Age and Interface

Equipping Older Adults with Technological Tools

By

Rittika Basu

A thesis presented to OCAD University in partial fulfillment of the requirements for the degree of Master of Design in Digital Futures

Toronto, Ontario, Canada, 2021

Copyright Notice

Abstract

Older adults around the world experience physical, psychological, social and economic issues that hinder their learning processes, performance in simple daily activities and other factors that facilitate a healthy lifestyle. Human factors associated with ageing such as poor motor skills, weakening of hearing/eyesight, slower reflexes, low stamina and deteriorating attention span/memory obstruct them from using digital tools like younger adults. Although the degree of impact may differ from person to person, these factors could be considered a gradual and dynamic process. In today's age, it is crucial to be aware of one's surroundings, to be updated with the latest news, to be improving one's knowledge and to remain socially connected. The ongoing COVID-19 pandemic made us realize that access to a steady internet is a necessity and not a luxury.

In recent years, several communities have observed that older adults find using the internet and technologies challenging. In 2019, statistics by Pew Research Center presented that only 53% of people aged above 65+ years owned smartphones. The objective of this project is to promote digital literacy, and to empower and build confidence among older adults. This research will provide insights and factual data and introduce strategies to improve human-centred design services specific to the older population intended to help them in the process of embracing modern technology. Surveying the current research on the issues regarding the challenges older adult's face while using technology, the research outcome involves an accessible online publication specifically tailored for the target user demographic, to teach them how to use technology. The second outcome of this research is a web-based platform containing tutorials for older adults about performing various tasks via smartphones and computers.

Acknowledgements

To Dr. Ashok Mathur, my primary advisor whose constant motivation, patience, guidance and unwavering support have made my thesis investigation fruitful, enjoyable and enlightening. Your methods have reshaped my vision and helped me in collecting the right information. To Professor Philippe Blanchard, my secondary advisor whose earnest support, methodical guidance and suggestions helped me to grow beyond my research. I am very fortunate to have you both as my supervisors for this project. I am immensely grateful to each and every professor associated with Digital Futures and the OCAD community for bestowing me with knowledge needed for my academic projects and career endeavours.

I would like to express my sincere gratitude to Dr Sara Diamond and Dr Ajaz Hussain for giving me wonderful opportunities to design mobile applications for people 60 years and older. Their valuable insights, guidance, kindness and encouraging words have helped me to improve my design sensibilities. I am very thankful to Mr. David Marrello. I am grateful to be a volunteer and serve at your noble organization, TechServeTo - dedicated to tutoring older adults regarding the use and application of digital tools. Lastly, I am fortunate to share cherished memories with my friends, classmates and colleagues at OCAD University and at Myant Inc. I will miss the laughter, group works and critique moments we had before and after the lockdown. Thanks to all for making my postgraduate studies beautiful.

Dedication

This project was created in loving memory of my late Dida and Dadu (the maternal Grandmother and Grandfather in *Bengali*), Shrimati Namita Chowdhury and Shriman Shudhir Chandra Chowdhury respectively. My Dadu was a well-respected, humble and honest engineer. He was a brilliant student and a philanthropist. He loved us a lot. During our childhood, whenever he returned from office, he would bring sweets, toys and surprises for us. My Dida was kind, helpful and generous to her family and beyond. I, my mother and my brother are forever grateful for their numerous sacrifices, devotion and commitment in raising us. This project is intended to help older adults who faced trouble in using digital tools like my Dida experienced during her lifetime. Dear Dida and Dadu, praying to the Almighty that you both rest together in grace, love and peace.

Table of Contents

List of Figures

1.0 Introduction

Older adults are an integral part of any family, community and country. They can provide knowledge, experience, support and love to younger family members and friends. 11% of older adults do not feel confident when using modern electronics (Pew Research center, 2015). Furthermore, apprehension surrounding smart devices or lack of digital literacy can lead to digital divide[1], computer anxiety[2] and can cause one to develop misconceptions regarding new media tools. With life expectancy continuing to increase, many people live beyond 60 years of age. Life expectancy will rise to 86.2 years and 82.9 years for women and men respectively. In 2014, older adults comprised 15.6% of the Canadian population. By 2030 this population will surge to 23% (Statistics Canada, 2014). Because more and more older adults have been postponing their retirement and anticipating longer lives, it is important to help them in their process of embracing technology: to bridge the digital divide, to provide healthcare, to communicate with relatives and to avail themselves of the benefits of modern technology. 57% of older adult populations perform online shopping, 44% use the internet to learn recipes and culinary sciences, 75% use the internet to communicate with friends and family, and approximately 66% of the queries made by older adults are regarding medical and health-related information (Holmberg, 2019).

1.1 Research Questions

The original intended output was a hardcover publication preparing older adults for digital

---

[1] Digital Divide: The segregation between individuals who have access to the internet, computers and technology in contrast to individuals who does not have such benefits. This could be caused by economic, social and educational privileges (McDonough, 2016).

[2] Computer Anxiety: coined by Maurer in 1994 as the fear and apprehension experienced by an individual while using or having the thought of using a computer.

literacy. During the COVID-19[3] pandemic, online services were preferred to reduce human contact and ensure the safety of the older populations' wellbeing as they fall under the vulnerable category. Hence, this publication became an eBook. The contents include introductory chapters on web iconography, touch gesture infographic, user interface guidelines, user interface fundamentals and several essentials.

1.1.1 Primary Research Question

"How can technology be used to teach older adults who have limited digital literacy[4]*?"* Older adults are often taught about the usage of technology by younger generations through face-to-face interactions (Heaggans, 2012). However, there is a need for self-explanatory teaching tools for older populations that do not require technical assistance from others that teach users how to employ existing and emerging digital gadgets, nurture a sense of independence and dignity, and reduce 'computer anxiety' amongst older populations.

---

[3] COVID-19 - CO(Corona), VI(Virus) and D(Disease)

[4] Digital Literacy: refers to the ability to use, operate and have knowledge of digital tools. It refers to the life skills individuals need and function in a community where accessing information and communication network is a necessity via digital technologies like new media tools, mobile phones, etc. (Silvestre, 2014; Western Sydney University, 2021)
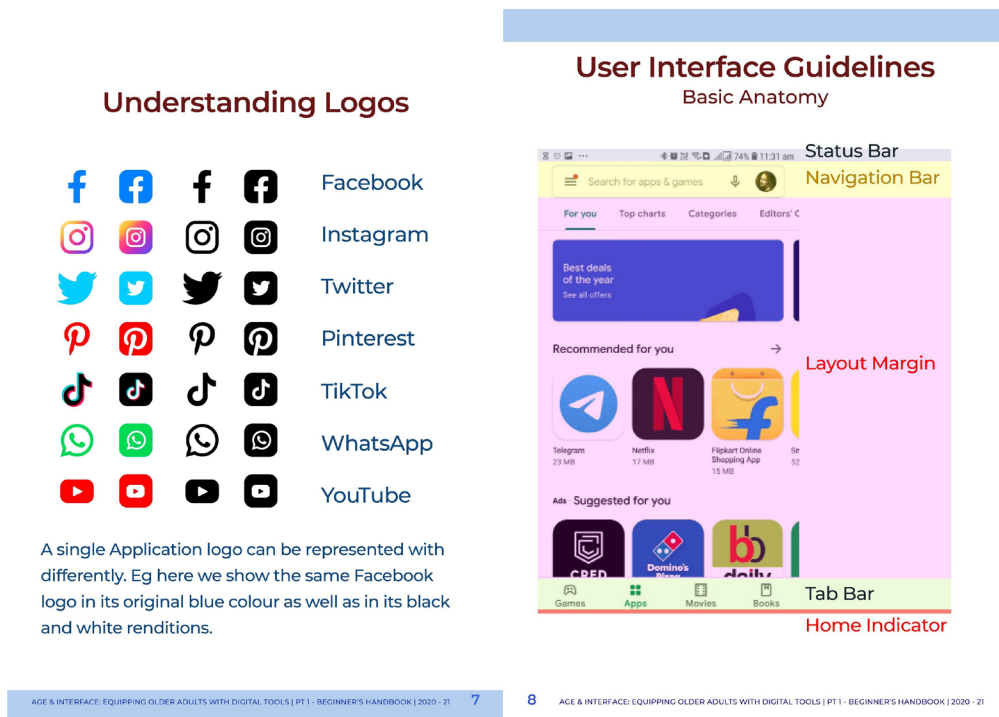
Fig. 1. & Fig. 2. Understanding Logos *(left)* and User Interface Guidelines *(right)*. These are important basic concepts for older adults using digital tools

1.1.2 Secondary Research Question

'What aspects of ageing obstruct the learning of digital tools among older adults that do not affect younger adults?' investigates types of physical, psychosocial and cognitive deterioration among older populations. The paper will present strategies, approaches and plans of action for tutoring older individuals whose age might be disadvantageous to them compared to younger adults who have grown up using technology like an extension of their body. Ageing factors, however, should be considered dynamic and not generalized. Dismantling the biases about older adults using technology is very important. (Heaggans, 2012).

1.2 Target Demography

The research focuses on serving individuals within the age group of 60 to 75 years old, also called **'older adults,'** who lack digital literacy skills and yearn to learn them. In 2006, according to a report researched by Aysha Mawani and the Alder Group, *'Each of us is ageing and Canada*

is ageing faster than before'. Currently, 13% of Canada's population is above the age of 65 years old. By the year 2031, this demographic will comprise 25% of the country's total population (Statistics Canada, 2005). WHO defines healthy ageing as "*the process of developing and maintaining the functional ability that enables wellbeing in older age*" (World Health Organization, 2020). Functional ability is about having the capabilities that enable all people to be and do what they have reason to value. Healthy ageing is not limited to physical fitness but includes mental wellbeing as well. Learning to use Digital Tools will expand opportunities and possibilities for older adults in terms of social networking, learning skills and accessing information.

1.3 Digital Rights, Net Neutrality and Cybersecurity

Since this project introduces an audience with limited technological knowledge to a realm of the Digital Era that is new and alien to them, it is essential to inform them about Basic Digital Rights, a subset of Human and Legal Rights that allows users to access, use and create, as well as publish digital content. Additionally, it grants the usage of computers, mobile phones, communication networks and other new media devices. Digital Rights/Cyber Rights[5] include the *Right to Online Privacy* and *Freedom of Expression* within the premises of the Internet Era and digital mediums (Hutt, 2015; IBERDROLA, 2021).

Preventing users from accessing the internet and its related facilities violates their Digital Rights, according to the UN. *Net Neutrality* states that Internet Service Providers (ISPs) should treat all internet networks/communications equally and uniformly, devoid of any discrimination. They shall not charge differently on the bases of users, content provided, platforms, applications, devices operated, internet servers, Internet Protocol address or any other criteria (Kenton, 2019). Above all, cybersecurity guarantees the freedom of users to make use of their digital right and protects them from cybercrime. (IBERDROLA, 2021)

---

[5] **Cyber Rights** and **Cyber Liberty** Activist raises the question of Governmental/Private agencies having the right to access private data sourced from digital mediums (BBC News, 1999). While **Digital Ethics** avert the violation of Digital Rights on the other hand **Digital Will** concerns what should be done with the Digital/Virtual Space of a deceased person. **Digital Disconnection** restricts the usage of digital communications (IBERDROLA, 2021).

1.3.1 Right to Internet - A Fundamental Right

The Right to Internet is also called the Right to Broadband or Freedom to Connect. In 2016, the Canadian Radio-Telecommunications Commission (CRTC) announced that "Canadian lawmakers declared that access to an inexpensive, dependable, and fast Internet connection is a basic right for all Canadian citizens no matter where they live". 18% of Canadians live in remote geographical regions that are inaccessible by telecommunication networks. Residents of such regions were forced to pay high fees for slow internet with low data caps (Onserve, 2020). Having access only to expensive and poor internet prevents the regular user from enjoying, exercising and obtaining information online. The lawmakers of Canada stated that the Right to Internet would aid residents of remote areas to access affordable, high-speed and stable internet connection with ease, convenience, and from the comfort of their home. According to Jean-Pierre Blais (2016) chairman of CRTC, every Canadian would be able to connect to and benefit from Net Neutrality even, if living in a rural or remote area. Despite making the internet a Basic Right, many older adults face still difficulty accessing the benefits of the World Wide Web. Hence, it is important to tutor them about the basics of the internet, make them aware of their Digital Rights, and educate them on the applications of digital tools, such as computers and cellphones, etc.

In 2016, The Canadian Press asserted that Canada's telecom regulator determined the internet to be a fundamental right and service for the whole country. The chief objective was to compell ISPs to guarantee a minimum internet speed: 50 Mbps in the case of downloading data, and 10 Mbps minimum in the case of uploading data (Terry, 2016).

1.4 Rationale to Teach Technological Tools

Knowing technological tools and accessing digital platforms have become requisites for any individual in this day and age, as using electronic devices is an inevitability in our daily lives. However, this research focuses on the importance of teaching mobile applications and user-interface basics to older adults in our society. With the several advantages of using smart devices, one finds it worthwhile to teach older adults about technology. The array of merits

ranges from the expansion of social circles, online shopping /grocery, learning new information, and reading news, checking weather and browsing through photo archive, to navigating to new places, remote working and watching Over-the-Top (OTT)[6] content (Goodman, 2020).

2.0 Literature & Contextual Review

According to Statistics Canada, nine million older adults will represent 25% of the country's total population and the working population 15–64 age group will decrease from 69% to 60% by 2031 (Blais, 2012). IDEO's toolkit conveys the importance of empathy towards older populations and taking care of them for the future. However, the physical, psychological, social, psychomotor and behavioural capabilities of older adults are different than those of younger or middle-aged adults in numerous ways, including limited mobility, reduced reflexes, poor eyesight, poor motor skills, short attention spans, hearing loss and deteriorating memory. These aspects of ageing adversely affect the processes of learning, comprehending and using advanced technological resources, all of which can lead to computer anxiety (Maurer, 1994).

---

[6] Over-the-Top (OTT): Online services that enable you to stream web-series and movies on smart devices. Eg. Netflix, Amazon Prime, etc.

Fig. 3. Design on Ageing, toolkits from Project catalyst and IDEO, This project has derived insights from *'Design on Ageing'*. An excellent resource for researchers on **Gerontology**[7] and on understanding mindsets of older adults.

My research argues that dismantling biases about older adults using technology is very important as misconceptions give rise to confusion. We are all ageing, hence the need to be empathetic towards our grandparents. Older adults need to embrace technology after they realise what a major role it will play in enhancing their quality of life and helping them in achieving their goals (Heaggans, 2012). In order to teach the aging population the merits of computer literacy, educators must try several coping strategies and learning models (such as the Technology Acceptance Model or Persuasion Design Model) and utilize accessible design principles. But, above all, one must approach with empathy (Human-Centered Design) and patience. Researchers and creators must consider happiness and user-satisfaction as the foremost priority

---

[7] Gerontology - Coined by Ilya Ilyich Mechnikov in 1903, it is the science of the psychological, physical, social and cultural facets of ageism.

over productivity and economic gain. Embracing assistive technology[8] and Gerontechnology[9] is a necessity for making the older population comfortable in the domain of digital applications (these terms are further explained in Chapter 5 and Chapter 6, respectively).

 The aforementioned technologies are specifically designed to cater to older adults aiding them to focus on their health and better comprehend digital interfaces (Graafmans, Eindhoven University, 1989). Assistive features are ingredients of user-centric design, and can be modified to accommodate special needs. In line with 'The Human Factors of Aging and the Micro-Environment, Personal Surroundings, Technology and Product Development' (2008), Sandra Howell observed that the older people preferred living in familiar and particular environments. They like to customize their living arrangements to make the architecture suitable for their ageing needs. Older adults' environments should give them a sense of security, peace and control. Environmental research highlights the difference between the living space of a younger person and an older person. For example, over the years, older adults acquire lots of things beyond their needs and daily usage. Personal artefacts give value and attachment to one's environment. Photographs, collectibles and memorabilia are part of such an ecosystem. They have nostalgic value and are associated with memories (Koncelik, 2008).

