Ageing-friendly smartphones: An analysis of design and user-interface to understand smartphone 'usability' for elderly citizens

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Abstract

This work analyzes the features of design and user-interface of the smartphones exclusively designed for the elderly citizens in a bid to enhance their usability among people aged 65 or more to overcome digital divide in the ageing society of today. These features are more focused on size of the device, visibility, text-speech function and emergency tools. It was found that ageing-friendly smartphones have metallic body structure, large display, icons and text fonts, simplified navigation, text-to-speech and speech-to-text feature, and technical and emergency support facilities. Although all of these features successfully address the inabilities of seniors and explain the nature of usability of smartphones among them, there is a need to move towards more universal and inclusive designing of user-interface of smartphones for their universal adoption.

1. Introduction

As the ageing continues, people aged 65 or above are expected to outnumber children under the age of 5 in 2020 for the first time in recorded human history, becoming 17% of the total human population on earth (He et el, 2016). Twenty-two percent of the world's total population will be aged above 60 years in 2050, according to an estimate of World Health Organization (WHO) in its report "Ageing and health" (2018). Amid this stark transition, the efforts for establishment of an ageing-friendly world are also underway. This also includes a movement to increase "technology acceptance" among elderly citizens; however, studies show a rather pessimistic picture on this front. But, in recent years, several smartphone manufacturers have focused on the needs and requirements of the elders to launch few devices that are easy to use, provide emergency support and have better visibility and audio compatibility.

Owing to the situation, this study aims to identify the nature of certain features of design and user-interface in the elderly citizens-centric smartphones that can possibly contribute to "sense of ease in use" and increase the adoption rate of smartphones among them.

1.1. Background of study

It is a commonly accepted belief that elderly citizens are more inclined to the use of smartphones and other new media technologies in the developed countries as compared to the others. Anderson and Perrin (2017) found that around 42% of citizens aged 65 or more use a smartphone in the United States, a country considered leader in the technology adoption around the world. Interestingly, the technology adoption among elderly citizens is the lowest in Asian and Pacific countries, including the nations such as Malaysia, India and China, which have quite high ageing rate. Most of the elders in these regions expressed their disinterest towards mobile phone adoption, either considering it of no use for them or believing it was too complicated to use (The unconnected senior citizens of Asia, 2015). Qiuhui (2008) also noted that elderly citizens face problems related to interface and software complexity while using mobile phones, which results in their limited usage. The developers and manufacturers of smartphones and software applications have almost failed to cater the needs of those people who are unable to use the technology (Neves & Amarno, 2012). Realising the crucial situation, the European Union marked 2012 as "the year of active ageing and solidarity between generations" in a bid to improvise a formal struggle to

bridge the gap between generations and prepare them for the change. Similarly, Turkey also announced to dedicate the year 2019 to the elderly citizens. It is an opportunity as well as a challenge for the IT sector to address the needs of elderly citizens who make up a considerable percentage of the population and more efforts are required on this front.

1.2 Objectives of study

The increased use of smartphone-centered information and communication technology (ICT) has made smartphones the most common device of communication in the society (Kleinberger et al, 2007). Due to this, smartphones can play a significant role to close the communication gap between elderly citizens and young generations as well as to pave the way for successful diffusion of information and communication technologies (ICT). The main objective of this study is to identify the distinctive features of design and user-interface of smartphones available in the market for the elderly citizens. It provides a checklist of features and recommendations to enhance "usability" of regular smartphones among elderly citizens by making them ageing-friendly.

1.3 Research Questions

This study primarily tries to find answers to the following research question through empirical research methodology:

- What are the distinctive features of the design of the smartphones exclusively marketed for the elderly citizens?
- What are the distinctive features of the user-interface of the smartphones available in the market exclusively for elderly users?
- What kind of SOS features are provided by the ageing-friendly smartphones?
- Which key changes or modifications in the design and user-interface of smartphones can enhance their "usability" among elderly citizens?

2. Literature Review

This study is an attempt to analyse the smartphone design and user-interface with a focus on elderly citizens as the potential users, with an aim to improve the usability of smartphones among people aged 65 and above. The existing literature provides a strong rationale and basis for this study and provides clear guidelines for the future scholarship on the subject.

