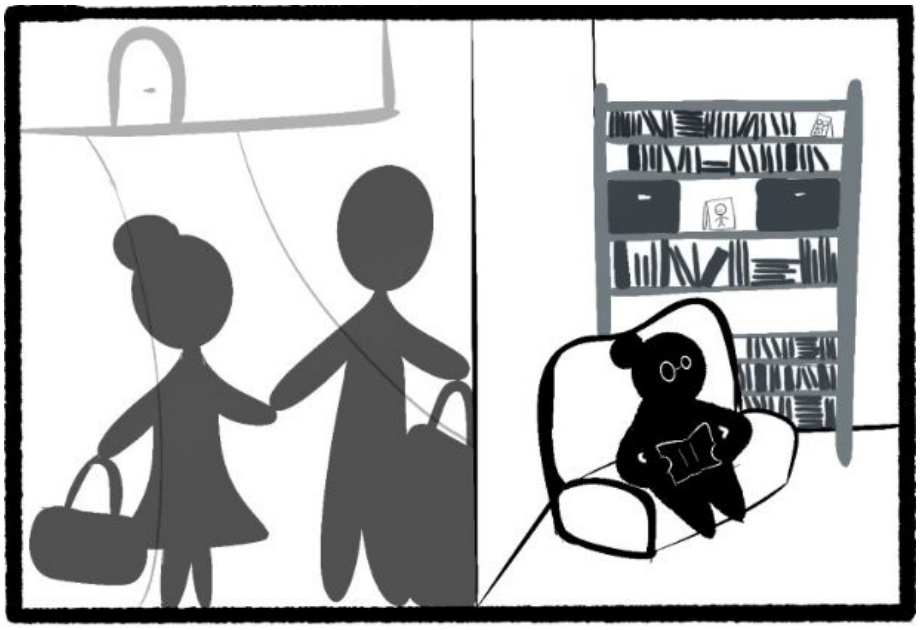


Com a ajuda do robô, Aida consegue o espaço necessário para respirar na sua rotina diária. Agora, já pode ir às consultas médicas ou fazer uma curta caminhada para cuidar do seu bem-estar mental, enquanto monitoriza o bem-estar da mãe através da câmara do robô. A presença do robô adiciona uma nova camada de segurança e tranquilidade, permitindo que Aida equilibre as suas próprias necessidades com as suas responsabilidades de cuidadora.