Several infographics were created by the Axess Lab (2019) displaying user statistics specific to older people, including graphic aids and information regarding modern technology usage among older adults. Developed by digital accessibility experts, these infographics were presented in the simplest form for easy understanding, targeting the general public. They presented factual data regarding the percentage of older adults that went online for news/weather, entertainment and other information, and to procure resources, access recipes and engage in social networking. Research documented in 'Teaching Older People using Web Technology: A Case Study.

---

[8] Assistive Technology: devices or software that aid in the daily lives of people with special needs, eg. voiceover, motorized wheelchairs and screens.

[9] Gerontechnology: portmanteau of gerontology and technology. Gerontechnology is concerned with well-being, improving life-quality, increasing vitality and ceasing morbidity with respect to ageing with the aid of innovative technology.

International Conference On Advanced Computer Science Applications And Technologies' states that the older population needs to be updated with the rapid advancement of digital technology to bridge the age-based digital gap. Since many older adults are affected with physical weakening and sensory loss, older people should be taught one lesson at a time. They need to be familiar with the visual language, navigation basics and fundamental knowledge regarding the internet and how a website functions (Ahmad et al, 2013).

For instance, before creating a Facebook account, one needs to create an email ID where they must choose one of multiple services and define their ID and password. They also need to manage this information and keep it somewhere. Since customization for individual users is not possible, many designers have used *user-persona techniques* and human-centred design methodologies for products, services and visual aids targeted at people 60 years and older. Drawing roughly sketched ideas of how the user will learn about one's idea-; how users will be interacting with it, how the experience will change his/her lifestyle, and if/how the idea will influence their friends and family should be considered. The publications '*Design on Aging: Independent Living'* and '*Design on Aging: Connected Living'* highlight the importance of happiness and emotional support. These toolkits studied 4 major user-mindsets of older adults and presented in-depth analysis of personality traits, such as being a social butterfly, over an Organized Individual, or an Introspective Homebody vs the Guarded Stability Seeker. The publication highlighted their *personal preferences* and sketched their *User Journey Maps*; whether they preferred domestic activities or social outgoings was considered (Project Catalyst & IDEO, 2017). Using this knowledge, the user-flow of the web-based tutorial platform was designed.

3.0 Present Scenario

Seniors are less confident when using electronic devices

% of U.S. internet users who say they feel ____ confident when using computers, smartphones or other electronics to do the things they need to do online, by age

■ Very ■ Somewhat ▪ Only a little ▫ Not at all

Age	Very	Somewhat	Only a little	Not at all
18-29	74	20	4	1
30-49	60	30	8	3
50-64	41	42	12	5
65+	26	39	23	11
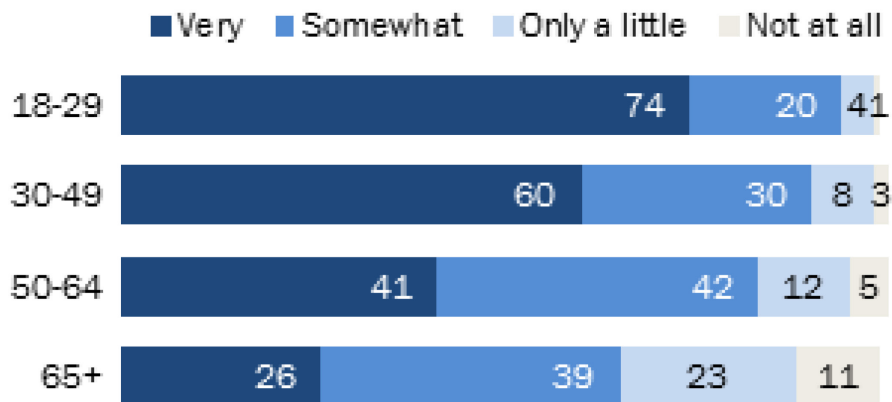
Source: Survey conducted Oct. 13- Nov. 15, 2015.
"Tech Adoption Climbs Among Older Adults"

PEW RESEARCH CENTER

Fig. 4. Older Adults are less confident when using electronic devices (Pew Research Center, 2015)

The above diagram shows the confidence level among the age-based demography of American populations with regard to their electronic usage. Generally, older adults feel less confident in using technology than their younger counterparts. Human factors that influence their relationship with technology could be both technical and social.

3.1 Today's Technology

Roughly four-in-ten seniors are smartphone owners
% of U.S. adults ages 65 and older who say they own the following ...
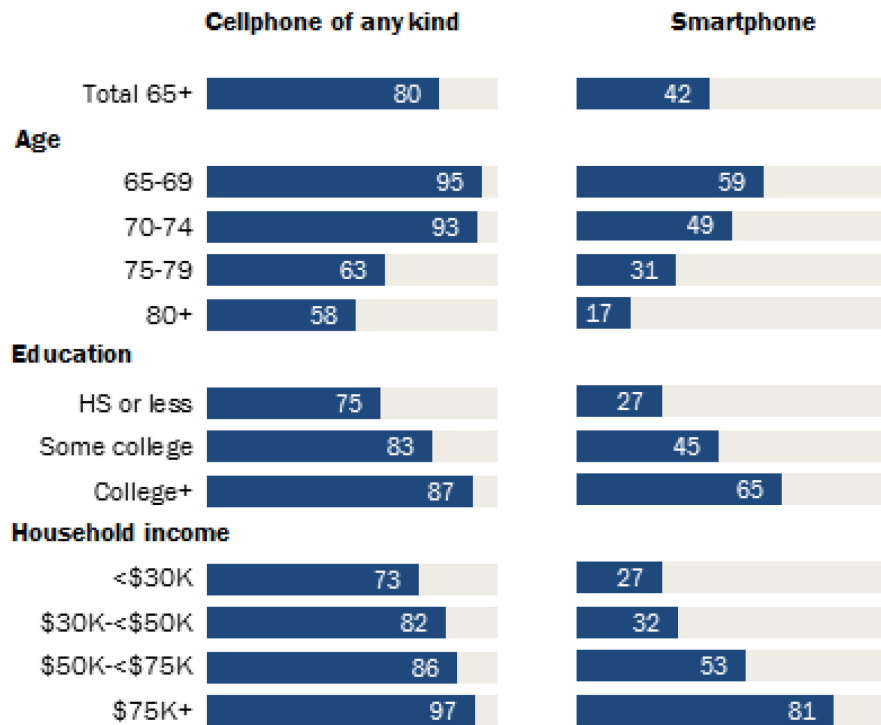
	Cellphone of any kind	Smartphone
Total 65+	80	42
Age		
65-69	95	59
70-74	93	49
75-79	63	31
80+	58	17
Education		
HS or less	75	27
Some college	83	45
College+	87	65
Household income		
<$30K	73	27
$30K-<$50K	82	32
$50K-<$75K	86	53
$75K+	97	81

Fig. 5. Statistics from Pew Research Center shows that '*Four-in-ten seniors now own smartphones, more than double the share that did so in 2013*' (2016).

The above diagram compares statistics of common phone and smartphone usage by users of different age groups. A digital revolution took the world by storm in the late 1980s (Clarke, 2012). Ever since, new media has been advancing and innovating each day, causing technological tools to progress at a rapid pace. Older adults find it difficult to keep pace with these fast-paced and complex digital platforms. For example, Facebook was first launched in 2004, limited to a Harvard fraternity, whereas today it has over 2.8 billion users with usage spread across several countries (Richter, 2021). Moreover, older adults began learning new media tools in their mid-30sor -40s, while the younger adults grew up using and learning about digital gadgets. This made them proficient, familiar, skilled and experienced with user-interfaces and digital platforms (Heaggans, 2012).

3.1.1 Digital Literacy Vs Digital Citizenship

Digital literacy refers to the ability to use, operate and have knowledge of digital tools (Silvestre, 2014). It is an umbrella term that encompasses computer literacy and mobile literacy. A user is called a Digital Citizen when he/she is capable of writing emails, editing online documents, communicating, socializing, accessing information, studying and participating across digital platforms and utilizing various kinds of digital tools. He/she will be able to create, share and consume digital content with ease and responsibility.

Digital Citizenship covers areas of internet safety, cyberbullying, online etiquette, creative credit, copyright issues and digital footprints in addition to online privacy and security, etc. (Australian Government Department of Education, Skills and Employment, 2021). Digital literacy (or computer literacy) is considered a mandatory life skill in this day and age. (Silvestre, 2014). It guarantees better job opportunities and career prospects as well as exposure and access to a wide spectrum of knowledge, including e-learning, e-health, and the latest news and entertainment. This project intends to empower older adults with the fundamentals of digital literacy and computer literacy; to help them to understand technology vocabulary, and to make them proficient Digital Citizens.

3.1.2 Computer Illiteracy Vs Computer Anxiety

Computer literacy comprises the skills, expertise and familiarity with computer usage and other related technologies. This may involve the user's ability to perform an array of tasks, ranging from rudimentary use to complex problem-solving via computers (Tobin, 1983). Teaching users about the basics of digital interfaces is compulsory before teaching him/her about technology applications via these digital tools.In the 21st century, smart classes are conducted across many countries, wherein audio-visual media such as computers, projectors and speakers are used to display animations, multimedia and PowerPoint presentations to promote e-learning. This will spark curiosity, interest and desire in children towards digital gadgets. Moreover, this will aid in

the use of technology vocabulary[10] among budding Digital Citizens. From personal experience: since the 2000s, Indian educators have been teaching about the history of digital achievements and the impacts of digital evolution in India's economy. They have nurtured an interest in students of the wonders of technology and its merits. Computer illiteracy or digital illiteracy can be caused by computer anxiety and technophobia among potential Digital Citizens who are new to computers or related technology. Computer anxiety was coined by Maurer in 1994 as the fear and apprehension experienced by an individual while using or having the thought of using a computer. Technophobia is defined as a wider spectrum fear, aversion or unease towards using modern technology (Rungta, 2016). The different types of computer anxiety according to Torkzadeh and Angulo in 1992 (Heaggans, 2012) are as follows.

1. Psychological - Caused by behaviours towards computers, personality traits, avoidance and reluctance towards new technology.
2. Operational - Caused by courses, teachers, category of the computer or owning a computer from an early age.
3. Sociological - Caused by several circumstances like ageing, sex, nationality, socio-economic status and field of study.

The Six-Factors Computer Anxiety Model by Beckers and Schmidt (2001) is explained below -

1.   Computer literacy of fundamental skills

2.   Self-efficacy on learning computer usage

3.   Physical awareness of bodily sensations such as breathing, sweating, etc.

4.   Attitudes toward computers

5.   Optimistic view with regard to computers & their usage

6.   Pessimistic beliefs on the effects of computers

Research shows that individuals who grow up using computers or who spend more time with digital gadgets are better equipped and knowledgeable about technology than those who begin to

---

[10] **Technology vocabulary** refers to terminologies used to address technological-related matters in the domain of human-computer interactions. For example, internet access, cloud storage, computer literacy, surfing websites, social media networking, Internet of Things (IoT), search engines, glued to screens, wireless hotspots, ethical hacking, downloading/uploading files and signup/login, etc. (IELTS Podcast, 2014).

learn about digital tools in their mid-40s. The former group will have reduced levels of computer anxiety than the latter (Heaggans, 2012). Many older adults in the 21st century object to using advanced technology because they think such complicated tools are difficult to learn and operate. Similar to 'technophobia', computer anxiety is completely psychological and needs to be psychologically addressed. The older population needs to be taught about dismantling apprehension and biases towards technology. This will help them to try using the tools for their benefit and self-development.

3.2 Human-Computer Interaction (HCI) amid COVID-19

Human-Computer Interaction (HCI) is a multidisciplinary discipline focused on the study, assessment and evaluation of the relationship between computers and their human users (Interaction Design Foundation, 2021).
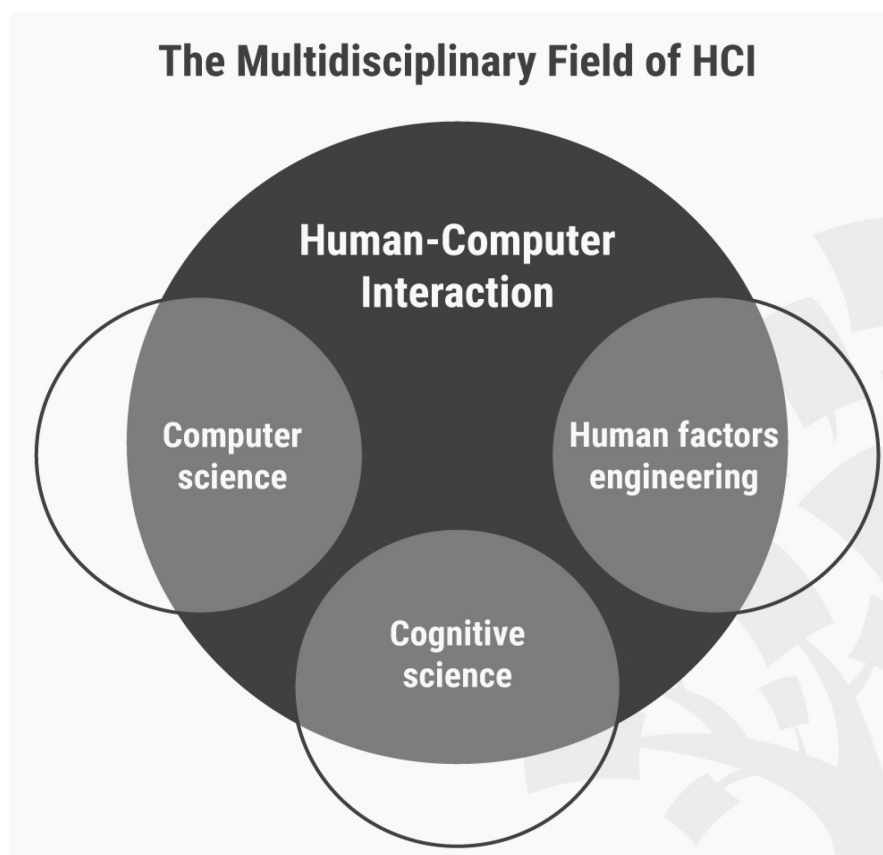
Fig. 6. HCI overlapped with related disciplines, such as human factors engineering, computer science, behavioural science and cognitive science, etc. (Interaction Design Foundation, 2021).

The HCI concept attained popularity in the 1980s with the emergence of 'personal computing'. For the first time, computers were priced at affordable rates, made portable and lightweight, no longer needed special environments and were accessible by the common consumer. Amid the COVID-19 global pandemic, technology has played a major role in providing timely information, continuing employment and tracking the latest updates related to COVID's mortality rate. Digital platforms were extensively used for social networking, connecting with loved-ones from the comforts of home, working remotely, accessing e-health information and receiving groceries at one's doorstep via mobile applications, services that were difficult to access manually when the COVID-19 outbreak was at its peak and social isolation was mandatory.

 People lacking computer literacy skills faced difficulty in accessing these advantages and features. In the ongoing pandemic, this project is a stepping stone for them to avail themselves of the above facilities by learning about computer applications. Technology was used during COVID-19 outbreaks in several countries like Canada, India, the United States, China, Sweden, Singapore, Germany, Ireland etc, created Data Dashboard (Heat Map Data Visualizations) to track the disease spread, death rates, graphs showing active cases, screening for infections, digital thermometers, real-time monitoring of individuals via mobile devices to control the situation (Whitelaw, Mamas, Topol & Van Spall, 2020).

4.0 Human Factors that Challenge HCI among the Target Demography

Joseph E. Koncelik works at the Center for Assistive Technology and Environmental Access, Georgia Institute of Technology, U.S. In 2008, he authored the journal titled, 'The Human Factors of Aging and the Micro- Environment, Personal Surroundings, Technology and Product Development' that calls for the attention of the creators, engineers, architects, makers and researchers to consider ageing as a human factor when designing products and the environment. The journal does not consider ageing as a hindrance but a dynamic factor which needs special attention in the creation process. Many researchers state that old age comes with the deterioration of senses, motor skills and cognitive issues. For example, one might consider using larger font sizes, short descriptions for poor cognition and ergonomic forms for easy gripping considering the weakening of physique. However, this is neither universal nor a principle that can be generalized (Ref. table 2 and 3).

