Context-Aware Peer-to-Peer Service Exchange

(Technical Report)

Accessibility Needs of Senior Citizens as a Factor for Designing Mobile Applications

(STS Research Paper)

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On my honor as a student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Ever since Apple released the iPhone in 2007, the way people interact with services has changed dramatically. “There’s an app for that” becomes the answer to more questions every day. Combined with the shift to contactless transactions induced by the coronavirus pandemic, it can increasingly feel like the only way to interact with the world is through a smartphone. Whether this is a positive development is its own question, but there is one group that faces a unique set of challenges in adapting to this shift: senior citizens. Despite any stereotypes about old-timers disliking anything invented after the turn of the century, there are serious challenges surrounding the wide-scale adaptation of mobile technology by senior citizens that run deeper than attitudes.

The goal of this paper is to discuss the challenges senior citizens face in accessing the internet through a mobile device, both through mobile apps and mobile web browsers. This discussion will happen within the context of Social Construction of Technology (SCOT) theory.

Background

In this paper, we will use the term “app” to refer to a software application that runs on a mobile device such as a smartphone, usually downloaded from Apple’s app store for iPhones or the Google Play store for devices that run the Android operating system. Many websites, such as Facebook, Twitter, Reddit, or Wikipedia, in addition to having a site that can be visited on a desktop computer, also maintain an app that makes using their service easier on a mobile device. Not all apps correspond to a regular website, such as a shopping list app, calculator app, or mobile game. Many smaller websites do not have a corresponding mobile app, such as those for small businesses or government agencies. To access these sites on a mobile device, one must

visit the site through a mobile web browser app, such as Safari or Google Chrome. Websites that do not have the resources to build an app can instead choose to optimize their regular website to also work well in a mobile browser. We will refer to this as a mobile site. Because a mobile device screen is both much smaller than a desktop or laptop screen and in a different orientation (portrait instead of landscape), visiting a site not specifically optimized for mobile browsers will be at least difficult (if not impossible).

A screen reader is a tool that allows a visually impaired user to use a computer by producing an audio-only rendering of what is shown on the screen. When visiting a website with a screen reader, the reader will read the text shown on the screen left to right and top to bottom (citation, W3C?). Additionally, the screen reader may look "behind the scenes" at the source code, such as the HTML, to provide other useful information. For example, a site may include information about images that is not shown on the screen but is picked up by a screen reader. A refreshable braille display, or simply "braille display", is a physical device that converts text into braille.

Lastly, keeping with the federal Medicare program's definition, we will define a senior citizen as any person aged 65 or older (U.S. Department of Health and Human Services, 2014).

Senior Citizens and Mobile Technology Accessibility Challenges

Though senior citizens vary greatly in health and ability, they are more likely to suffer from at least one disability and/or experience declines in cognitive function, eyesight, and hearing than their younger counterparts (Manini, 2013). Seniors also became adults over 45 years ago, when computers held niche status and the internet did not quite exist. They may have lived their whole lives without needing to use any kind of digital device. Transitioning from, for

example, placing a delivery order over the phone with a paper menu to using a restaurant's website is a significant change, even for the sharpest among us.

There are several areas of mobile app and site design that affect accessibility. A study conducted by Trinity College Dublin in 2019 identified a list of 20 design checkpoints for evaluating the accessibility of mobile applications to seniors (see figure 1) (Alamo & Golpayegani, 2019). Alamo & Golpayegani suggest that apps with highly visible and intuitive controls will make a mobile application more accessible to senior citizens. We will focus on the visual, cognitive, and cultural challenges seniors face in accessing this technology.