2.1. Human-computer (smartphone) interaction

While immense advancements in technology provide mankind with countless opportunities to benefit from machines, the human being itself is the biggest limitation of this process as well (Buxton, 2001). The main reason behind this is the machine's inability to be compatible to its human users. The IT projects, which involve an interaction between human beings and machine, depend on "machine's understanding of user" for its success (Banum, 2011). In other words, the machine's user-interface plays a key part in interaction with the user and creation of a perception of its usability and ease of use (Nielsen, 1993).

In theory, most of the time this interaction is said to be taking place between humans and computers.But, in reality, smartphones and other digital gadgets have started playing their roles. However, the user experience and device's usability still remain the same. Nielsen (2012) defined smartphone as a mobile device having full-size multi-touch screen, 3G, Wi-Fi, web browsing and graphical user-interface. Anything called as smartphone was first mentioned to be public in 1973 and made available for sale in 1993, but it was the year 2013 when the smartphones outnumbered the traditional feature phones in the market (Malley, 1994).

2.2. Usability

While terming usability as simplest yet a complex concept, Donald Norman (2013) went on to claim that usability is in every product; however, we are unable to notice it unless something goes wrong. Indirectly, usability of some product is a set of its abilities which let the user fulfil its tasks. The International Organization for Standardization (ISO) defines usability as: "The effectiveness, efficiency and satisfaction with which specified users can achieve specific goals in particular environments…"

Nielsen (1993) laid down five major attributes to evaluate the usability of anything as following:

Learnability: Any system or product should be easy to use and it should enable the user to understand its functioning easily.

Efficiency: A system which provides high productivity as compared to other comparable systems.

Memorability: A system should have an ability to get memorised quickly and easily, for repetition after some time.

Errors: A system should have an/the ability to minimise the errors and avoid any major mistakes.

Satisfaction: A system should provide the users with satisfaction.

2.3. Ageing of human population

While Neves and Amarno (2012) noted ageing as the demographic trend in most of the societies, it remains unclear that under which criteria someone will be classified as an ageing person. Moreover, many people who technically fall under this category don't want to be called such as elderly, senior or old and rather prefer to be placed in a "special group" (Smith, 2012). However, according to the World Health Organization (WHO) anyone aged 65 or above is categorised as an elderly citizen.

In the light of this definition, Fisk and Rogers (2012) argue that although every individual has a different approach towards ageing phenomenon, the overall biological, social and psychological characteristics of elderly citizens are found to be the same. They further suggested to place elderly people into two groups: aged between 60 to 75, and aged over 75. However, Gregor and Newell (2002) contradicted this categorisation based on the age number, arguing that elderly citizens should rather be categorised based on their disabilities. In other words, they turned the debate towards an individual's accessibility.

2.4. Impact of ageing-related disabilities on user-interface

At this stage, one may argue that understanding the adoption of technology or smartphones among elderly citizens is actually the study of these devices' usability for the people having certain

disabilities caused by ageing. As one grows older, the set of personal characteristics and abilities continues to shed some skills and add some talents, especially the ones which can be helpful for adaption to ageing. This transformation of capability and limitations among the elderly citizens enables the developers to create a more suitable under-interface of devices (Caprani & Connor, 2012). Conci, M., Pianesi F. & Zancanaro, M. (2009) noted that people face some critical changes in their sensory, motor and cognitive infrastructure as they go through the process of ageing. Adding more to that, Roupa and Nikas (2010) linked the trend of getting exhausted and losing temper among seniors to functional deduction in their biological and mental processes. All these changes should clearly be visible in any interface specially designed for the elderly citizens.

2.5. From user-friendly to universal or inclusive designing of user interface

The researchers working in the field of human-computer interaction have found that certain changes associated with the growing age i.e. vision, hearing, cognitive thinking and movements based on motor neurons affect the probability of smartphone usage by the elderly citizens (Fisk, Rogers, Charness, Czaja, & Sharit, 2009). During the last decade, as the number of people aged 65 or more is growing around the world, scholars have been trying to identify the factors of screen-based controls and user-interface that could help in developing a checklist of designing features of the smart devices that will make them more friendly towards elderly citizens. While user-friendliness of the interface enables the majority of the intended users to accomplish the desired tasks with ease and hence providing a sense of empowered users in general (Ng, 2004), the inclusive designing, or otherwise called as universal designing, is purely based on the concept of usability by all types of users without any exclusive designing or development (Mace, 1985). Steinfeld and Maisel (2012) further argued that an inclusive design must also cater the needs of people with disabilities or users with special requirements.