% of U.S. adults who own the following devices

	Any cellphone	Smartphone	Cellphone, but not smartphone
Total	96%	81%	15%
Men	98%	84%	14%
Women	95%	79%	16%
Ages 18-29	99%	96%	4%
30-49	99%	92%	6%
50-64	95%	79%	17%
65+	91%	53%	39%

Figure 7. Percentage of Americans owning devices as by age-group and gender
Statistics by the Pew Research Center (2019) show that only 53% of persons aged above 65+ years owned smartphones, suggesting that older adults owned less electronic devices than the younger adults.
(Edited: Colour changed)

The depth and breadth of M. Powell Lawton's defined micro-environment has been discussed with respect to ageing and psychology. Designers must accommodate the process of ageing as a design criterion of products and the environment. Lawton was the Founding Editor of Psychology and Ageing (Koncelik, 2008). From a logical perspective, customization for each and every user is difficult. Hence, the idea of presenting divergent alternatives with detailed specifications will suffice the consumer's demands. The environment and the objects that surround the older adults are not only utilized by them but are associated with their memories as well. There is a need for empathy and a human-centred approach while developing products (Project Catalyst and IDEO, 2017).

Ageing comes with a blend of complications in terms of physical, psychological, sociological and emotional issues. Accommodating the needs of persons 60 years and older is a necessity in a healthy ecosystem. For example, a 65 year old person's abilities are completely different than a 75 year old's. Some may have arthritis, diabetes, migraine or cardiovascular complications. As reported by 'Designing for The Elderly: Ways Older People Use Digital Technology Differently,' published in Smashing Magazine, takes direction from the concept of younger people designing for older people in the technological space.

For example, colour vision, hearing, motor control, relationship, life stages and few cognition/memory abilities. In detail, colour contrast ratio, large typography, providing subtitles, loud audio, clean interfaces and sensitivity to issues of loneliness/isolation should be taken into consideration while creating interfaces for older adults (Campbell, 2015). Designing for older adults can be challenging and requires extensive research of their ageing abilities. With accordance to the above tables 2 and 3, numerous service-design strategies, plans of action and assistive principles are to be followed to achieve optimum results. These are laid out in multiple works of literature, journals and articles issued by Geriatrics Health Centers, IDEO, Canada's Technology and Ageing Network and Smashing Magazine. The issues related to old age should be familiarized beyond designers and service providers. Their caretakers, relatives, friends and family members must be acquainted and cautioned as well.

4.1 Physical Human Factors:

4.1.1 Vision and Hearing

- With age, the lens in the human eye loses its flexibility, a condition called "presbyopia". In some cases, older patients lose their sense of colour with age. Hence, they face difficulty in identifying different shades of blue, greens and purples altogether.
- Older adults cannot distinguish colours with shorter wavelengths. Similarity, they experience difficulty in reading texts or tracking the cursor movements.
- Similarly, most people over the age of 60 start losing their hearing. They face problems in hearing the audio instructions.

   Precautions

- Do not use small fonts in devices for older adults. Design a system where they can change the font sizes.
- Avoid using the too many blue colour shades
- In case audio is involved, implement the option of subtitles.
- Speak at a slower-than-normal pace and use non-verbal means of communication like hand gestures and facial expressions. Speaking slowly will allow older adults ample amount of time to absorb the information and respond accordingly (Guo and Ding, 2019 and ref. Table 2).
- Use audio-visual guidebooks for teaching older adults with weakened hearing abilities.

4.1.2 Motor Control

- Motor skills decline with age. Older people have slower reflexes and longer reaction times. They may also find it difficult to use devices with high precision input requirements (like pressing small buttons or responding quickly by seeing notifications).
- Maximal strength, muscle power and movements get reduced with ageing. Older adults experience fatigue easily.

   Precautions

- Buttons of touch interfaces should be more than 9.6mm diagonally The device should not require rapid input or extremely precise input and should allow errors.

- The designer must avoid using typefaces below the size of 12pt and apply the Web Content Accessibility Guidelines 2.0.
- Traditional pedagogical methods: due to potentially weaker eyesight and degraded cognitive abilities, older people should be taught through one-to-one interactions.

4.2 Psychological & Behavioural Human Factors:

4.2.1 Device use

- The device should be designed keeping in mind the person who will use it. Older adults often prefer that the device be easy to use and match their habits (they would rather use a large screened tablet with naked-eyed than a small screened phone with glasses).
- It has been seen that older adults will adopt new technology when they see a clear benefit. Hence, the device should be friendly to use for them.

4.2.2 Behavioural Changes

- Older generations take longer to respond and think. They become rigid, weak and unenergetic as they age.

4.3 Sociological Human Factors

4.3.1 Relationship

Older people sometimes prefer to use the same connections over a long time. They would visit the same doctor for years and work on a basis of trust.

4.3.2 Life Stage

Sometimes important aspects of technology that are needed for the youth are not applicable to the older people. For example, almost all youth have an email address but not all older adults have emails. So an online form should not have compulsory email as that won't allow an older person without an email address to use the form.

Precautions

Avoid content or functionality that assumes someone is young or at a certain stage in life.

4.3.3 Experience with Technology

Older people have a varied range of technical knowledge. The designer may have difficulty predicting their knowledge.

Precautions

- Assume the person has no or limited prior knowledge
- Avoid using features that need complex and advanced technical knowledge

4.4 Cognitive Human Factors

4.4.1 Memory Loss

With age, memory deteriorates in a person. Short-term and episodic memory are usually most affected. Old people often find it difficult to memorize complex new concepts. They also prefer technology that helps them to remember things (like the reminder option in phones) or (planning using google calendars).

4.4.2 Attention Span

Age may affect a person's cognition abilities in varied and unpredictable ways. Older people develop shorter attention span. They might lose focus easily and get exhausted quicker than their younger counterparts.

Precautions

- Avoid using features that require the use of complex concepts or needs the user to memorize things (like passwords).
- The instructor or designer must let older individuals remember their past memories to connect with the present content and knowledge.
- Sufficient intervals of time and breaks should be provided to sustain the attention span, focus and strength of older adults.
- Memorizing strategies should be applied for better remembrance like association, localization, association, categorization and repetition techniques (Guo and Ding, 2019).
- Provide a backup option in case important information is forgotten, such as a password.

- Include features that help people remember (as a reminder option in the phone)
- Users need to be familiar with visual language, navigation basics and iconography. For example, before creating a Facebook account, one needs to create an email ID.

4.5 Financial Human Factors

- **Post-retirement:** With no financial income, older adults tend not to experiment, buy or invest in new technologies. Generally, most older individuals live by their savings or investment and pensions.

Precautions

- Use digital platforms that are affordable, common, simple, consists of clean interfaces and easy to learn.

5.0 Older Adult Technological Empowerment: Case-Studies

This project derived inspiration from existing products, services and equipment that have transformed the lives of older patients, promoted digital literacy (Ref. 5.4 DEF) and improved human-centred health services. It involves the research and professional expertise of geriatrics, nurses, psychologists, designers, engineers and doctors. Since this thesis research is attempting to make older adults independent and empowered, it is necessary for me to understand how gerontechnologies and gerontechnological designs function.

5.1 Age Technology

Age technology, or 'Age Tech' is an emerging subdomain of the health technology sector focusing on upgrading the health and well-being of older adults. The wide acceptance of innovative and novel wearable technologies, health watches, smartphones, fitness trackers, genomics, Internet of Things, ageless design, healthtech monitors and haptic sensors aiming to benefit the older population led to Age Tech's popularity. In Europe, the market for technology that assists older patients is estimated to be €3.7tn (Kraydel Limited, 2019). Age Tech has been used in domains of domiciliary care, residences, post-retirement insurance, nursing homes and health care. In 2012, the Ageing 2.0 Startup, founded by Stephen Johnston and Katy Fike, began operating in the United States and conducted 150+ meetings. They have signed up with SingFit[11] and other reputed organizations for its accelerator program that concerns healthy and happy ageing. Currently, it is spread across 31 countries (Aging2.0, 2021).

5.2 Gerontechnology

While gerontology is the science of cultural, social and psychological characteristics of ageing. The term gerontechnology is a portmanteau of gerontology and technology. It concerns well-

---

[11] **SingFit**: This awarded agency has 26K older adults singing, 1800+ certified facilitators and 450+ communities using the benefits (SingFit, 2021). Along with musical therapy sessions for healthcare professionals, caregivers and older adults, SingFit PRIME supplies human-centred care.

being, improving life-quality, increasing vitality and lowering morbidity with respect to ageing with the aid of innovative technology. The term was devised by Jan Graafmans, the Eindhoven University of Technology in 1989. Gerontechnologists create technology to transform the lives of older adults. These technologies are specifically designed to cater to older adults and focus on their health improvement (Graafmans, 1989). Gerontechnology is presented as a type of assistive technology and universal design.

5.3 Gerontological Design

Gerontological design is a design discipline that utilizes the knowledge of gerontology and design research methodologies to create products and services with the intention to help the older population. They are created with a unique infrastructure that will meet the process of ageing and the functional and psycho emotional needs of older patients. '*application Of The Gerontological Design And Ergonomics In The Products*' was a project introduced in the Industrial Design program at the National University of Colombia. The motivation was to develop an object system prototype that would improve, support and sustain the deteriorating visual, motor and auditory capacities specifically to cater to the older adults of a society. This object must sustain and aid older adults to carry out their daily chores.

5.3.1 Gerontological Design Requirements

The innovation of such projects promotes a noble vision of inclusive design and universal design approaches (Saray and Silva, 2018). These products/services should encourage movements of gross motor skills (walking, running, lifting, etc.) and fine motor skills (writing, cutting, stitching, etc.) through percussion generated by the system. The principles of gerontological design are as follows:

1. Accessibility Requirements: products/services should be created in line with the accessibility design principles such as wheelchairs.
2. Psychological Requirements: products/services to promote autonomy among older persons, socio-communication relations, material integration to produce pacific music

and colour identification. For example, Trayendo Melodías De La Memoria[12]

3. Biomechanical Requirements: encouraging systems of medical extensions, supination and pronation maneuvering. Involves user-testing for anthropometric and biomechanical related decision makings.

5.3.2 Key Examples

1. **iN2L aka It's Never 2 Late** - Promotes 'dignity through technology'. iN2L is a touch screen computer that uses larger visual elements like enlarged fonts, bigger graphics and content libraries. This platform allows older adults users to connect, share experience, access knowledge, learn and socialize with their caretakers plus family. It can work with 4000+ content applications that support wellbeing, provide therapy (games, dance & karaoke) and cognitive and physical exercises, hobbies, memory aids, and education for group sessions and individual engagement (MedTech Boston, 2015). It facilitates self-reliance, giving a sense of belonging and purpose among every member of the society. Some features of this device are as follows:

   ● Helps in reducing PRN Medication: when an older person is unwell, iN2L enables staff to access his/her patient's profile. This way the staff can discover the previous solution that was used to calm the patient. This reduces the usage of PRN medication.

   ● Supports Person-Centred Care: since every individual is different, so are their needs. iN2L can be customized accordingly with the older adult's preferred content.

   ● Enhance Staff performance: increases the efficiency of staff with respect to their time, productivity and meeting the user's requirements.

2. **Rendever**: this device is credited with resolving the sense of social isolation by creating Virtual Reality environments for persons 60 years of age and older across the US and

---

[12] **Trayendo Melodías De La Memoria aka Do-Re Mayor**: *bringing melodies to the memory*. Created for a nursing home in Palmira Valle targeted for 70-80 years old. It was designed to accommodate older patients with limb mobility, sensory deficiency, color recognition issues, dementia and cognitive disruption (Saray and Silva, 2018).

Canada. It progressed over a span of 4 years, reaching 650,000 users and accessed by 190+ clients (Rendever Inc., 2021). Using the VR headset, older adults can travel virtually to any part of the globe, create memories and explore distant locations. It is helpful for older adults with mobility, vision and cognitive issues (Medtech Boston, 2018).

3. **BoundaryCare Mobile Application** - BoundaryCare is a location-tracking iPhone and Apple Watch application created for the older population suffering from dementia and Alzheimer's disease. There are two kinds of users for functioning.

   1. *Caregiver(s)*: the individual who takes care of the older patient. He/she needs to install the iPhone (iOS) application and track the loved one. There could be single or multiple caregivers.

   2. *Loved One*: the individual/older patient who suffers from dementia or Alzheimer's disease. He/she needs to wear the Apple Watch which will be tracking their location. BoundaryCare will be installed in the Apple Watch.

The caregiver creates a geofence (virtual zone in a geographical area) for the loved one. The loved one will remain autonomous in the safe zone. But as soon as they leave the safe zone, the caregivers are cautioned by the application. The zones could be circular, polygons or a path. The path features are for loved ones who are driving, walking in a route or are cycling. This application includes numerous features such as accurate location specification with history, emergency tracking mode and entry/exit alerts to the caregiver, as well as low battery alerts, etc. It gives the additional advantage to cancel the subscription anytime without commitment or Medicare coverage information. Currently, around 50 million dementia patients exist worldwide. This number is estimated to triple by 2050 (World Health Organization, 2019).

All the above examples helped me to understand what is expected of geriatric products and services. I studied the colour palette, visual language, descriptions and use of simple vocabulary across these digital interfaces. It seamlessly blends aesthetics with utility principles. These case-studies give information on how the human-centred design approach has been utilized in the creation of AgeTech devices and assistive technology.
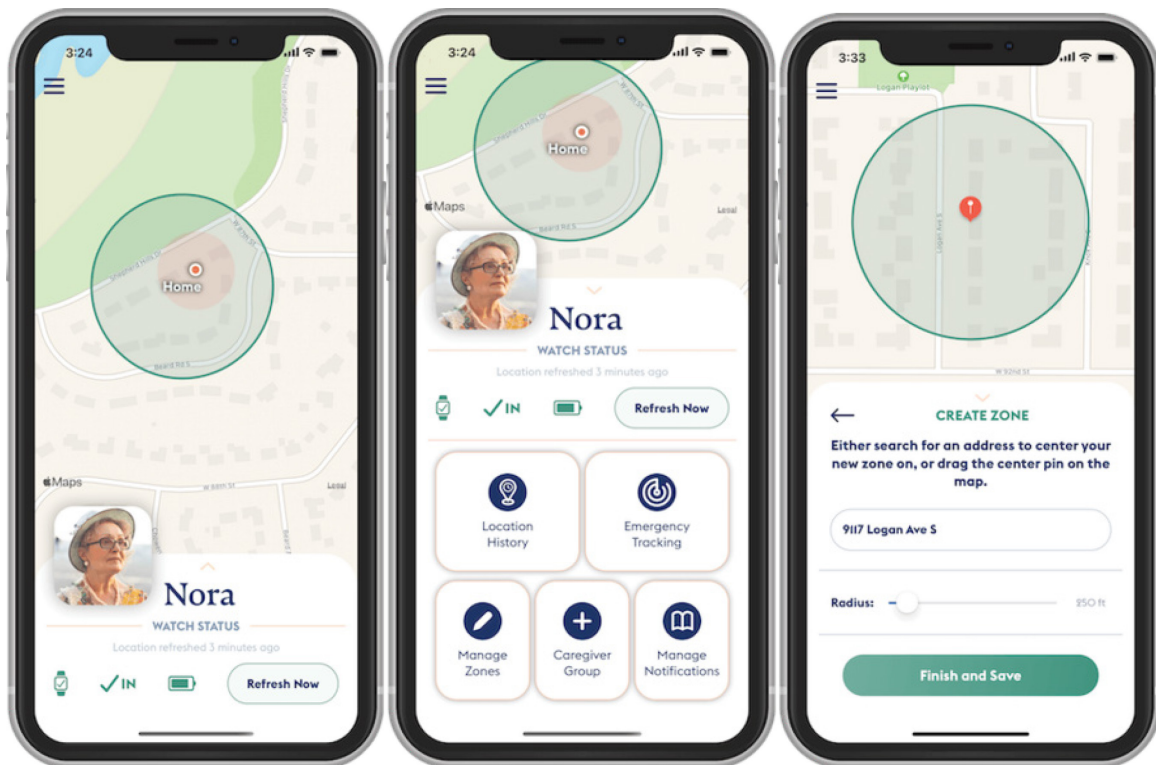
Fig. 8. Screenshots of the BoundaryCare mobile application

BoundaryCare is created by Beatrice Health LLC. It is the premier and sole application that uses geofencing technology and geo-tracking notifications via Apple Watch. Beatrice Health LLC is based in Minnesota. The iOS application 'BoundaryCare' was created after reading information on Dementia issued by the World Health Organisation, Alzheimer's & Dementia: The Journal of the Alzheimer's Association and other literature.