Principle	Dimension	Checkpoint	Code
Perceivable	Small screen size	Reduce information	SG-01
		Font size	SG-02
		Form field below label	SG-03
	Magnification	Text resizing	SG-04
		On-screen control to change text size	SG-05
		Zoom	SG-06
Operable	Touchscreen gestures	Easy	SG-07
		Touch-end event	SG-08
	Buttons	Accessible	SG-09
Understandable	Screen orientation	Support both	SG-10
	Consistent layout	Multiple pages	SG-11
		Screen orientations	
	Page elements	Important page elements before page scroll	SG-12
	Operable elements	Group operable elements performing same action	SG-13
		Visually differentiate actionable elements	SG-14
	Instructions	Available	SG-15
		Easily discoverable and accessible	SG-16
		Available anytime	SG-17
Robust	Data input	set virtual keyboard to the type of data entry required	SG-18
		Reduce amount of text entry required	SG-19
	Support characteristic properties of platform	Zoom	SG-20
		Font size	
		Captions	

Figure 1- Design Checkpoints for Accessibility of Mobile Applications by Senior Citizens, identified gby Alamo & Golpayegani

Visual

Some senior citizens are completely or mostly blind, needing the help of a screen reader, braille display, or caretaker to use a computer. However, most have sufficient eyesight to be able to use a screen in some capacity (citation). The relatively small smartphone screen forces mobile developers to be efficient with space, and this can often mean making text quite small.

Before we can discuss text size, we must first address accessibility options built into mobile device operating systems. Apple, for instance, provides options to enlarge and bolden most text and increase color contrast, among others, in its IOS that runs on all iPhones and iPads (Aquino, 2019). These settings affect all parts of the Apple IOS, as well apps and mobile sites that support these features. This not only makes the Apple IOS more accessible, but those apps that are configured to support it. For example, when reading an article on a mobile site, increasing the text size in IOS settings will increase the text size in the article, making this content accessible.

The issue comes with parts of apps that do not support this integration, or that do not handle this integration well. For instance, on the "listen" screen of National Public Radio's NPR One app, if the user has large and bold text enabled, the "interesting", "share", and "later" buttons are hidden behind the playback slider, as seen in figure 2 and figure 3, making them untouchable.