Cenário 13



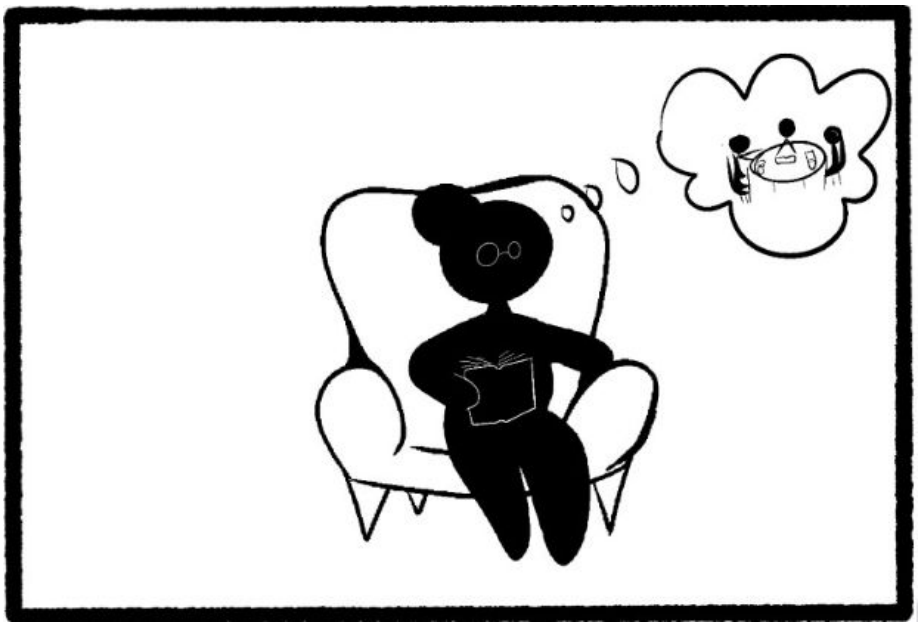
Cenário 14



Maria é uma viúva de 70 anos que mora sozinha numa cidade tranquila. Sempre gostou muito de ler, e era organizadora de um clube de leitura antes de mudar de terra devido ao trabalho do seu falecido marido. Desde o seu falecimento que não encontra uma oportunidade para falar sobre literatura tantas vezes quanto gostaria.

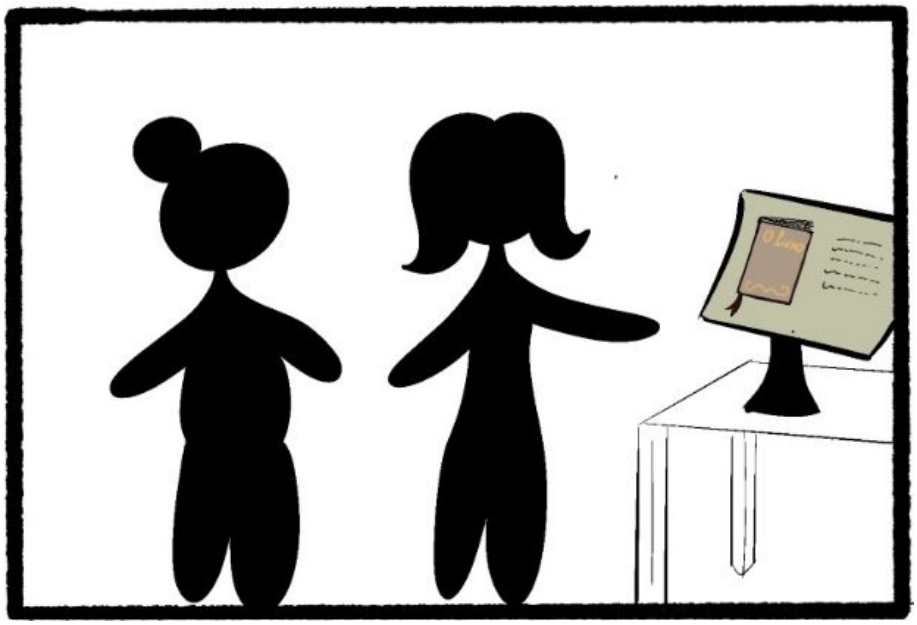
1

Cenário 14



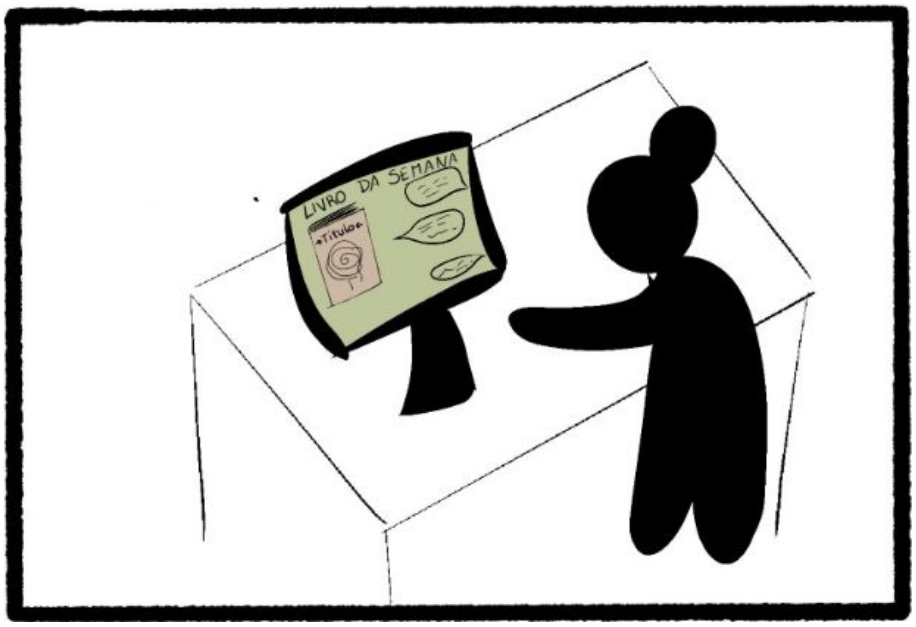
Maria sente falta destas conversas na sua vida, principalmente em torno da sua paixão pela literatura. Ela sente falta das conversas animadas e das análises sobre os livros que antes a faziam sentir-se viva.