5.4 Digital Empowerment Foundation (DEF)

Established in 2019 in India, DEF is an organization dedicated to empowering technologically and economically depressed areas affected by computer illiteracy by making information accessible, consumable and leading the digital revolution. Their six-fold paths are as follows:

1. Access & infrastructure - Making internet accessible and promoting digital literacy.

2. Governance & entitlements - Being the voice to demand education, government services, human rights and entitlements.

3. Education & Empowerment - Providing people with better healthcare, education, skills and livelihood via digital tools.

4. Markets & Social Enterprise - Digitally empowering micro-enterprises and communities with online presence and protecting culture, heritage, environment and natural resources.

5. Knowledge Hub & Database - Developing a knowledge network of digital practitioners and interventions for scaling up socio-economic needs.

6. Advocacy & Research - Ensuring the internet as a basic human right, and the easy use of information and communication technology.

6.0 Methods and Methodology

6.1 Primary Research Methods
6.1.1 Survey Questionnaire

There was a need for up-to-date, bespoke and raw data from older adults with regard to their perceptions and relationships with smart devices. Therefore, a survey questionnaire (refer to Appendix A) was distributed among older adults residing in different countries to gather data from diverse mindsets within the age group of 60 to 75 years old. However, some surveys were filled by younger adults on behalf of older individuals who faced difficulty in completing the online survey. The primary goal was to determine the current trends, popular mobile applications and users' attitudes towards technological tools, and aid in predicting the next behavioural patterns. The questionnaire has been shared and filled online to safeguard the wellbeing of older adults in the midst of the pandemic outbreak. There were 18 responses in total; below are some of the key findings.

1) 44% of older adults reported that they do not face any problem using a computer & mobile phone.

2) 46.2% want to learn how to check the calendar, set reminders and take down notes.

3) 58.3% want to learn a new skill.

4) 35.7% want to learn about navigation & directions.

5) 94.1% faced problems in discovering the latest features.

6) 68.8% faced difficulty in remembering instructions.

7) 56.3% had difficulty in understanding icons, symbols and navigation.

The participants were eager to learn about technology and shared their feedback. Following the final documentation, I will share this project. Below are some of their insights (verbatim).

"If my smartphone give instruction in voice then it would be better to follow. Switching back and forth between youtube and applications becomes too difficult to follow." - Anonymous, 5

"1) For understanding icons, I will only click on the icons that I could recognize. For those I do not understand, I do not click on them. 2) For size and brightness, I will set up to a comfortable size (by myself or by my daughter) and then keep that. 3) I can only remember easy instructions." - Anonymous, 7

6.1.2 Work Experience - TechServeTo Volunteer

Founded as a response to the COVID-19 pandemic in 2020, TechServeTo is a non-profit organization devoted to teaching older adults about the usage of technology. They connect tech-savvy volunteers like me with older adults struggling to use mobile phones and computers, in order to help them connect with their younger family members. Since 2021, they have conducted over 25+ workshops and helped over 1000 older individuals in Canada. In 2020, TechServeTo reported that '78% of seniors aged 65-75 owned a smartphone, but only reported "moderate" levels of confidence in using them.'
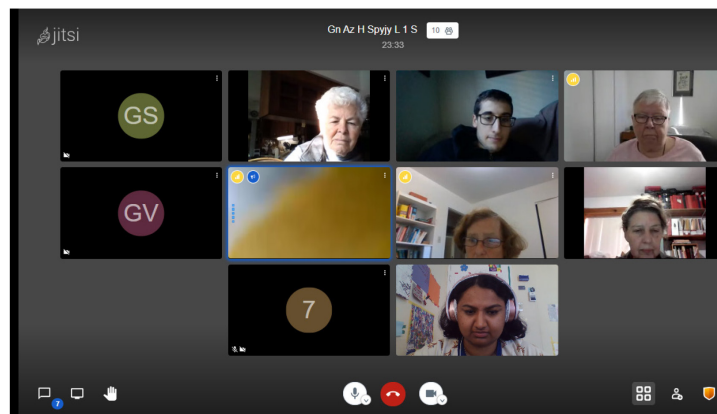

Fig. 10. Conducting a YouTube tutorial workshop with older adults at TechServeTo

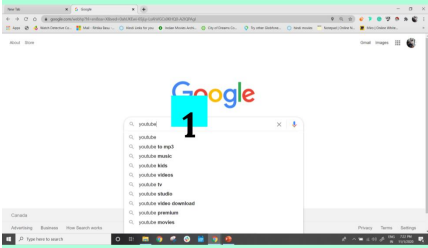## 6.1.3 Workshop - YouTube Tutorial Workshop for Older Adults, TechServeTo

During my volunteering service at TechServeTo, I organized a workshop with 10—12
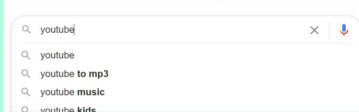
older adults on using and accessing YouTube (Refer to Appendix B). The aim was to understand the expectations and behavioural patterns of the target users, and gain an idea of their current knowledge of technology. The participants were taught the following via step-by-step instructions.

1. Searching Tutorials: engaging in skill learning, practicing Yoga or exploring different courses.
2. Accessing Infotainment (Information & Entertainment): either watching one's favourite movie, gaining knowledge from a documentary or inspiration from someone's interview.
3. Signing Up for an Account: applicable if the user has a pre-existing email ID. This will enable them to like, dislike or comment below any videos.
4. Sharing Videos: sharing content across other social media platforms like Facebook, LinkedIn, Twitter, Pinterest, etc.
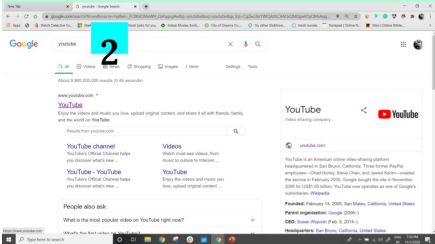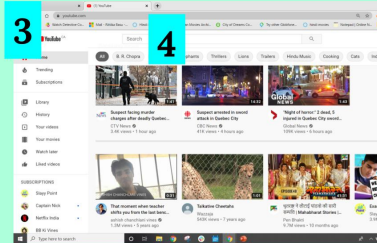
Participants signed up for the workshop to learn specific functions of YouTube, such as learning 'how to listen to music/watch videos.' They gave positive feedback, followed my instructions and discovered new things about the video-streaming platform. A few encountered issues operating the video call software, so I helped them out using the Screen Sharing feature.

6.1.4 Non-Participant Observation

During my internship at Myant Inc.[13] we conducted research on effective ways of representing health-related data of older patients through exploratory data analysis[14] (EDA). I created interfaces of their mobile applications titled *Skiin*, whose primary users were older adults. It was created to improve their quality of life, promote fitness and track their metrics such as BPM, current activity, body temperature, etc. During the user-testing phase, older adults posed as participants, gave real-time feedback and evaluated the mHealth application through the **talk aloud method,** where participants are asked to speak what they are thinking while carrying out the task intended for user-testing protocol. As the non-participant observer, I noticed several traits among older adults while exploring technology at a first glance which are as follows:

1. The participants had difficulty reading typography below the point size of 14, since eyesight weakening is inevitable with ageing.
2. Too many visual elements led to unnecessary confusion. Many had difficulties in understanding some icons without any descriptions.
3. Prior Tooltips are useful when introducing new interfaces to the target demography (older adults who lack digital literacy skills). The question mark *(?)* icon, which explains digital features, was helpful.

---

[13] Myant Inc.: pioneer of the world's first textile computing platform that connects people and their environment with other people. Data regarding the bodily sensations are communicated from both the parties to create fitness targets and determine health status (Myant Inc., 2020).

[14] EDA: quoting an article from Towards Data Science, 'Exploratory Data Analysis refers to the critical process of performing initial investigations on data so as to discover patterns, to spot anomalies, to test hypothesis and to check assumptions with the help of summary statistics and graphical representations' (Patil, 2018).

4. Simple forms, clean data visualizations and primary colours are more helpful than using different shades and tints of one colour.

6.2 Secondary Research Methods

6.2.1 Case Study - Existing Digital Games for Older Adults

'Playing Ageing: Digital Games for Older Adults,' published by Canada's Technology and Aging Network, discusses how older adults play video games to accept challenges, achieve rewards, avoid cognitive decline, experience fiction, enhance mental stimulation and engage in social networking. Older adults are a different gamer audience than younger generations. Their games must accommodate poor eyesight, physical/cognitive issues, reduced hearing, declining reaction time and limited physical movement (Kaufman et al, 2020).

1. Physical health: 'exergaming' refers to technology-driven physical activities — especially video games — that require participants to be physically energetic, engaging body activities or exercise in order to play a game. It enhances social skills if played in groups, makes exercising fun and improves physical health. Examples include Nintendo Wii and Kinect. They combine motion detecting and proximity sensors. Simple tasks improve mobility, flexibility and balance. Exergames like iStoppFalls reduce fall risks and related costs among sexagenarians and septuagenarians.
2. Cognitive Health: games like Brain Age, Lumosity, NeuroRacer, World of Warcraft, Tetris, Medal of Honor are brain training games.
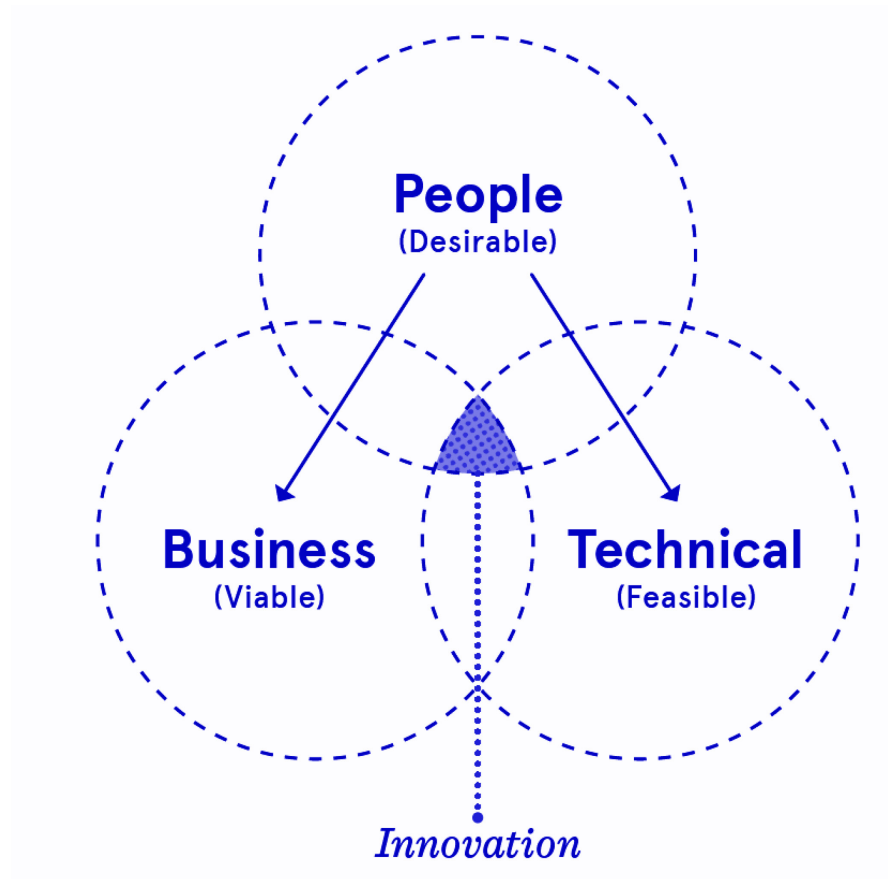
6.3 Human-Centered Design Strategies

Fig. 12. Innovation emerges from human-centered design approaches

It should meet the needs of people (users' desire to use it), technical aspects (feasibility of its production) and should make the business prosperous (growth should be viable). [Edited: Colour changed]

IDEO's toolkit for 'Design on Ageing' prioritized happiness and satisfaction over productivity. The importance for empathy is essential for any designer to understand the consumer's needs. 80% of older adults are at high risk of social isolation and find difficulty in living with their weakening abilities (Project Catalyst & IDEO, 2017). Two practice-based models (TAM & Persuasive Design Model) that use empathy as a basic ingredient are listed as follows -
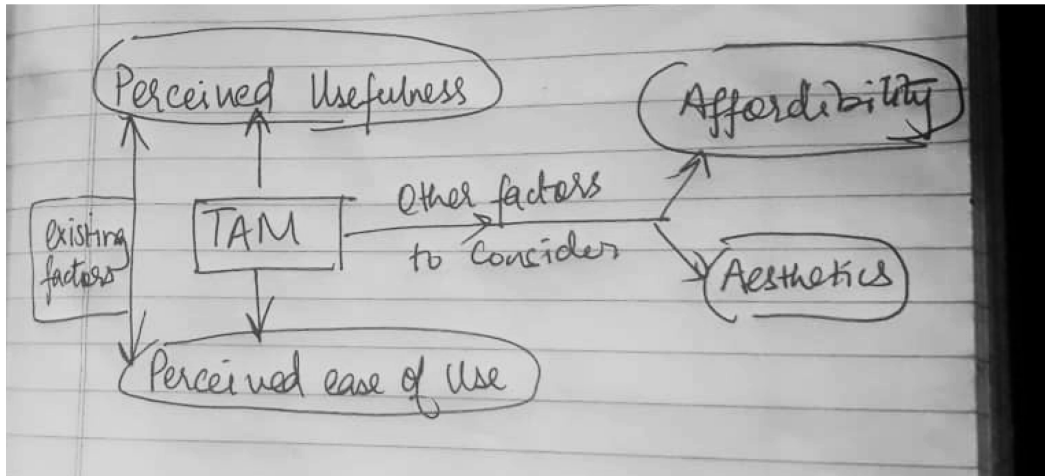
6.3.1 Technology Acceptance Model (TAM)

Fig. 13. Conceptualising the Technology Acceptance Model
This is a rough conceptualisation by myself.

In 1989, Fred Davis and Richard Bagozzi conceptualized TAM from Ajzen and Fishbein's theory of reasoned action. This was further extended by Venkatesh in 2000. Suppose the attitude of a person (A) which is the general impression of the technology influences the behavioural intention (BI), a factor that leads users to use the technology. TAM measures technological acceptance by the following two major parameters.

I.   Perceived usefulness (PU) - defined by Fred Davis as "*the degree to which a person believes that using a particular system would enhance his or her job performance"* (Davis, 1989). The user contemplates whether utilizing this technology will help him/her in any way or not.

II. Perceived ease-of-use (PEOU) - defined by Fred Davis as *"the degree to which a person believes that using a particular system would be free from effort"* (Davis, 1989). The user contemplates whether the technology is user-friendly and simple.

Synthesis - Personally, I feel the model is inadequate for assessments of its user-group. Besides the 'being user-friendly' and 'being useful' criteria, technology is evaluated on other conditions as well. For example, aesthetics and affordability are also considered while buying gadgets.