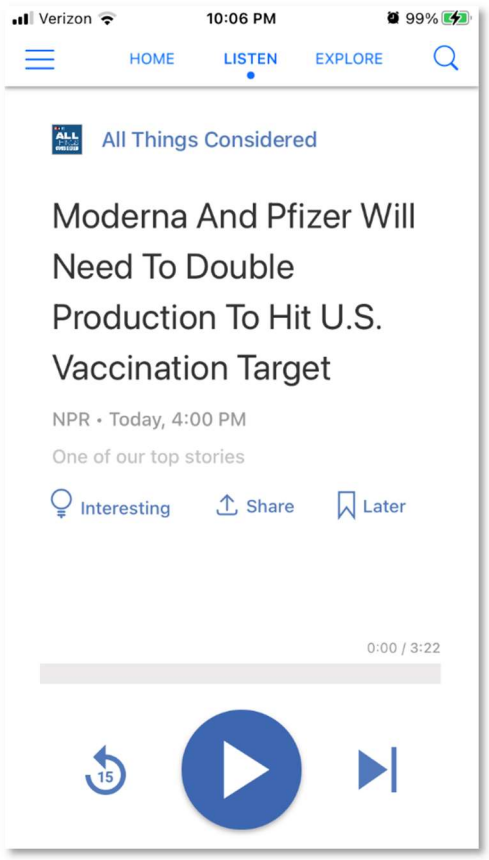

Figure 2- Home Screen with normal text

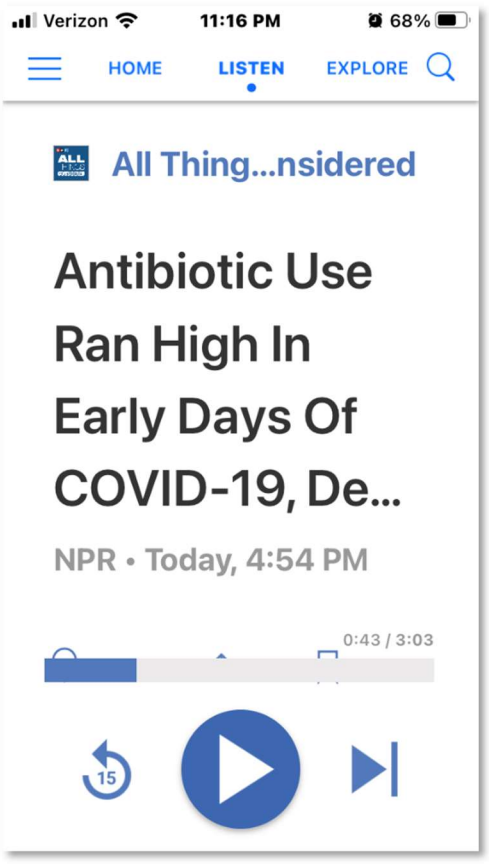

Figure 3- Home Screen with largest, bold text. The lightbulb, share, and later buttons are hidden behind the playback slider

Additionally, though some text is enlarged by the enlargement feature, some text is not. As seen in figures 2 and 3, the light gray text of the time information toward the bottom right of the screen above the playback slider, though made slightly larger, is still quite small and offers little contrast against the white background.

Cognitive

Because a smartphone screen is so small, it can be tempting to replace a clearly labeled button with a symbol, such as a pencil to edit or a little gear for settings. This may be fine for many users, but not for someone who has little experience with smartphones. A good example of this is Snapchat, a popular photo/video messaging app, in which users may send their friends a

photo or a video that the recipient can only view once. As a disclaimer, I do not intend for this to be a bashing of Snapchat; Snapchat is hugely successful, and its design choices are clearly intentional, optimized for a younger audience. However, it is a good example of a UI that is heavily steeped in icons and gestures.

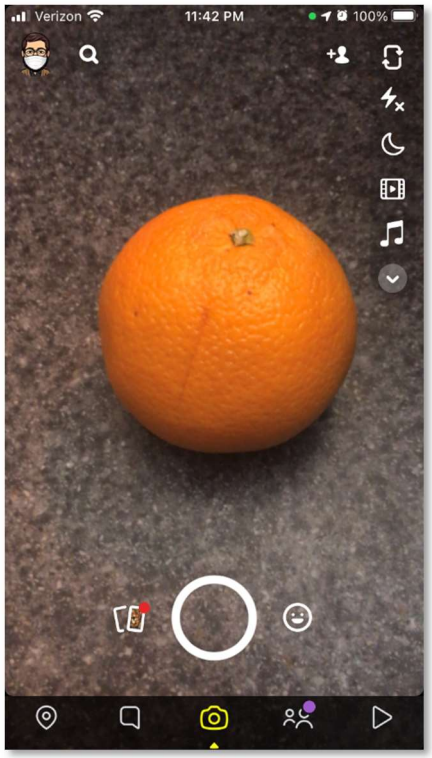

Figure 4- Snapchat's Home Screen

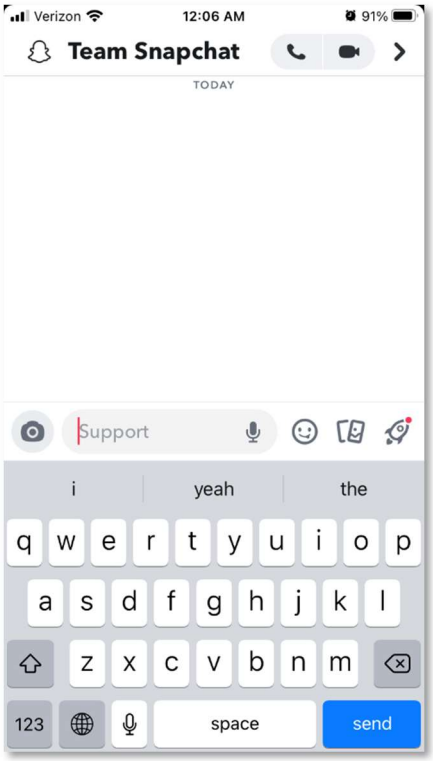

Figure 5- Snapchat's direct messaging page

As seen in figure 4, Snapchat's home screen is a border of buttons superimposed on the camera display. There are a lot of controls to unpack, so I will keep this explanation brief. The lowest row of buttons navigates to other screens, as does swiping left or right. The rightmost column of buttons provides options such as switching to front-facing camera, turning on the flash, or adding music to a video. The big circle in the bottom middle takes a picture if tapped or takes a video if tapped and held. Swiping from bottom to top navigates to saved photos and videos.