The extension of existing user-interface of smartphones to include the senior citizens to the pool of users is a challenging task (Dickinson, Arnott, & Prior, 2007) as it also involves the literacy factor of technology and usability. Zhou et al. (2014) found that elderly citizens face problems in switching between multiple screens of smartphones, arranging and operating applications, and handling multitasking feature of such devices despite the large size of the screen. That's why an ageing-friendly or user-inclusive designing of interface involving seniors must also address other

changes or growing disabilities, as identified by the researchers, among this huge group of population in order to enhance usability and adoption of smartphones.

2.6. Ageism

Butler (1969) coined the term "ageism", calling it prejudicial attitude of one age group towards another. This concept actually evokes the widely accepted set of stereotypes which reflects the uneasiness of youngsters or people in their 30s or 40s for growing old. This notion of generation gap is actually a result of assumed sense of diseases, disabilities, powerlessness and uselessness of the old age (Butler, 2008). While Butler (2008) endorsed his definition and assumed set of stereotypes associated with ageism through advertisements showing characteristics such as forgetful, childlike, sexless and dependent being associated with elderly citizens, Palmore (1999) identified mean behaviour and biased attitude i.e. being told that they were too old to do a certain thing towards senior citizens calling it negative ageism. Over 77 percent of survey respondents confirmed to have faced negative ageism (Palmore, 2001).

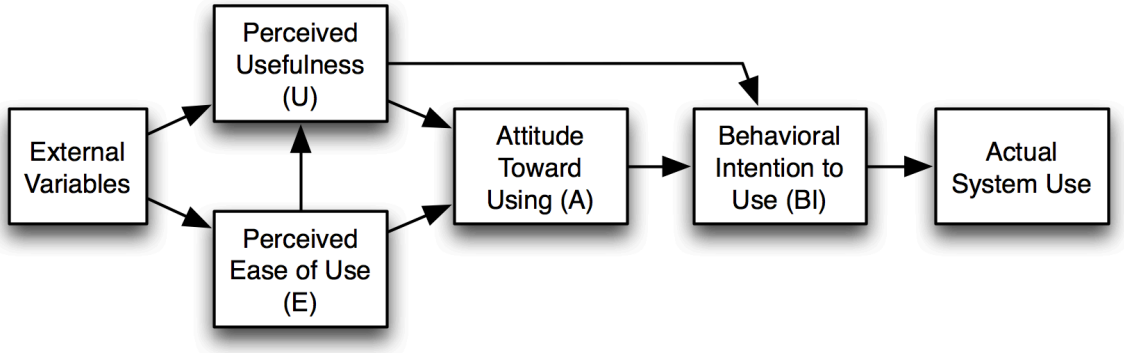
McDonough (2016) found that ageism might also be exacerbating the technology adoption among older adults due to internalised-negative perceptions of old age. Therefore, a new digital divide can pave its way into society due to their reluctance to adopt advanced, complex and convergence-based technologies. The effective features of usability of the technologies and willingness to learn and adopt among such group of population are prerequisites to bridge this gap.

3. Theoretical Framework

The core concept of usability is to make some product more compatible to certain users to fulfil some specified goals effectively and efficiently (Panagiotis, 2002). The theoretical framework of Technology Acceptance Model (TAM) further provides basis for testing of usability of certain product, which in this case is smartphone. Although TAM has been revised by a number of researchers over the time, the original conceptance of this theoretical design is completely aligned to this work.

Davis (1989) argued that users accept new technology or product based on two factors: perceived usefulness and perceived ease of use. He further elaborated:

- **Perceived usefulness:** the extent to which people believe that using a system would be beneficial.
- **Perceived ease of use:** a degree to which people can use a system without any considerable effort.



Technology Acceptance Model (1989)

In this study, the given theoretical framework has been adapted as: "certain features of design and user-interface can positively affect the perceived ease of use of smartphones among elderly citizens, as a result changing their intention to use smartphones".

4. Research Methodology

For this study, the design and user-interface features of the five smartphones marketed as ageing-friendly by the makers have been analysed to draw the empirical inferences. These smartphones include: Jitterbug Smart 2, Moto G5 Plus, ZTE Blade ZMax, Mitashi Play Senior Friend AP103 and The Doro 8035.