Despite all the contradictions, TAM has been used to contemplate which tasks will be taught to the user group depending on their level of complexity (PEOU), potential utility (PU) and if they

can be taught easily or not. For example, learning how to 'make notes' will be more beneficial to older adults than knowing how video games are played on smartphones.

6.3.2 Persuasive Design Model

This design model strives to alter the attitude of the consumer through the usage of the designed product or its service. Consumer behaviour can be changed gradually due to different behavioural stimuli factors, which are of two types.

1. Proposed by Prof BJ Fogg, also known as the *Fogg Behaviour Model,* where the user's behaviour is influenced by the ability, motivation and trigger of the design.
2. Interactive Design Persuasion Design Model, proposed by Oinas-Kukkonen and Harjumaa, is divided into 4 parts: task support, dialogue support, system reliability support and social support. Health education should be taught to the targeted users (loved ones) & their friends and relatives, who can be potential caregivers (Guo & Ding, 2019).

For example, an older person might not want to try a PUBG game because they find it too difficult/complicated to use, or do not find it useful in his/her professional field. Henceforth, he/she won't be playing the games or devoting any time to learning such games in the future. On the other hand, if a teenager starts liking a game as a recreational activity, he will continue playing it in the future.

 Synthesis - The tasks which could presumably enhance the quality of life, enrich social networking and improve health (we take both physical and mental well-being into consideration) were chosen from the opinions shared by older adults through the survey questionnaire. As per the Fogg Behaviour Model, consumer behaviour would be affected by the tutorial platform's objective, infrastructure, user-flow and design. In other words, an older adults would want to learn a skill if he/she found the tutorial platform more engaging, user-friendly and useful.
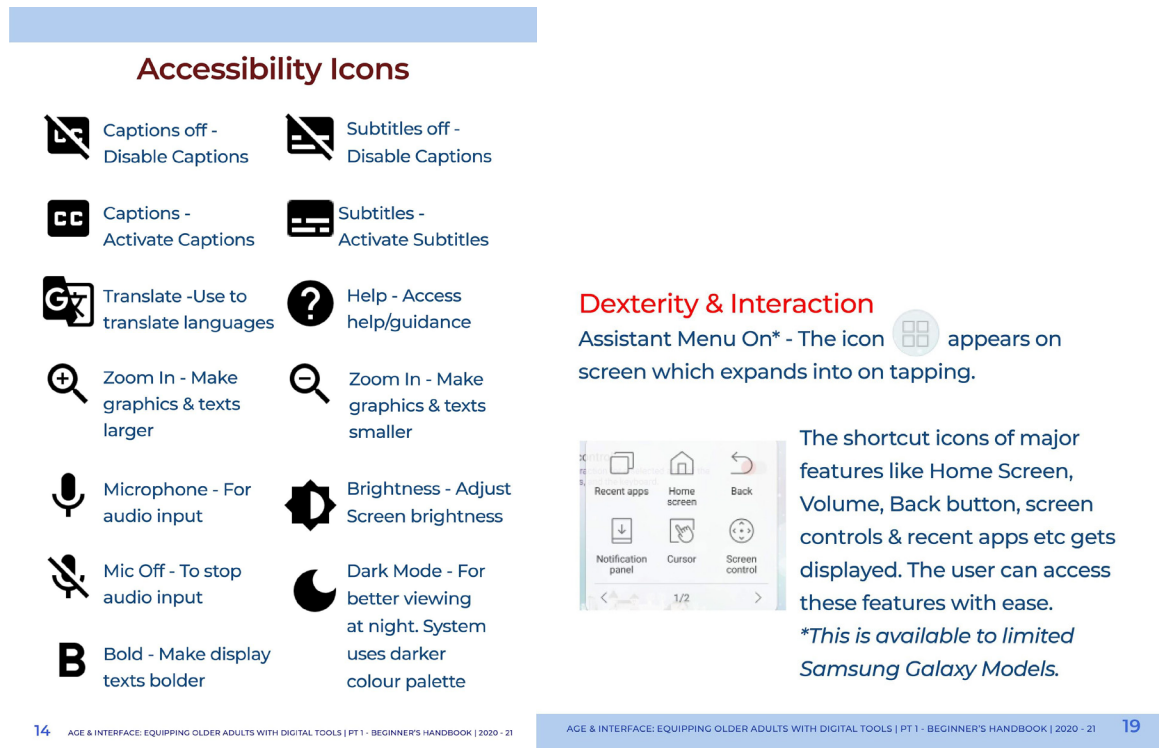
6.4 Assistive & Inclusive Design for Older Adults

Accessibility Icons

Captions off - Disable Captions

Subtitles off - Disable Captions

Captions - Activate Captions

Subtitles - Activate Subtitles

Translate -Use to translate languages

Help - Access help/guidance

Zoom In - Make graphics & texts larger

Zoom In - Make graphics & texts smaller

Microphone - For audio input

Brightness - Adjust Screen brightness

Mic Off - To stop audio input

Dark Mode - For better viewing at night. System uses darker colour palette

B Bold - Make display texts bolder

Dexterity & Interaction

Assistant Menu On* - The icon appears on screen which expands into on tapping.

The shortcut icons of major features like Home Screen, Volume, Back button, screen controls & recent apps etc gets displayed. The user can access these features with ease.
This is available to limited Samsung Galaxy Models.

Fig. 14 & Fig. 15. Accessibility icons *(left)*, dexterity and interaction settings *(right)*: present in every smartphone for users with special needs.

Every smartphone has features, known as accessibility features, to aid users with special needs and disabilities. They enable users to customize the system according to their needs and ease viewing. This is useful for users with low vision, poor hearing and limited dexterity like older individuals, for example, the zoom in/zoom out feature. The visual language (graphics, colours, font size, etc.) of this project has been created with adherence to accessibility and inclusivity design guidelines.

6.4.1 Colour Palette with WCAG 2.0

Color Safe is an assistive and universal design tool to choose colour combinations to cater designs for older adults, individuals with weak eyesight or for individuals with special needs. It is based on the Web Content Accessibility Guidelines 2.0 (Berg & Rapp, 2020). The designer may choose the contrast ratio at level AA or AAA accordingly.
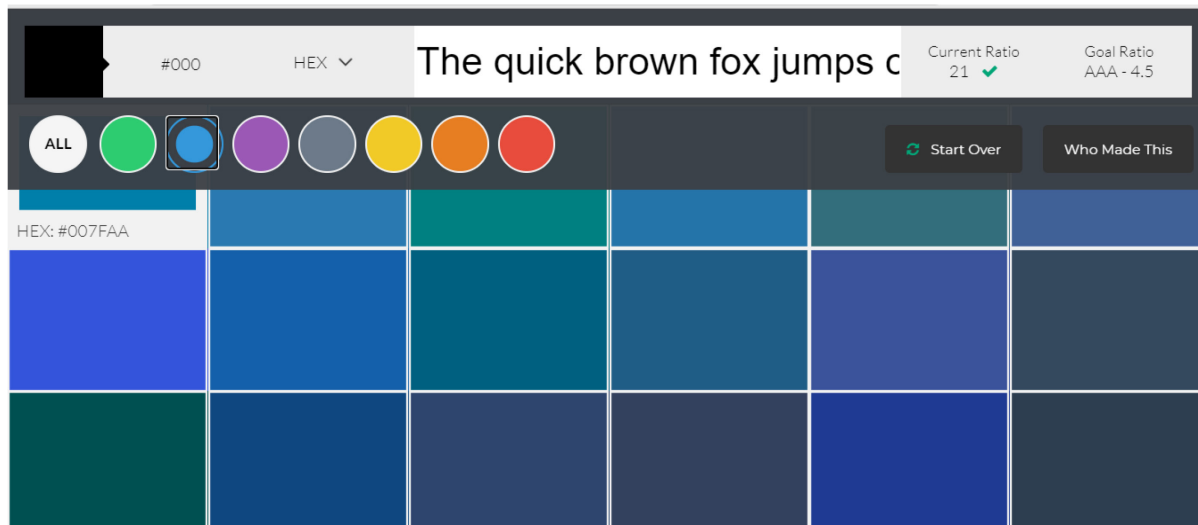
Fig. 16. Color Safe - presenting various blue shades against white with AAA contrast ratio as per the WCAG 2.0

6.4.2 Designing with Accessibility Infographics

Infographics issued by the Home Office, United Kingdom provided visual guidelines, graphic aids and information regarding designing for accessibility. These infographics were intended to help graphic, interaction and user-experience designers to implement accessibility rules and considerations into their creations for users with special needs, including individuals with low vision, physical/motor disabilities and deaf/hard of hearing.

7.0 Prototype and Project

The outcome of this research is divided into two parts. The former consists of an online guidebook. This serves as the preliminary introduction to technological basics. This project has turned into a paradox because of the pandemic; what was first conceived of as a physical publication had to be adapted into a digital format. Ironically, technology is utilized to teach the usage of technology to individuals lacking digital literacy. The secondary section incorporates a web-based tutorial that presents a step-by-step guide to the older individuals regarding carrying out various tasks through mobile phones and computers.

7.1 Part 1 - Beginner's Handbook
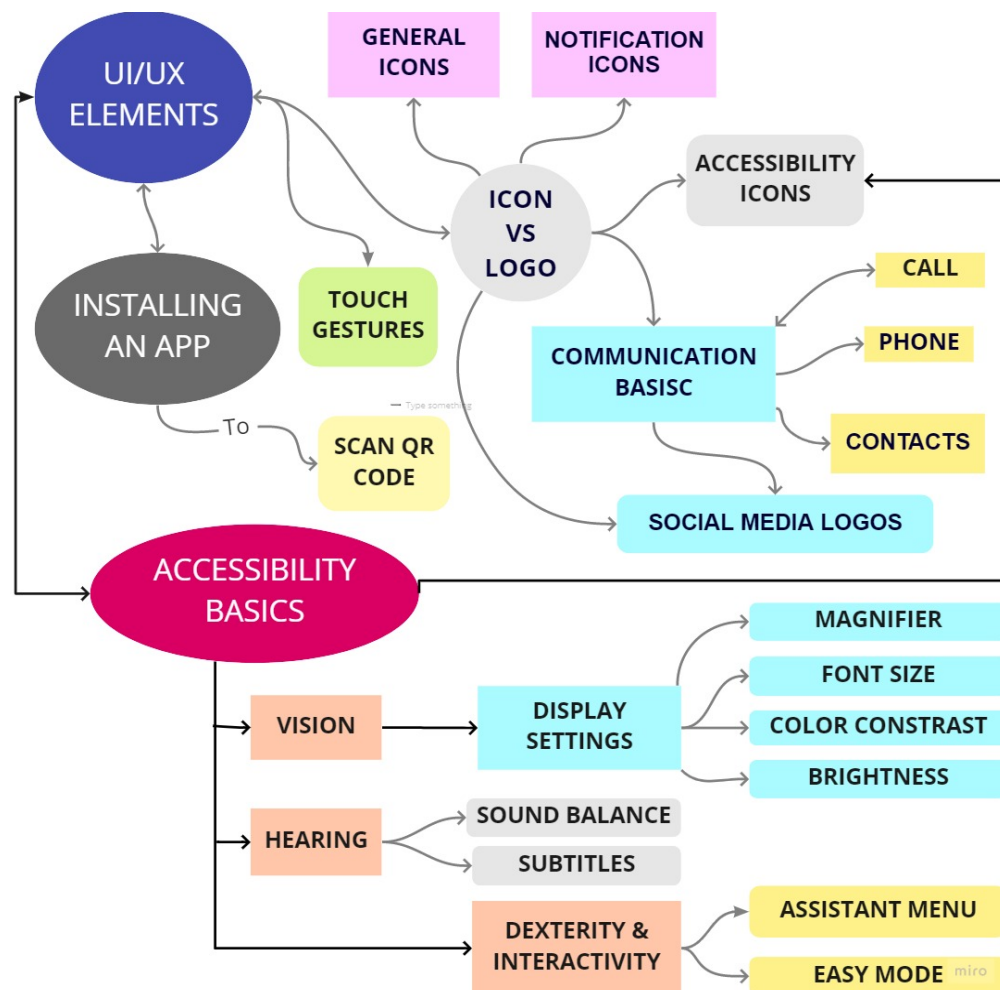
Fig. 17. Flowchart: Planning the introductory chapters for the Beginner's Handbook

The Beginner's Handbook is a preliminary introduction to digital interfaces for older adults. This guidebook is created keeping the 'Six-factors Computer Anxiety Model' by Beckers and Schmidt (2001) in mind. An attempt has been made to familiarize older adults with fundamental descriptions of iconography, touch gestures, installation of mobile applications and scanning QR codes. It is important to embed a sense of comfort and confidence to change attitudes towards digital tools (see 1st & 4th factor, p. 23). This is designed to help Android users because of affordability and reaching out to a wider audience. The handbook is available free of cost and can be accessed via Issuu, an online publication platform that allows writers, journalists, reporters and designers to upload their books, magazines, journals and catalogues. Every day, around 20K digital content gets read, browsed and published on Issuu (Issuu, 2020).

7.1.1 Planning the Introductory Chapters

The decision-making process as to what to include (what to teach) and exclude (what not to teach) is complicated and difficult, as every task is interrelated (refer Fig. 23) We assume that this handbook will be useful for older adults who have limited dexterity, weak eyesight and a beginner-level digital vocabulary, and intend to become digitally-literate individual s to accommodate aspects of ageing.

1. Iconography: explaining different categories of icons (common, contact-specific, notifications, settings, etc.)
2. User-Interface Anatomy: each user-interface has a status bar/notification bar, navigation bar, layout margin, tab bar and a home indicator in the bottom. These terminologies are defined with diagrams and examples.
3. Vital smartphone applications like the Google Play Store and Google Lens are explained.
4. Installing an Application: a step-by-step process is documented with mobile screenshots that shows the user how to search applications in the Google Play Store and install them.

Easy Mode
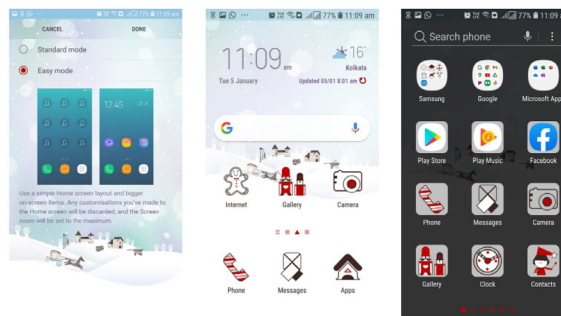
Standard Mode
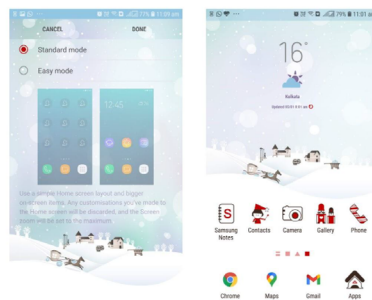
Easy Mode maximizes the Screen Zoom & implements a simple screen layout.

Fig. 18. The above image displays the difference between the layouts of '*Easy Mode'* and *'Standard Mode'* (Default View)

The Beginner's Handbook is a preliminary introduction to digital interfaces for older adults. This guidebook is created keeping the 'Six-factors Computer Anxiety Model' by Beckers and Schmidt (2001) in mind. An attempt has been made to familiarize older adults with fundamental descriptions of iconography, touch gestures, installation of mobile applications and scanning QR codes. It is important to embed a sense of comfort and confidence to change attitudes towards digital tools (see 1st & 4th factor, p. 23). This is designed to help Android users because of affordability and reaching out to a wider audience. The handbook is available free of cost and can be accessed via Issuu, an online publication platform that allows writers, journalists, reporters and designers to upload their books, magazines, journals and catalogues. Every day, around 20K digital content gets read, browsed and published on Issuu (Issuu, 2020).