Cenário 14



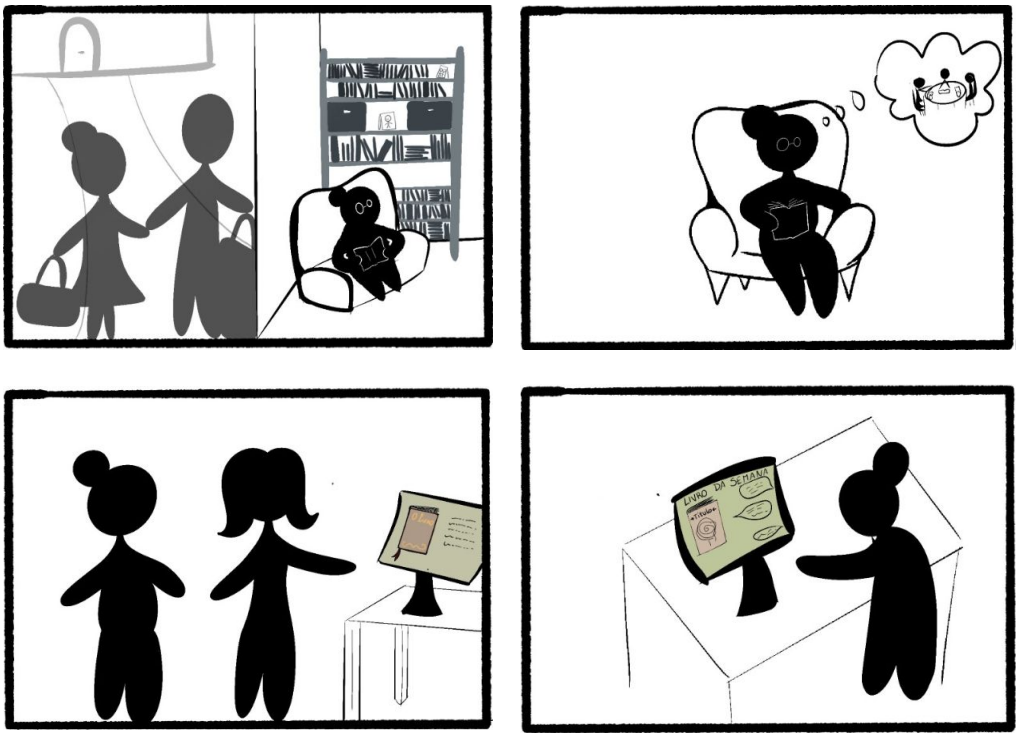
A sua neta apresenta-lhe um robô inteligente que sugere listas de leitura, e ajuda a facilitar discussões virtuais com outros clubes de leitura. O robô é equipado com inteligência para perceber as diferenças entre as histórias dos livros e ajuda a criar conversas interessantes.