These devices have been analysed based on these five features of smartphone design and user-interface:

Design: the dimensional size of the device, screen size, touch area size and nature of device body

Visibility: Font and icon size, screen light and colour correction

Menu & Navigation: Presentation style of menu and nature of navigation between screens and applications

Text-Speech: Ability to provide speech of the text on screen and convert speech into text to ease typography

SOS Feature: Ability to provide emergency message broadcast option, call user's family and reach out a dedicated call-center to get usage guidelines or emergency help

5. Analysis and Findings

The empirical analysis of the design and user-interface features of selected smartphones (Jitterbug Smart 2, Moto G5 Plus, ZTE Blade ZMax, Mitashi Play Senior Friend AP103 and The Doro 8035) was conducted in terms of five criteria (design, visibility, menu and navigation, text-speech and SOS function). The findings were as following:

5.1. Jitterbug Smart 2

The smartphone is being marketed by Great Call and is available globally through online purchase. It is priced around USD 150.

No.	Feature	Description
1	Design	The total size of device is 6x3 inches (dimensional size of 5.5 inches), and a thickness of 0.3 inches. The touch screen covers 100% area of the screen, and there are no physical buttons on the device, except power and volume keys.

2	Visibility	The phone provides large-sized fonts and icons with white-lit background to enhance visibility. Colour correction option to address colour blindness related matters is not available.
3	Menu & Navigation	Menu has been designed for two-way scrolling only (upwards and downwards). The menu items appear with their icons as well as name in the textual form to ensure easiness of use and increased area on the touch screen to select the item. The opened applications can be inter-switched.
4	Text-Speech	Text-speech feature is available in the phone. The users can hear what is on their screens whenever they want and they can also type text in the device by simply talking to their phones.

5	SOS Feature	The device comes with 5-Star Button for immediate access to emergency help in any situation. Emergency contact numbers can also be added to the device. The customers based in the United States can also access to tech support and customer service through a 24/7 call-center.

5.2. Moto G5 Plus

This smartphone has been made available globally through online purchase by Motorola. It is priced at USD 140.

No.	**Feature**	**Description**
1	Design	The total size of device is 5.91x2.91 inches (dimensional size of 5.2 inches), and it has a thickness of 0.3 inches. The touch screen covers 100% area of the screen and there are no physical buttons on the device, except power and volume keys. The device has full-metal body.

2	Visibility	The phone provides white-lit background screen light and has medium sized icons and text. The size can be further increased through accessibility option in settings. The size also increases by 3 times by simply tapping the screen three times quickly. Colour correction is not available.
3	Menu & Navigation	Menu is designed in two modes: upward and downward scrolling only, and four-way scrolling. The menu items appear with their icons as well as name in the textual form. In upward-downward only scrolling mode, the device provides an increased area on the touch screen to select the item. The opened applications can be inter-switched.
4	Text-Speech	The phone comes with text-speech feature through users can hear what is being displayed on the screen whenever they want, and they can also type text by simply talking to the phone.
5	SOS Feature	The device provides an option to enter emergency contact numbers. There's no specialised emergency button or technical guidance through any call-center.

5.3. ZTE Blade ZMax

The device is available globally through online purchase and has been marketed by Metro PCS. It is priced at USD 130.

No.	Feature	Description
1	Design	The total size of the device is 6.4x3.3 inches (dimensional size of 6 inches), and a thickness of 0.33 inches. The touch screen covers 100% area of the screen and there are no physical buttons on the device, except power and volume keys.
2	Visibility	The phone provides medium-sized fonts and icons with white-lit background to enhance visibility. The size of the icons and text can be increased from accessibility option from settings. Colour correction feature is not available.
3	Menu & Navigation	Menu has four-way as well as upwards-downwards only scrolling features. The menu items appear with their icons as well as name in the textual form. The applications under use can be inter-switched.

4	Text-Speech	Text-speech feature is available in the phone. The users can hear what is shown/displayed on their screens whenever they want and they can also type text in the device by simply talking to their phones.
5	SOS Feature	The device comes with SOS emergency contact option and has no technical guide support through call-center facility.

5.4 Mitashi Play Senior Friend AP103

It is mainly available in India and has been marketed by Mitashi at the price of around USD 50.