7.1.1 Planning the Introductory Chapters

The decision-making process as to what to include (what to teach) and exclude (what not to teach) is complicated and difficult, as everything is connected with each other (refer Fig. 23) We assume that this handbook will be useful for older adults who have limited dexterity, weak eyesight and a beginner-level digital vocabulary, and intend to become digitally-literate individuals to accommodate aspects of ageing.

1. Iconography: explaining different categories of icons (common, contact-specific, notifications, settings, etc.)
2. User-Interface Anatomy: each user-interface has a status bar/notification bar, navigation bar, layout margin, tab bar and a home indicator in the bottom. These terminologies are defined with diagrams and examples.
3. Vital smartphone applications like the Google Play Store and Google Lens are explained.
4. Installing an Application: a step-by-step process is documented with mobile screenshots that shows the user how to search applications in the Google Play Store and install them.

7.2 Part 2: Web-based Tutorial on Mobile Applications
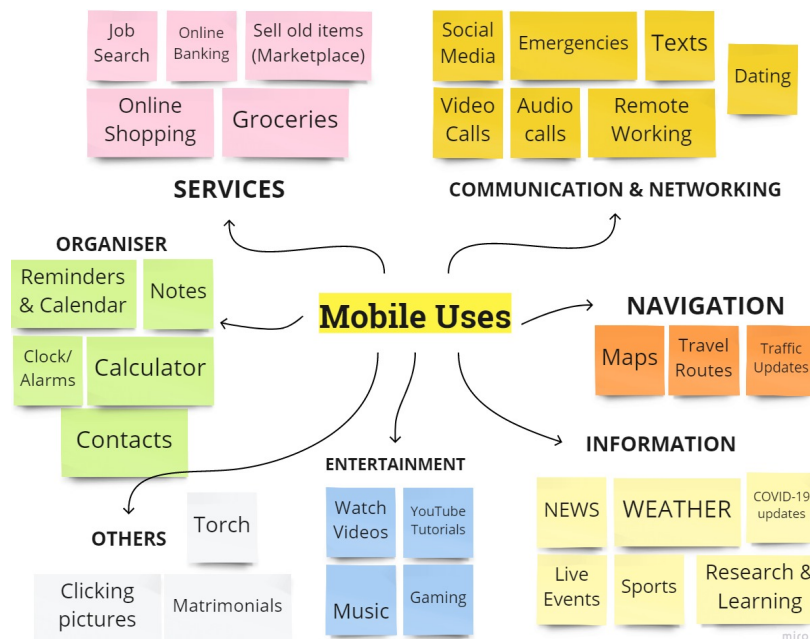
Fig. 19. Mind Map: Mobile Uses

Before finalizing which tasks should be taught to the target demography, popular applications of the mobile phone were listed across a mind map.

7.2.1 Selecting and Structuring Modules

The survey questionnaire queried which tasks the targeted users desired to learn. The results were as follows -

1. 31.3% want to learn how to **share links/media files** across various online platforms, such as images, video, etc. Users need to know about sharing icons and procedures.
2. 23.1% want to **browse topics** for their own interest: users need to know about search engines.
3. 58.8% faced difficulty in **updating the systems and applications**: users need to be shown how smart devices are updated in the settings section.
4. 35.3% find the system consists of **illegible font sizes** and **insufficient brightness**: here users need to know about accessibility features and how to increase screen brightness.
5. 28.6% want to learn how to **access information:** read news, check temperatures/weather, or get updates on COVID-19.
6. 22% of users faced difficulty in using a computer, compared to 11% of users who struggled with mobile phone applications.
7. 43.8% don't know how to **install new applications**.

7.2.2 User Flow & User Persona

These two concepts go hand-in-hand, and are used for enhancing the experience of the user while using an application or software. User personas involve the creation of fictional consumers based on the target demographic data. User personas are used to study and understand the target users' expectations, behavioural traits and needs (Dam & Siang, 2021). User flow involves the stages and steps the user needs to complete in order to accomplish the task (Optimizely, 2021). This research utilized the user-personas described in the two 'Design for Ageing toolkits' (Project Catalyst & IDEO, 2017). Developing the user persona involved sketched ideas of how the user will learn about an idea, how they will be interacting with it, how this experience will change his/her

lifestyle and how this idea will influence their friends and family. IDEO's design strategy prioritized emotional support over technological and caregiving services. The two user personas and their social models are as follows:

Fig. 20 - User Persona 1: Defiant Social Butterfly

1. User Persona 1: Defiant Social Butterfly

    Name: Dhananjay Smith

    Age: 66 years

    Ethnicity: Indo-American

    Education: Diploma in Hotel Management

    Occupation: Former Tourist Guide

    Personality Traits:

    - New challenges help them to grow and evolve
    - Wants to be understood
    - Building professional identity & leading community groups
    - Creating professional identity

    Task - How to learn new language and make friends overseas

Fig. 21 - User Persona 2: Introspective Homemaker

2. User Persona 2: Introspective Homemaker

   Name: Julia Watson

   Age: 72 years

   Ethnicity: British

   Education: Masters in English Literature

   Occupation: Fiction Author

   Personality Traits:

   - Likes to self-reflect domestic activities
   - Peaceful and self-reliant
   - Prefers to perform solo

   Task - How to create a Gmail account
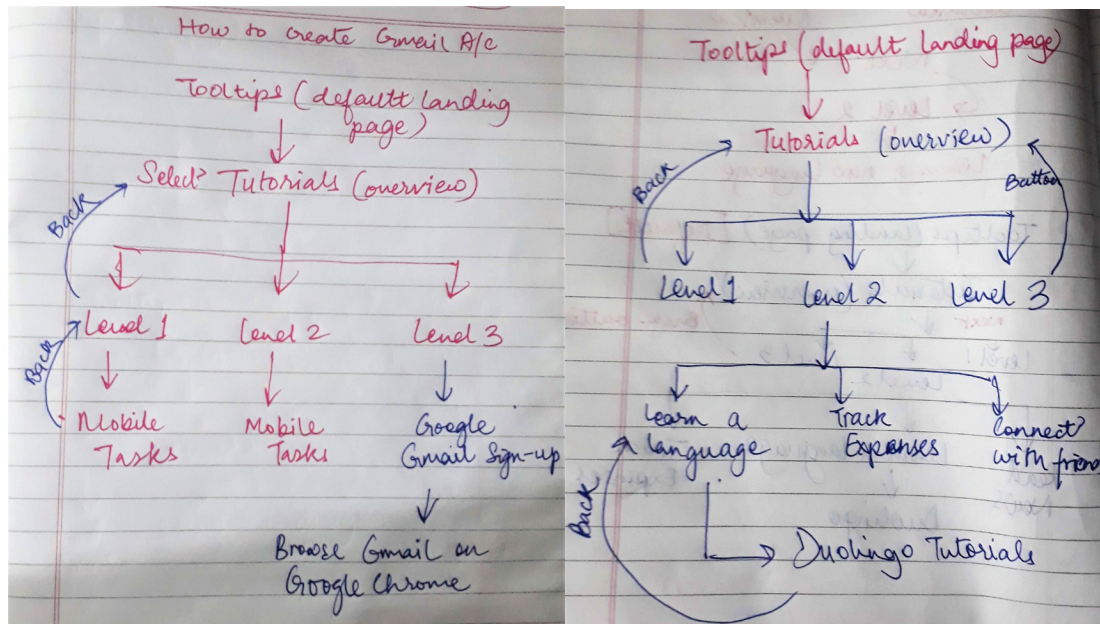
Fig. 22 (left) & Fig. 23 (right) - Drafting User-Flow of Introspective Homemaker (creating a Gmail account, left) and Defiant Social Butterfly (learning a new language, right)

7.2.3 Prototyping the Platform

Several tasks were selected and taught to older adults. They were categorized into three levelled cards. The applications which would be utilized to accomplish such tasks were

presented in the cards. For example if online banking is taught in the Level 2 card, then budgeting applications (Wallet) will be placed over it.
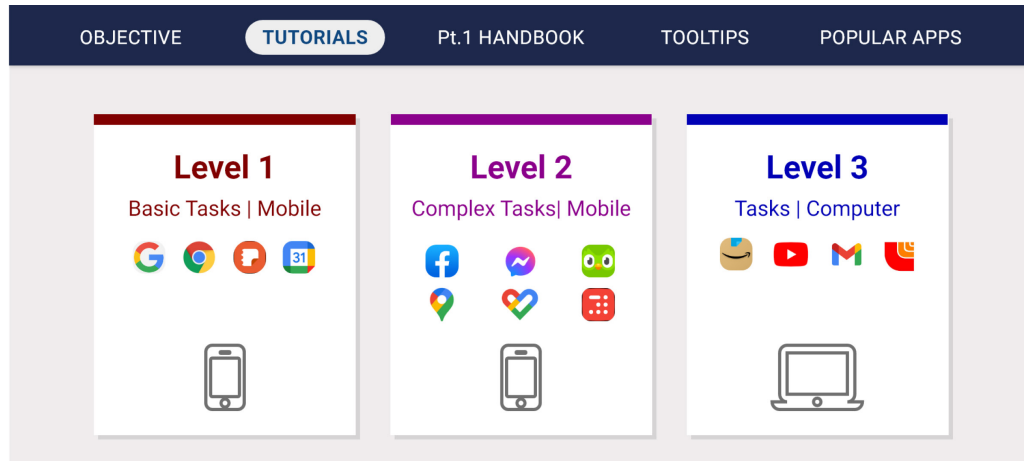
Fig. 24. Tasks are categorized under level 1, 2 & 3

1. **Level 1**

   - Consists of simple and easy tasks to be accomplished using a smartphone.
   - For example: making notes, checking events on calendar, viewing COVID-19 updates, updating software, installing new mobile applications and checking the temperature of the current location, etc.
   - How to add and use 'widgets[15]' will be shown as well.
   - Applications taught: Google Chrome, Samsung Notes & Calendar etc.

2. **Level 2**

   - Consists of complex tasks to be accomplished using a smartphone.
   - For example: learning a new language, tracking monthly expenses, location navigation and exploring locality, etc.
   - Applications taught: Google Maps, Duolingo, Wallet, etc.

3. **Level 3**

   - Consists of tasks to be accomplished using a computer.
   - For example: opening Google Chrome + Youtube, sharing media on social platforms, learning new skills, creating a Gmail account, etc.

---

[15] Widget: an easy-to-use graphical user interface element which is placed in the home screen of smart devices. Widgets serve basic utilities like calendars, email clients, clocks, etc.

- Applications taught: YouTube, Google, Gmail, etc.
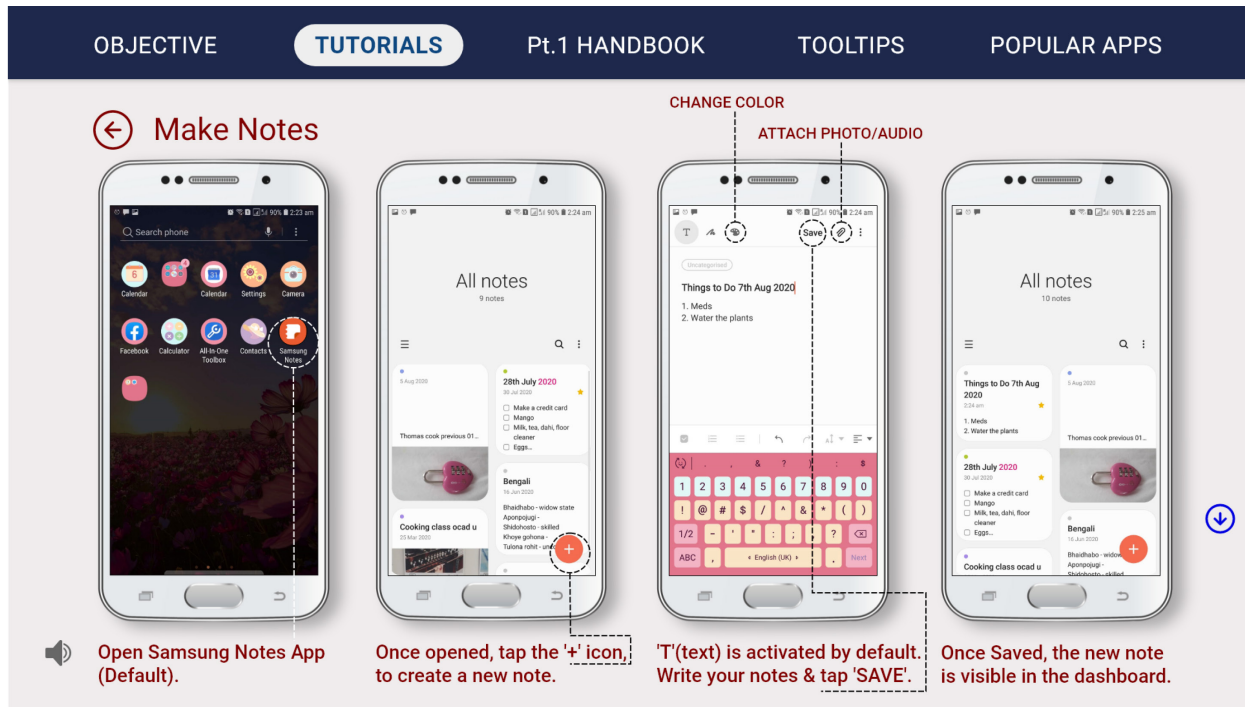
Fig. 25. Step-by-step guide on making notes on smartphones
By clicking the speaker icon, users can listen to descriptions by a voice-over feature

The website is created to tutor on the identified tasks (see fig. 25). Each task is documented through mobile screenshots displaying a step-by-step process. The tasks were chosen based on the survey questionnaire results (see 6.1.1) and my work experience at TechServeTo (see 6.1.2). The ideologies of the Technological Acceptance Model (see 6.3.1) were applied. Chosen tasks were considered for their usefulness to older adults. Design strategies (see tables 2 & 3) were implemented while creating the interfaces, and every section and textual description is accompanied by audio-visual aids. Moreover, large typefaces, precise instructions, high contrast colours (Ratio AA & AAA) and comfortable leading (line spacing) have been implemented. Infotips/tooltips simplify user navigation, explain technical features and contain helper texts. The Beginner's Handbook was also added for quick reference.

OBJECTIVE   TUTORIALS   Pt.1 HANDBOOK   **TOOLTIPS**   POPULAR APPS

Pt. 1 HANDBOOK

Tap/Click to access various sections

PART 1. HANDBOOK

Tap/Click to read aloud the text

This beginner's handbook is a preliminary introduction to digital interfaces for the older adults. This includes fundamental descriptions of iconography, touch gestures, installing mobile applications and scanning QR Codes. It is designed

Tap/Click on the Next button to access the following pages

Next

Drag Down button to view content below

Scroll Down

BASIC ACTIONS

OBJECTIVE   TUTORIALS   **Pt.1 HANDBOOK**   TOOLTIPS   POPULAR APPS

PART 1. HANDBOOK | OVERVIEW

This beginner's handbook is a preliminary introduction to digital interfaces for the older adults. This includes fundamental descriptions of iconography, touch gestures, adjusting accessibility features and scanning QR Codes. This is designed to help Android Users as of now.

CLICK TO LEARN - INSTALLING MOBILE APPS

Scroll Down

BASIC ACTIONS

Fig. 26. (upper) Tooltips/Visual Aids provided for every section.

Fig. 27. (lower) Part 1. Handbook Section

8.0 Conclusion

Based on my intensive investigation, I will try to answer my research questions: *How can technology be used to teach older adults who have limited digital literacy?* and *What aspects of ageing obstruct the learning of digital tools among older adults that do not affect younger adults?* It is difficult but not impossible to teach methods of using technology through digital mediums. As the saying goes, with regular practice, any skill can be perfected. One learns English vocabulary by extensively using the language (speaking, listening and reading). But digital literacy skills is a separate subject which one needs to learn by themselves through practise and experience.

It is impossible to teach someone everything regarding this subject within a short period of time.. Learning about the use and application of smartphones and computers is a complex, non-linear and multi-layered phenomenon. Therefore, the grasping of information is better and more efficient when beginners — such as older adults, who have limited digital literacy skills — learn at a slower, steadier and more gradual pace.