Cenário 14

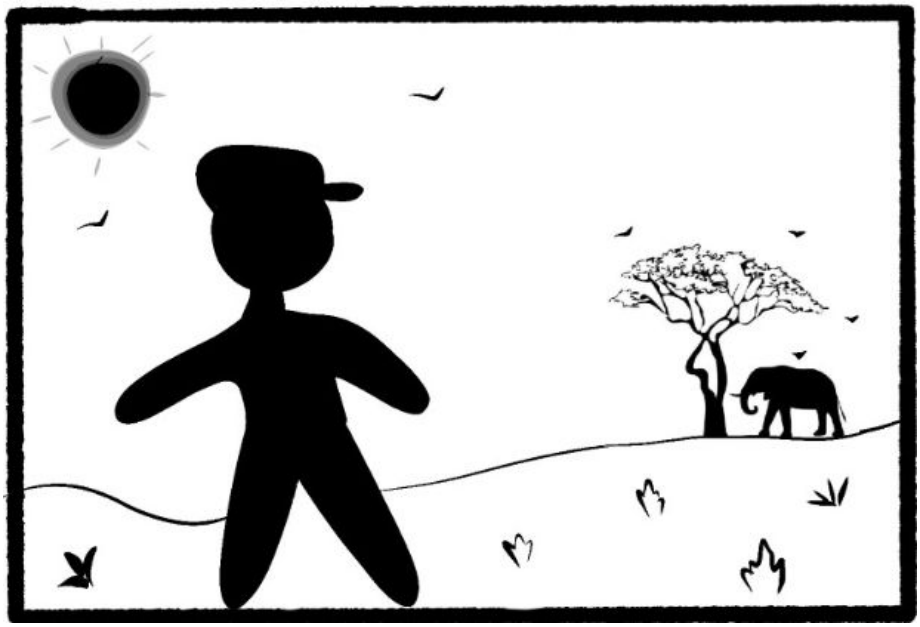


Através do robô, Maria descobre de novo o seu amor pela literatura. Ela torna-se um membro ativo de um clube de leitura à distância, facilitado pelo seu robô inteligente, que a conecta a pessoas com ideias semelhantes em todo o mundo. Maria sente os seus horizontes cada vez mais abertos à medida que interage com mais pessoas que também lê em, estimulando a sua capacidade cerebral.

Cenário 14



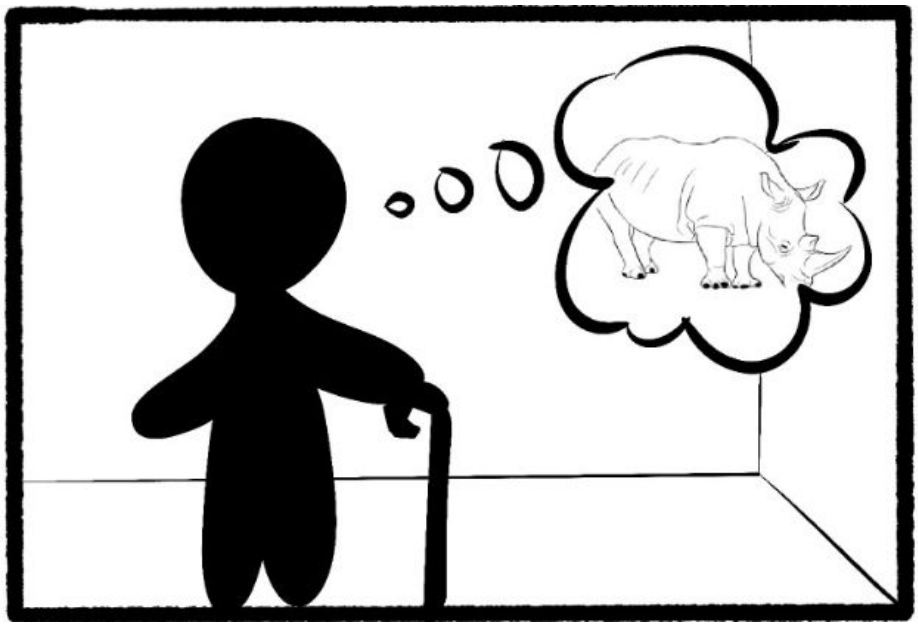
Cenário 15



1

Carlos é um homem de 92 anos com boas lembranças dos seus tempos como guarda florestal em África. Agora mora numa comunidade de aposentados, e conta histórias de quando seguia rinocerontes, elefantes e outros animais da savana.