Without getting into the other screens, or even the other buttons and menus on the home screen, there is already a lot to remember. None of these buttons have labels. They are also quite close together, proving difficult for anyone with wide fingers or limited dexterity. For a user who is new to smartphones, most of these icons' meanings are likely hard to intuit. To leverage another example from Snapchat, see the top right corner of the messaging screen in figure 5. The arrow in the top right corner exits the screen, but the button immediately to its left immediately starts a video call. If a user didn't know that symbol meant "start a video call", it may be quite startling when the call suddenly starts.

The reason I chose Snapchat as an example is that I once tried to get my Mother to use it so that I could easily integrate communicating with her into my communications with my peers. I thought she would love it, since she is always asking for more pictures, and improve our relationship. However, within a few hours of her downloading it, she was so frustrated with the experience that I was forced to abandon the attempt. Her chief complaints were the cryptic buttons, the seemingly random gestures, and the general lack of explanation of how to use the app. Though this is an extreme example, and one could argue a foolish decision on my part, it is a case where app design directly hindered a senior citizen trying to engage with her children. If this attempt had been successful, it would have brought a new user to Snapchat, and perpetuated my own usage by hosting my correspondence with my Mother. Instead, I use other apps to communicate with my dearest mom. This is an example of members of society, myself and my Mother, shaping what technology is adopted and what technology is not.

Cultural

Mobile technology, being so new, is often perceived to be by young people and for young people. Stack Overflow, a company that runs a popular Q&A forum for developers, found

that three quarters of the nearly 90,000 software engineers who answered their annual developers survey were aged 35 or younger (*Developer Survey Results*, 2019). Further, pew research studies in 2019 found that roughly 96 percent of respondents aged 18-29 and 92 percent aged 30-49 owned smartphones, compared with only 53% of seniors (Pew Research, 2019. So why, then, must we cater to seniors? Though potentially frustrating, these challenges discussed so far could likely be overcome with the assistance of a family member, friend, or caregiver. This, however, is what makes this problem so dangerous. Though it is beneficial for senior citizens to receive help from their support network, there is the issue of independence. Many senior citizens do not have a full-time caregiver. For those who do not need or want help with most tasks, accessing mobile technology can be its own source of frustration.

To a younger person who grew up with a smartphone in hand, using one is trivial. If you ask your grandkids to help you do a task that would be simple to any seasoned user, they may perceive you as stupid (even though this is certainly not the case) or just get annoyed and disengage. This is also where pride becomes a factor. Part of ageing is needing help with some things for the first time. Admitting you need help and asking for it can be embarrassing. It is a loss of independence, an acknowledgement of getting old, which can be a major life challenge for some. Further, it is a gradual shift. It can take a long time to admit to yourself that you really do need reading glasses, and plenty of struggling will take place until that happens. Building software that preempts these challenges by presenting a neat, accessible, intuitive user experience is certainly a great way to reach the largest possible audience.

Social Construction of Technology (SCOT), Mobile Technology, and Senior Citizens

Technological constructivism, also referred to as Social Construction of Technology (SCOT), argues that society shapes the way technology is developed and used. SCOT rejects

technological determinism, which argues that technology determines how society will develop. While it may make sense that technology shapes society (life has indeed changed in many ways since mobile phone technology became widely available), SCOT would make the case that the way that humans act and make choices influences how mobile phones and apps are developed.