 This project solely serves as a stepping stone in the realm of digital empowerment. New media devices can be only learned through comprehension, practice and frequent usage. The following statement is not a generalization but derived from statistics: younger adults are more up-to-date with the latest technologies and are yet unaffected by aspects of ageing (hearing or visionary deficits in few older adults). Also, their fitness status is at its peak, giving them the energy to explore and experiment more. In this case, a hardcover publication and face-to-face tutorials would have been more efficient than digital publications. The shortcoming of this project would be that designers need to treat the ageing factors as dynamic, and not as a hindrance to learning new skills. This project created a generalized platform and tried to cover a larger age group. Maybe if this project was limited to North America, it would have been different.

 With respect to the methodologies I utilized in this project, the survey questionnaire, work experience and studying Web Content Accessibility Guidelines were useful. But the TAM was unnecessary because it does not consider affordability and aesthetic appeal as acceptance factors. The reason I used Android in my projects to reach the common and wider range of users is

because Android phones are cheaper and more accessible. If I had a chance to restart, I would visit geriatric care centers, hospitals and old age homes to have face to face interactions with the target demography and conduct user testing. Projects such as these that require raw data must be done once the pandemic is over. Despite the given circumstances, this research has accomplished what it aimed for: empowering older adults with digital literacy fundamentals.

8.1 Future Scope

Empathy is an important ingredient for any design. User happiness should be prioritized over capital gain (Project Catalyst and IDEO, 2017). One needs to be compassionate, patient and even-tempered while catering to older adults. This project can be further evolved by introducing tutorials on complex tasks such as online banking, online shopping and creating YouTube channels through mobile or computers. One interesting aspect of this project will be considering its efficiency in the coming years. For example: will older adults in 20 years face the same challenges (as they have used digital technology a lot more throughout their lives), or is this strictly a generational issue? Older adults may take time in adapting to newer technology due to their ageing aspects. Moreover, technologies change at a faster pace and humans might have difficulty in keeping pace with this rapid transformation. Human beings need to create dynamic strategies to tackle such challenges.

Secondly, an upcoming opportunity for budding gerontological designers, technologists and researchers could be to consider if digital tool usage by the older population is different on the bases of region, profession and gender. Right now, this project aims to help general older adults within the age group of 60 to 75 living in region of the world; can we develop customized solutions catering to region-specific users with shorter age range groups, like 60-65 or 70-75 years? Hypothetically, a dynamic teaching tool could be created utilizing machine learning and deep learning (AI technologies) that customize according to the user's interactions and needs. However, these are scenarios for the speculative future.

Thirdly, the requirements and structure of this project could be reengineered to serve cultural domains. It could provide tutorials regarding matrimonial sites for South Asian countries like India, Bangladesh or Pakistan, but such features will be futile for America or European

countries. Since every region has different values, characteristics and unique norms, it is difficult to cater every need with a single teaching toolkit; it is impossible to address every regional requirement. Henceforth, the project must provide scope for feedback which enables its components to expand as well as modify along with co-design and participatory research processes. Incorporating feedback from the user-group will be the key to better design solutions.

8.2 Reflections from the User-Group

After reviewing the outcomes, my mother (a potential target audience) suggested that for first time users, the creator/instructor could provide a walkthrough of both the teaching tools. This will help the users to understand about their functionalities and navigation. It will be helpful to incorporate a feedback section as well. Post-pandemic, this project will have a supplementary hardcover publication that will be distributed among the target demography. The publication will have QR codes, making it interactive and more engaging than traditional guidebooks. It is a struggle to teach, learn or practice digital mediums when one lacks digital literacy skills. There is a need for handheld materials for preliminary stages.

Bibliography

1. 10 facts on dementia. (2019). Retrieved 1 November 2020, from https://www.who.int/features/factfiles/dementia/en/

2. About Issuu. (2006). Retrieved 18 February 2020, from https://issuu.com/about

3. Akma Ahmad, N., Zainal, A., Kahar, S., Hanis Abdul Razak, F., & Adilah Wan Adnan, W. (2013). Teaching Older People using Web Technology: A Case Study. International Conference On Advanced Computer Science Applications And Technologies, 19, 2-4. doi:10.1109/ACSAT.2013.84 Retrieved 18 May 2020, from https://ieeexplore.ieee.org/document/6836613/citations#citations

4. BBC NEWS | Special Report | 1999 | Encryption | Digital freedom: the case for civil liberties on the Net. News.bbc.co.uk. (1999). Retrieved 16 October 2021, from http://news.bbc.co.uk/2/hi/special_report/1998/encryption/58154.stm.

5. Beckers, J. and Schmidt, H., 2001. The structure of computer anxiety: a six-factor model. Computers in Human Behavior, [online] 17(1), pp.35-49. Available at: https://www.researchgate.net/publication/222240534_Structure_of_computer_anxiety_A _six-factor_model [Accessed 11 March 2020].

6. Berg, D., & Rapp, A. (2020). Color Safe - accessible web color combinations. Retrieved 4 June 2020, from http://colorsafe.co/

7. Blais, E. (2012). Living Longer Using today's emerging technology to address issues related to aging in Canada in the year 2032 [Ebook] (1st ed., pp. 5-15, 23-27). Toronto: OCAD University. Retrieved 12 November 2020, from http://openresearch.ocadu.ca/id/eprint/106/1/mrp_eric_blais_final.pdf

8. BoundaryCare by Beatrice Health LLC. (2019). More than just a GPS tracker for the elderly (Version 1) [IOS - Apple Watch and iPhone]. The United States. Retrieved 17 April 2020, from https://www.boundarycare.com/

9.

10. Campbell, O. (2015). Designing For The Elderly: Ways Older People Use Digital Technology Differently — Smashing Magazine. Retrieved 7 October 2020, from https://www.smashingmagazine.com/2015/02/designing-digital-technology-for-the-elderly

11. Canada.ca. 2014. Government of Canada — Action for Seniors report - Canada.ca. [online] Retrieved 12 January 2021, from https://www.canada.ca/en/employment-social-development/programs/seniors-action-report.html

12. Clarke, M. (2012). The digital revolution. Information Technology Social Networking Social Networking Siteworld Wide Web. https://doi.org/https://doi.org/10.1016/B978-1-84334-669-2.50004-4

13. Davis, F. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, 13(3), 319. doi: 10.2307/249008. Retrieved 27 October 2020, from https://www.jstor.org/stable/249008?casa_token=5XLypkwyegoAAAAA%3AQnODcvlN2K6yhlxcdp81FstcTKHhoyxYiMr0rHO5zBW__ygXE4fjc5UvZWI0CUTSveb8xt4uKviPB

14. Designing for accessibility. (2020). Retrieved 2 December 2020, from https://ukhomeoffice.github.io/accessibility-posters/posters/accessibility-posters.pdf

15. Digital citizenship | Digital Technologies Hub. Australian Government Department of Education, Skills and Employment. Retrieved 12 January 2021, from https://www.digitaltechnologieshub.edu.au/teachers/topics/digital-citizenship\

16. Digital Empowerment Foundation, DEF. (2019). Retrieved 7 November 2020, from https://www.defindia.org/

17. Digital rights, essential in the Internet age. Iberdrola. (2020). Retrieved 24 January 2020, from https://www.iberdrola.com/innovation/whataredigitalrights#:~:text=Digital%20rights%2C%20closely%20linked%20to,electronic%20devices%20and%20communications%20networks.

18. Friis Dam, R. and Yu Siang, T., 2021. Personas – A Simple Introduction. [online]

19. Gerontology & Geriatric Medicine, [online] 2(1), pp.1-7. Available at: https://www.heraldopenaccess.us/openaccess/the-effect-of-ageism-on-the-digital-divide-amongolderadults#:~:text=The%20literature%20attributes%20the%20digital,and%20physical%20and%20cognitive%20deficits.&text=internet%20use2%20.-,Older%20adults%20as%20a%20group%20are,with%20respect%20to%20internet%20usage. [Accessed 12 March 2021].

20. Goodman, P. (2020). 20 Advantages of Mobile Phones. https://turbofuture.com/. Retrieved 30 December 2020, from https://turbofuture.com/cell-phones/advantages-Mobile-Phones.

21. Government of Canada. (2021). Healthy Aging in Canada: A New Vision, A Vital Investment From Evidence to Action. A Background Paper Prepared For The Federal, Provincial And Territorial Committee Of Officials (Seniors), 1-40. Retrieved 19 January 2020, from https://www.health.gov.bc.ca/library/publications/year/2006/Healthy_Aging_A_Vital_latest_copy_October_2006.pdf

22. Guo, Y., & Ding, W. (2019). Study on the Persuasive Design Method of Health Education for the Elderly Adults. Springer Nature Switzerland, 22–33. doi: 10.1007/97e8-3-030-22012-9 Retrieved 25 November 2020, from https://doi.org/10.1007/978-3-030-22012-9_2

23. Harris, D.K. (1988). Dictionary of Gerontology. New York: Greenwood Press. p. 80. Retrieved 20 November 2020, from https://archive.org/details/dictionaryofgero0000harr/page/80/mode/2up

24. Heaggans, R. (2012). The 60's are the new 20's: Teaching older adults technology. SRATE Journal, 21(2), 1 - 6. Retrieved from https://files.eric.ed.gov/fulltext/EJ990630.pdf Accessed: 16th January 2020.

25. Herrera Saray, G., & Silva, E. (2018). The gerontological design: a practice to improve life quality of the elderly. Nursing & Care Open Access Journal, 5(4), 1-5. doi:10.15406/ncoaj.2018.05.00148 Retrieved 16 October 2020, from https://medcraveonline.com/NCOAJ/NCOAJ-05-00148.pdf

26. Holmberg, J. (2019). Real Facts about the Elderly and the World Wide Web | Axess Lab. Retrieved 1 May 2020, from https://axesslab.com/real-facts-about-the-elderly-and-the-world-wide-web/

27. Myant Inc. (2020). Care is Close: Myant announces the launch of Phase 1 of the Skiin Early Access Program - Myant. [online] Available at: https://myant.ca/care-is-close-myant-announces-the-launch-of-phase-1-of-the-skiin-early-accessprogram/ [Accessed 14 March 2021].

28. Hutt, R. (2015). What are your digital rights?. https://www.weforum.org/. Retrieved 20 August 2020, from https://www.weforum.org/agenda/2015/11/what-are-your-digital-rights-explainer/.

29. IELTS Vocabulary about About Modern Technology. (2014). Retrieved 16 September 2020, from https://www.ieltspodcast.com/ielts-speaking-vocabulary-modern-technology/

30. Information Technology. MIS Quarterly, 13(3), 319. doi: 10.2307/249008. Retrieved 27 October 2020, from https://www.jstor.org/stable/249008?casa_token=5XLypkwyegoAAAAA%3AQnODcvl N2K6yhlxcdp81FstcTKHhoyxYiMr0rHO5zBW__ygXE4fjc5UvZWI0CUTSveb8xt4uKv iPB-R6CkCdSePPacnulArylryjKH9bSoWyMW9Ss

31. Kaufman, D., Sauve, L., & Ireland, D. (2020). Playful Aging: Digital Games for Older Adults. Canada's Technology And Aging Network, 1(1), 1 - 44. Retrieved 21 October 2020, from https://agewell-nce.ca/wp-content/uploads/2020/02/AGE-WELL_WP4.2_White-paper_GAMES.pdf

32. Kenton, W. (2019). ECONOMY > GOVERNMENT & POLICY | Net Neutrality. https://www.investopedia.com/. Retrieved 13 June 2020, from https://www.investopedia.com/terms/n/netneutrality.asp#:~:text=What%20Is%20Net%20 Neutrality%3F,%2C%20platform%2C%20application%20or%20device.

33. Koncelik, J. (2008). The Human Factors of Aging and the Micro- Environment, Personal Surroundings, Technology and Product Development. Journal Of Housing For The Elderly, 11719. doi: 10.1300/J081v17n01_09 Retrieved 15 November 2020, from https://www.tandfonline.com/doi/abs/10.1300/J081v17n01_09

34. McDonough, C., 2016. The Effect of Ageism on the Digital Divide Among Older Adults. Gerontology & Geriatric Medicine, [online] 2(1), pp.1-7. Available at: https://www.heraldopenaccess.us/openaccess/the-effect-of-ageism-on-the-digital-divide-among-older-adults#:~:text=The%20literature%20attributes%20the%20digital,and%20physical%20an d%20cognitive%20deficits. [Accessed 12 March 2021].

35. Musical Health Technologies (MHT). (2021). SIngFit [SingFit™ PRIME App, SingFit™ PRIME Toolkit with speakers, percussion, Award-Winning SingFit™ PRIME Online Training Program movement props, and storage case, SingFit™ PRIME Operations

Playbook and]. Los Angeles, CA. Retrieved 11 August 2020, from
https://www.singfit.com/

36. Optimizely. 2021. User Flow. [online] Available at:
https://www.optimizely.com/optimizationglossary/userflow/#:~:text=User%20flow%20is
%20the%20path,such%20as%20purchasing%20a%20product. [Accessed 17 March
2021].

37. Patil, P., 2018. What is Exploratory Data Analysis?. Medium. Retrieved 14 March 2021,
from https://towardsdatascience.com/exploratory-data-analysis-8fc1cb20fd15

38. Pedwell, T. (2016). CRTC declares broadband internet a basic service. thestar.com.
Retrieved 11 August 2020, from https://www.thestar.com/news/canada/2016/12/21/crtc-
declares-broadband-internet-a-basic-service-like-telephone.html.

39. Project Catalyst and IDEO. (2017). Design on Aging: Connected Living [Ebook] (1st ed.,
pp. 7,9,47,54-67). Retrieved from https://www.ideo.com/post/tools-and-insights-for-
enhancing-the-lives-of-older-adults Accessed: 16th January 2020.

40. Project Catalyst and IDEO. (2017). Design on Aging: Independent Living [Ebook] (1st
ed., pp.7,9,47,54-67). Retrieved from https://www.ideo.com/post/tools-and-insights-for-
enhancing-the-lives-of-older-adults Accessed: 16th January 2020.

41. Richter, F., 2021. Infographic: Facebook Keeps On Growing. [online] Statista
Infographics. Available at: https://www.statista.com/chart/10047/facebooks-monthly-
activeusers/#:~:text=Despite%20being%20shrouded%20in%20controversy,grown%20to
%202.8%20billion%20users. [Accessed 13 March 2021].

42. Rungta, A., 2016. What Is Technophobia and How to Overcome It?. [online]
Indusnet.co.in. Available at: https://www.indusnet.co.in/what-is-technophobia-and-how-
to-overcome-it/ Accessed 12 March 2021].

43. Serino, S., Cipresso, P., Morganti, F., & Riva, G. (2014). The role of egocentric and
allocentric abilities in Alzheimer's disease: A systematic review. Ageing Research
Reviews, 16, 32-44. doi:10.1016/j.arr.2014.04.004 Retrieved 1 November 2020, from
https://www.who.int/features/factfiles/dementia/en/

44. Silvestre, M., Muñoz, S., & Rubio, M. (2014). A successful entrepreneurship formula for
solving computer illiteracy. IEEE Global Humanitarian Technology Conference (GHTC
2014), pp. 318-324. https://ieeexplore.ieee.org/abstract/document/6970299

45. The Canadian Government Says High-Speed Internet is Essential. – Onserve. https://www.onserve.ca. (2020). Retrieved 20 November 2020, from https://www.onserve.ca/the-canadian-government-says-high-speed-internet-is-essential/.