No.	**Feature**	**Description**
1	Design	The total size of the device is 4.84x2.85 inches (dimensional size of 4 inches). The touchscreen covers 100% area of the screen and there are no physical buttons on the device, except power and volume keys.
2	Visibility	The phone provides large sized fonts and icons with white-lit background to enhance visibility. Colour correction feature is not available.

3	Menu and Navigation	Menu consists of large icons on multiple screens which can explored by right-left scrolling. The menu items appear with their icons as well as name in the textual form.
4	Text-Speech	Text-speech feature is available at a very limited level.
5	SOS Feature	The device comes with a special SOS emergency button and emergency contact option. The device has no technical guide support through call-center facility.

5.5. The Doro 8035

The ageing-friendly smartphone device was launched by Doro at the price of USD 220. It is available worldwide.

No.	Feature	Description
1	Design	The total size of the device is 5.85x2.75 inches (dimensional size of 5 inches), and a thickness of 0.33 inches. There are no physical buttons on the device, except power and volume keys.

2	Visibility	The phone provides large sized fonts and icons with white-lit background to enhance visibility. Colour correction feature is not available.
3	Menu and Navigation	Menu has two options for navigation. The simple navigation only primary features displayed on the screen and the advanced mode enables users to navigate through 4-way scrolling.
4	Text-Speech	The device comes with hearing impairment device compatibility. The phone can be instructed to perform functions through. The text on the screen can be converted into speech and speech-typing is also enabled.
5	SOS Feature	The device comes with SOS emergency contact option, built-in TeamViewer software, which enables users to get technical support from friends or family members remotely. The phone also provides technical guide support through call-center facility.

6. Discussion

The analysis of the selected smartphones that have been marketed as ageing friendly or devices appropriate for the elderly citizens showed that almost all of these phones carry large

display and their body structure is also made of metal. This is exactly in alignment with the findings presented by Fisk et al (2009) that seniors happen to face issues related to vision, hearing, cognitive thinking and movements based on motor neurons. Hence, addressing ageing is actually tackling a number of disabilities at the same time. This is why the devices being marketed as suitable for them have a large display so that they can get enough space to show large sized text fonts and icons. Due to the assumption that motor neurons of the aged people are not so efficient and it can cause trembling at times, the metallic structure has been chosen to provide a sense of increased protection to the device.

In terms of other features of user-interface large icons and text fonts have been placed to address the certain of visual inefficacy of the elders. To resolve the matter regarding limited technology literacy among them, the makers have chosen a more simplified navigation method, menu and inter-application switching so that these users don't have to struggle with the complexity of the operations of the smartphone. Additionally, the Doro 8035 even provides built-in TeamViewer software, so that elders can get immediate technical assistance from their friends of family in case of trouble with operation of the smartphone. The dedicated call-center services provision is also available to handle technical as well as emergency situations.

For hearing-related problems as well, all of the ageing-friendly phones analysed here were found to be having text-speech features which enable the user to interact with the device by giving commands through talk. On the other hand, this feature also lets them hear whatever is on the phone's screen to avoid trouble of reading. Furthermore, some smartphones even provide compatibility with the medical/technical gadgets used by the hearing-impaired seniors. Only one of the analysed smartphones did not have an advanced text-speech feature.

Apart from addressing the inabilities of elderly citizens and enabling to use smartphones to bridge the digital divide in the society through exclusive smartphone designing, it must also be kept in view that this exclusive designing doesn't lead to a sense of ageism, or in other words discrimination towards elders, in the society as argued by Palmore (1999). For this, the designers and developers need to keep the concept of universal or inclusive design in their minds while designing the under-interface of smartphones: focusing on enhancing usability among all segments of the potential users. The development of applications and software products related to common

use should also be undertaken as per the concept of universal design, so that the technology adoption can be increased in the society as an overall.

7. Conclusion

In a society that is ageing at a great speed, the potential users of smartphones have a variety of needs and requirements in the light of their abilities and disabilities. The devices exclusively designed for the elderly citizens do carry certain features of design and user-interface to enhance adoption among this group of population to resolve the issue of growing digital divide among the generations. However, it is assessed that if these ageing-friendly features are incorporated in the commonly used smartphones (widely used by the members of all age groups) as well as the application and software development is undertaken according to the concept of inclusive design the sense of usability and adoption of smartphone technologies might be improved in all segments of society including the seniors leading towards their independent living.

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