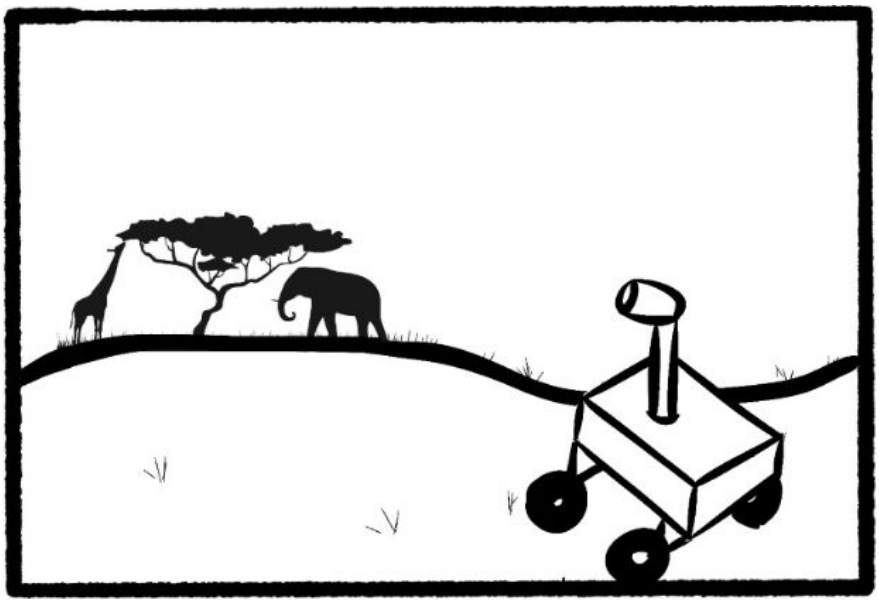
Cenário 15



2

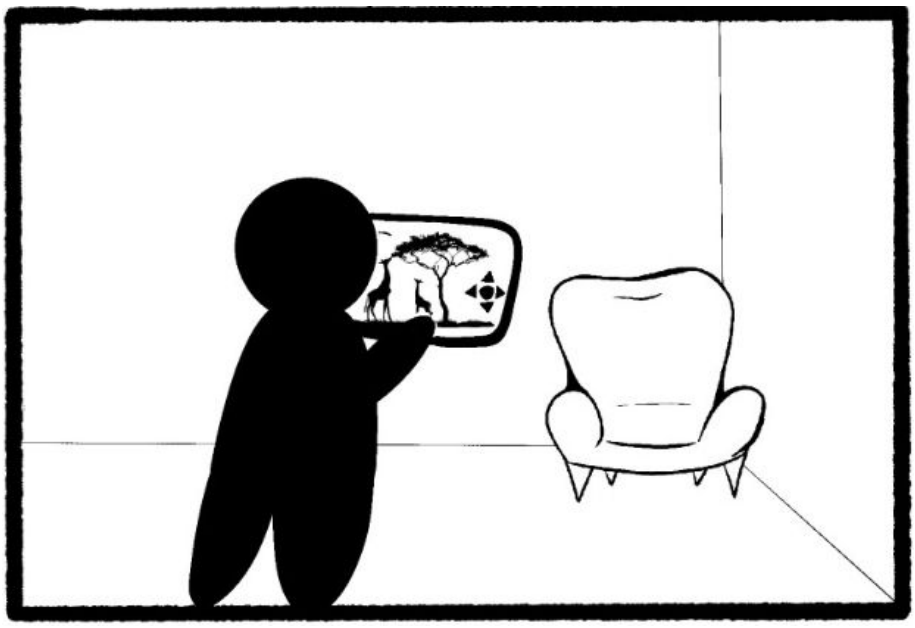
Embora Carlos tenha muitas histórias para partilhar, ele sente falta do sentimento de propósito que sentiu ao proteger os animais e os seus habitats. Ele deseja contribuir novamente para a conservação da vida selvagem, mas é fisicamente incapaz de regressar a África. Ele tem o tempo e a experiência, mas não os meios para atingir o seu desejo.