To identify how this construction takes place, it is helpful to start by identifying the relevant stakeholders. Mobile apps and websites optimized for mobile browsers are built by software engineers and designers for a business. The business's motivation is to maintain a user experience that will make the user want to return in the future and become a regular user. There multiple means toward this end. A designer may choose to make the app as simple and intuitive as possible, at the expense of making it too "fancy". A designer could also go all out with a sleek, beautiful design rife with unique gestures, cool icons, and pretty fonts, at the expense of simplicity. Which of these directions the designer will pursue is dictated by the business, and the business makes this decision by looking to how its customers use and perceive the technology.

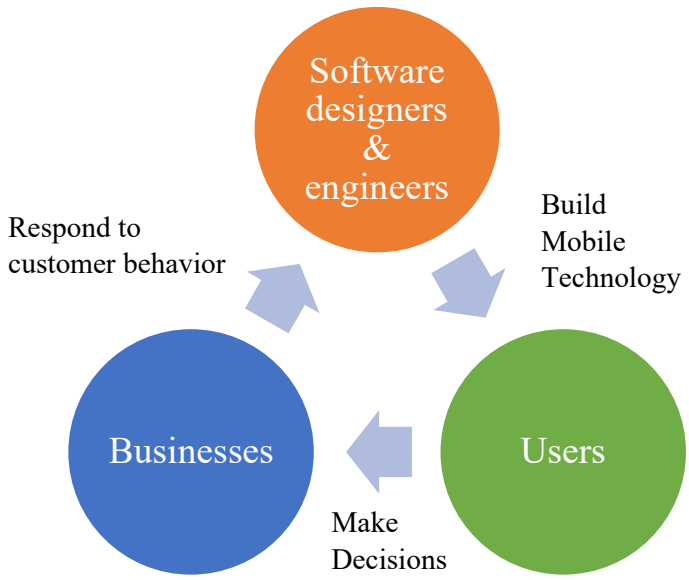

Figure 6- The social construction of mobile technology

As the designer responds to the business client, and the client responds to its users, mobile technology is constructed by the way it is used. If users will use an app with a certain feature, businesses will want their app to do just that to bring them in, and designers will build apps in that way. As these changes make their way into the technology, users respond with their usage, and the cycle continues.

An important observation in this cycle is the portion of mobile technology users that are senior citizens. Some apps have very narrow target audiences, while others seek a broad base. However, even if a business can ignore seniors as a demographic now, it will become much more difficult in the future due to their exploding numbers. The U.S. Census Bureau projects that adults 65 years and older will outnumber children under 18 in the U.S. for the first time by 2034, with the total population of seniors roughly doubling from 49 million in 2014 to 94 million by 2060 (U.S. Census Bureau, 2020). This means that, even if an app dominates the market of young users, an app that captures modest shares of both young and old audiences could be even more successful.

Also involved in this construction are disability rights advocates and organizations who must comply with the Americans with Disabilities Act (ada.gov, 2007). Title II of the ADA mandates that all state and local governments must provide equal access to services to persons with disabilities and those without (ADA Best Practices Toolkit TODO). This mandate includes web-based content, such as websites and mobile sites. ADA.gov uses the example of a tax form website. If a tax form is available on a government website 24 hours a day and 7 days a week but the website is not compatible with a screen reader, forcing blind individuals to request the same forms via mail, this would be illegal unequal access (ada.gov, 2007).

Conclusion

As mobile technology absorbs so many aspects of everyday life, we can see that some groups, especially senior citizens, face unique challenges. As engineers design and build apps for their clients, the challenge is not only building software that will be successful with a target group but building mobile technology that can be accessed by anyone regardless of ability. Building accessible mobile technology is not simply an altruistic endeavor. Users will demand technology that can be used by themselves and their loved ones of all age groups and levels of ability. As the population of senior citizens explodes over the next few decades, Apps and mobile sites that ignore this call will be forced to stand in their accessible competitors' shadow and join the petabytes of software that never quite caught on.

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