46. Tobin, C. D. (1983). Developing Computer Literacy, The Arithmetic Teacher AT, 30(6), 22-60. Retrieved Jan 21, 2021, from https://pubs.nctm.org/view/journals/at/30/6/article-p22.xml

47. Top 5 Gerontechnology Products (To Increase Social Engagement for Seniors). (2018). Retrieved 27 October 2020, from https://medtechboston.medstro.com/blog/2018/05/22/top-5-gerontechnology-products-to-increase-social-engagement-for-seniors/

48. Venkatesh, Morris, Davis, & Davis. (2003). User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly, 27(3), 425. doi: 10.2307/30036540. Retrieved 27 October 2020, from https://www.jstor.org/stable/30036540?casa_token=-2bEWaUaCc0AAAAA%3A14lf3TrdqLD7QOD9K7aookAP42u5kUquX6TpjzOUVhIM owJsKiMWD9nkV416v6zRf5d80hZnggNQg7StOhY0nXXQ9t0dRwgdRH6BVCl_ozPFl zFk3vQ&seq=1#metadata_info_tab_contents

49. Villamor, C., Willis, D., & Wroblewski, L. (2010). Touch Gesture | Reference Guide [Image]. Retrieved 27 October 2020, from https://www.slideshare.net/narf2916/touch-gestureguide

50. Virtual Reality for Seniors | Welcome to Rendever. (2021). Retrieved 11 January 2021, from https://rendever.com/

51. Welcome to TechServe | Make technology easy for you. We help older adults figure out technology, free of charge. (2020). Retrieved 10 August 2020, from https://www.techserveto.com/

52. What is AgeTech? Kraydel Limited. (2019). Retrieved 6 January 2021, from https://www.kraydel.com/what-is-agetech/

53. What is digital literacy? | Western Sydney University. (2020). Retrieved 4 November 2020 from https://www.westernsydney.edu.au/studysmart/home/study_skills_guides/digital_literacy/ what_is_digital_literacy

54. What is Human-Computer Interaction (HCI)?. (2021). Retrieved January 2021, from https://www.interaction-design.org/literature/topics/human-computer-interaction

55. What We Do - iN2L. Retrieved 27 November 2020, from https://in2l.com/what-we-do/

56. Whitelaw, S., Mamas, M., Topol, E., & Van Spall, H. (2020). Applications of digital technology in COVID-19 pandemic planning and response. The Lancet Digital Health, 2(8), e435-e440. doi:10.1016/s2589-7500(20)30142-4 Retrieved 20 December 2021, from https://www.thelancet.com/journals/landig/article/PIIS2589-7500(20)30142-4/fulltext

57. *"Desktop computers are most popular with adults ages 35-65, with 69% of Gen X, 65% of Younger Boomers and 64% of Older Boomers owning these devices. Additionally, about one in 11 (9%) adults do not own any of the devices we asked about, including 43% of adults age 75 and older."* ZICKUHR, K. (2011). Internet & Technology | Generations and their gadgets. Retrieved 20 December 2019, from https://www.pewresearch.org/internet/2011/02/03/generations-and-their-gadgets/

Figures

Fig. 1 & Fig. 2. Understanding Logo *(Left)* and user User Interface guidelines *(Right)* as the basics of digital tools. These are important concepts to comprehend preparatory to using digital tools.

 Basu, R. (2021). *Age and Interface: Equipping Older Adults with Technological Tools* [Ebook] (pp. 7, 8). Toronto: Rittika Basu, OCAD University. Retrieved from https://issuu.com/rittika/docs/handbook

Fig. 3 Design on Ageing, toolkits from Project catalyst and IDEO - This project has derived insights from *'Design on Ageing'* booklets.

Project Catalyst and IDEO. (2017). *Design on Aging: Independent Living* [Ebook] (1st ed., pp. 7,9,47,54-67). Retrieved from https://new-ideo-com.s3.amazonaws.com/assets/files/pdfs/Design_on_Aging_Independent_Living.pdf Accessed: 16th January 2020.

Project Catalyst and IDEO. (2017). *Design on Aging: Connected Living* [Ebook] (1st ed., pp. 7,9,47,54-67). Retrieved from https://new-ideo-com.s3.amazonaws.com/assets/files/pdfs/Design_on_Aging_Connected_Living.pdf Accessed: 16th January 2020.

Fig. 4. Older Adults are less confident when using electronic devices (Pew Research Center, 2015)*.* Anderson, M. and Perrin, A. (2017). *Barriers to adoption and attitudes towards tech among older Americans*. [online] https://www.pewresearch.org. Retrieved 7 October 2020, from https://www.pewresearch.org/internet/2017/05/17/barriers-to-adoption-and-attitudes-towards-technology/

Fig. 5. Statistics from Pew Research Center shows that 'Four-in-ten seniors now own smartphones, more than double the share that did so in 2013' (2016).

Pew Research Center. (2016). *Four-in-ten seniors now own smartphones, more than double the share that did so in 2013* [Image]. Retrieved 27 September 2020, from https://www.pewresearch.org/internet/2017/05/17/technology-use-among-seniors/.

Fig. 6. HCI overlapped with related disciplines such as human factors engineering, computer science, behavioural science and cognitive science etc (Interaction Design Foundation, 2021).

Interaction Design Foundation. (2021). *Human-Computer Interaction (HCI)* [Image]. Retrieved from https://www.interaction-design.org/literature/topics/human-computer-interaction

Fig. 7. Percentage of Americans owning devices as per age-groups and gender

Pew Research Center: Internet, Science & Tech. 2019. *Demographics of Mobile Device Ownership and Adoption in the United States | % of U.S. adults who own the following devices*. Available at: https://www.pewresearch.org/internet/fact-sheet/mobile/ [Accessed 11 March 2021].

Fig. 8. Screenshots of the BoundaryCare Mobile Application

Beatrice Health LLC. (2019). *More than just a GPS tracker for the elderly.* [Image]. Retrieved from https://www.boundarycare.com/

Fig. 9. Conducting YouTube tutorial workshop with older adults at the TechServeTo

Fig. 10. *(upper)* & 11 *(lower)*. These are the presentation slides for the YouTube Tutorial Workshop

Basu, R. (2021). Conducting YouTube Tutorial Workshop with older adults at the TechServeTo. Presentation, TechServeTo Video Call, Toronto. Retrieved from https://issuu.com/rittika/docs/techserveto_workshop_part_1

Fig. 12. Innovation emerges from Human-Centered Design approaches.

Project Catalyst and IDEO. (2017). *Design on Aging: Independent Living* [Ebook]. Retrieved 16th January 2020 from https://new-ideo-com.s3.amazonaws.com/assets/files/pdfs/Design_on_Aging_Independent_Living.pdf

Fig. 13. Conceptualising the Technology Acceptance Model

Fig. 14 & Fig. 15. Accessibility Icons *(left)*, Dexterity and Interaction Settings *(right) - p*resent in every smartphone for users with special needs.

Basu, R. (2021). *Age and Interface: Equipping Older Adults with Technological Tools* [Ebook] (pp. 14, 19). Toronto: Rittika Basu, OCAD University. Retrieved from https://issuu.com/rittika/docs/handbook

Fig. 16. Color Safe - presenting various blue shades against white with AAA contrast ratio as per the WCAG 2.0.

Berg, D., & Rapp, A. (2020). Color Safe - accessible web color combinations. Retrieved 4 June 2020, from http://colorsafe.co/

Fig. 17. Flowchart: Planning the Introductory Chapters for the Beginner's Handbook

Fig. 18. The above image displays the difference between the layouts of '*Easy Mode'* and *'Standard Mode'* (Default View)

Basu, R. (2021). *Age and Interface: Equipping Older Adults with Technological Tools* [Ebook] (p. 20). Toronto: Rittika Basu, OCAD University. Retrieved from https://issuu.com/rittika/docs/handbook

Fig. 19. Mind Map: Mobile Uses

Fig. 20 - User Persona 1: Defiant Social Butterfly

Project Catalyst and IDEO. (2017). *Design on Aging: Independent Living* [Ebook] (1st ed., pp. 7,9,47,54-67). Retrieved from https://new-ideo-com.s3.amazonaws.com/assets/files/pdfs/Design_on_Aging_Independent_Living.pdf Accessed: 16th January 2020.

Fig. 21 - User Persona 2: Introspective Homemaker

Project Catalyst and IDEO. (2017). *Design on Aging: Independent Living* [Ebook] (1st ed., pp. 7,9,47,54-67). Retrieved from https://new-ideo-

com.s3.amazonaws.com/assets/files/pdfs/Design_on_Aging_Independent_Living.pdf Accessed: 16th January 2020.

Fig. 22 *(left)* Drafting User-Flow of Introspective Homemaker

Fig 23 *(right)* Drafting User-Flow of Defiant Social Butterfly

Fig. 24. Tasks are categorised under level 1, 2 & 3

Fig. 25. Step-by-step guide on making notes in smartphones

Fig. 26. (upper) Tooltips/Visual Aids provided for every section.

Fig. 27. (lower) Part 1. Handbook Section

List of Appendices

1. Appendix A - Survey questionnaire

Survey | Technological use by older adults | Retrieved 1 October 2020, From
https://forms.office.com/Pages/ResponsePage.aspx?id=0WnkBiotj0aum33wlo6216EiKB
EPSTdPpV1473fSVyJUQTc2NkVQVFQ4VFJERlFJMVdKTk1RR0dINy4u

Time: 10 - 15 minutes

Mode of conduct: Online

Target demography: Older adults and their family members

Age group: 60 - 75 years old

Method - Survey, multiple choice questions and ranking questions

Objective: This research inquiry focuses on design-thinking approaches and guiding tools
are most effective for older adults in our society. This investigation strives to equip the
older people, better with digital media and technological tools to socially bond with loved
ones. The project needs human participants in my research and for user-testing to
determine whether my design solution was successful or a failure.

A survey questionnaire was distributed among older adults residing in different countries
to gather data from diverse mindsets. The responses helped us to determine the current
trends, popular mobile applications, user's attitude towards technological tools and aid in
predicting the next behavioural patterns.

Survey Form

This research inquiry focuses on design-thinking approaches and guiding tools are most effective for older adults in our society. My investigation stems from the premise that older adults (persons 60 years and older) are getting lonely and socially isolated. I believe that this generation has a lot to give the younger generations. I hope that my thesis project will equip the 'Older People', better with digital media & technological tools to socially bond with society. I need human participants in my research and for user-testing to determine whether my design solution was successful or a failure.
Please fill out the form carefully, without skipping any questions. Choose all that apply. Select multiple answers if needed, don't restrict yourself to one answer only. There are no 'right' or 'wrong' answers. This will take about 10 - 15 minutes only.

7. What is your name? If you want your identity to be confidential, you may changeyour name and write 'Name Changed' beside. (Optional) Please provide your e-mailaddress if you like to be contacted.

8. What is your age?

9. What profession are you engaged in currently? Which City are you from?

10. Do you face difficulties using a mobile or computer?

   ◯ Yes, mobile and computer both

   ◯ Only mobile

   ◯ Only computer

   ◯ I do not own a mobile or computer and have no intention of learning their applications

   ◯ No, I do not face any problems

11/27/2020

11. How often do you use the internet?

○ Several times a day

○ Once or twice a day

○ 3-5 days a week

○ 1-2 days a week

○ Rarely or Never

12. Which activities do you use the mobile and internet for?

	Use	Not Use	Don't Know
Making/taking down Notes	◯	◯	◯
Calling/texting Someone (both audio and video)	◯	◯	◯
Watching Video or Listening to Music	◯	◯	◯
Checking the Calendar/Setting a reminder/Making Notes	◯	◯	◯
Take Pictures/Videos	◯	◯	◯
Share links/media files from online platforms - Images, Video etc.	◯	◯	◯
Read News, check temperatures/weather or updates on COVID-19	◯	◯	◯
Banking - Monthly Budget Tracking or e-transferring money	◯	◯	◯
Check directions or share locations	◯	◯	◯
Browse topics for own's interest	◯	◯	◯
Online Shopping	◯	◯	◯
Reading books, magazines or listening to audio-books	◯	◯	◯
Learning a new skill	◯	◯	◯
No, I do not face any problems	◯	◯	◯

11/27/2020

13. Which activities would you want to learn or face difficulties using?

	Want to Learn	Don't want to Learn	Don't Know	Not Interested
Making/taking down Notes	○	○	○	○
Calling/texting Someone (both audio and video)	○	○	○	○
Watching Video or Listening to Music	○	○	○	○
Checking the Calendar/Setting a reminder/Making Notes	○	○	○	○
Take Pictures/Videos	○	○	○	○
Share links/media files from online platforms - Images, Video etc.	○	○	○	○
Read News, check temperatures/weather or updates on COVID-19	○	○	○	○
Banking - Monthly Budget Tracking or e-transferring money	○	○	○	○
Check directions or share locations	○	○	○	○
Browse topics for own's interest	○	○	○	○
Online Shopping	○	○	○	○
Reading books, magazines or listening to audio-books	○	○	○	○
Learning a new skill	○	○	○	○
No, I do not face any problems	○	○	○	○

14. Where do you face problems in using technological tools and online services?

	Problematic	Not Problematic
Reading jargons like #hashtags, millennial slang etc	○	○
Understanding icons, symbols and navigation	○	○
Illegible font size and insufficient brightness	○	○
Installing new mobile apps	○	○
Remembering instructions	○	○
Exploring and figuring out settings	○	○
Discovering latest features	○	○
Updating the systems and applications	○	○
Multi-tasking	○	○

15. Any suggestions and insights you would want to impart?

Microsoft Forms

2. Appendix B - YouTube tutorial workshop to older adults at TechServeTo

Time: 60 minutes

Mode of conduct: Video Call

Target demography: Older adults associated with TechServeTo

Age group: 60 - 75 years old

Methods - Presentation via screen sharing, live demo YouTube navigation followed by Q&A

Objective: During my volunteering service at the TechServeTo, I organized a workshop with the 10 - 12 older adults on using and accessing YouTube. The aim was to understand behavioural patterns of the target users, their expectations and gain an idea regarding their current knowledge on technology.

These are the presentation slides for the YouTube Tutorial Workshop
Basu, R. (2021). *TechServeTo Workshop Part 1* [Ebook] (1st ed.). Toronto: Rittika Basu. Retrieved from
https://issuu.com/rittika/docs/techserveto_workshop_part_1

These are the presentation slides for the YouTube Tutorial Workshop
Basu, R. (2021). *TechServeTo Workshop Part 2* [Ebook] (1st ed.). Toronto: Rittika Basu. Retrieved from
https://issuu.com/rittika/docs/techserveto_workshop_part_2

Interacting with David Marrello, co-founder of TechServeTo

3. Appendix C - Part 1 - Beginner's handbook

Age And Interface: Equipping Older | Adults With Technological Tools, Retrieved 1 October 2020, From https://issuu.com/rittika/docs/handbook

The project titled 'Age & Interface: Equipping older adults with Digital Tools' focuses on teaching older adults about usage of technology, accomplishing simple tasks using mobile applications and navigating common user-interfaces. This beginner's handbook is a preliminary introduction to digital interfaces for older adults. The project includes fundamentals, descriptions of iconography, touch gestures, installing mobile applications and scanning QR Codes. Currently, this is designed to help Android Users only.
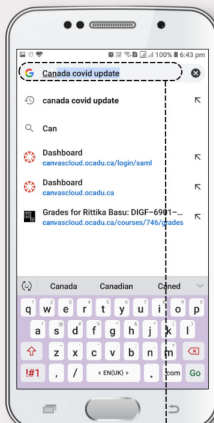
4. Appendix D - Part 2 - Web-based tutorial platform

https://xd.adobe.com/view/e8b02ca2-fd8e-46a1-8d01-7ddc9846b70f-bde3/?fullscreen
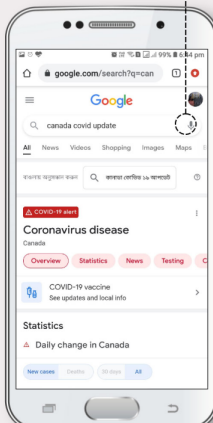
This interactive and engaging platform consists of both the handbook and step-by-step guidance presenting 'How various tasks can be accomplished by using Smart Devices'. It is divided into five parts, each having its own overview and tooltips. In addition to the textual instructions, users can interact with text-to-speech options.