Cenário 15

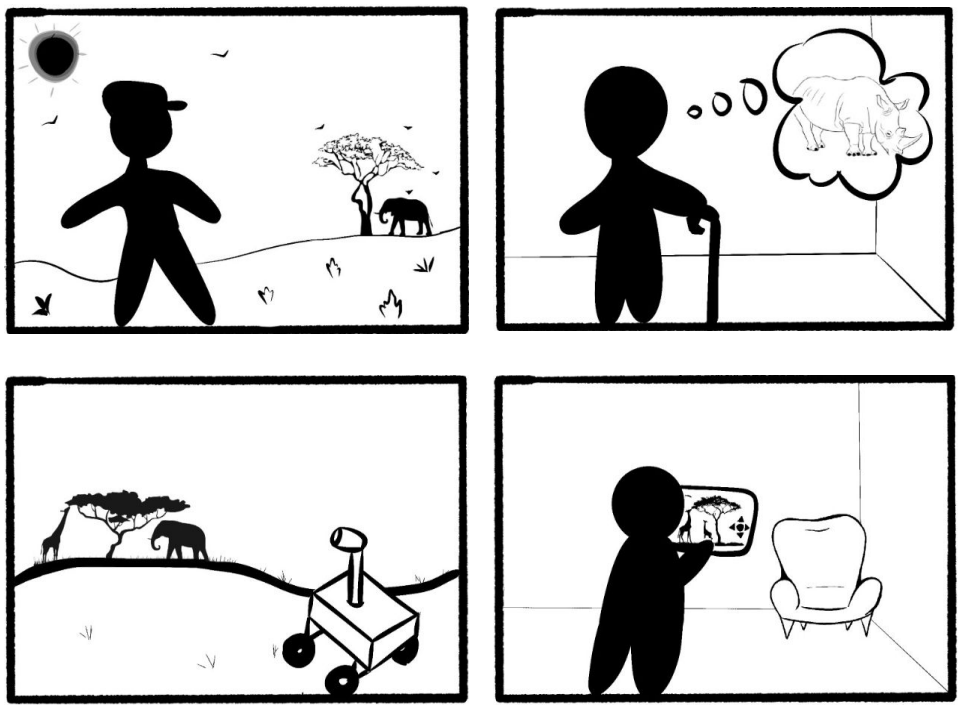


Carlos descobre uma iniciativa sem fins lucrativos que desenvolveu robôs de vigilância ambiental. Esses robôs podem ser controlados à distância e possuem vários sensores e câmeras. Este robô tem um programa para guardas florestais aposentados como o Carlos, para continuarem a contribuir com a sua experiência por meio da patrulha à distância de reservas naturais.

Cenário 15



4

Carlos inscreve-se no programa, e aprende a trabalhar com os robôs e o programa associado. Várias vezes por semana, ele pilota remotamente um robô, seguindo a vida selvagem, vigiando a saúde dos animais e avisando quando há sinais de caçadores que caçam elefantes e rinocerontes. Esta nova atividade dá-lhe novamente um sentido de propósito e permite que ele partilhe as suas experiências com outros residentes na sua comunidade.

Cenário 15