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Challenges Encountered by Older Adults while Navigating Mobile Device User Interfaces

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Abstract: Though mobile technology is one of the fastest growing technologies, usability challenges are still noted. Users mostly find difficulties and are weighed down using the technical devices and need to keep up with the sophisticated technology. The restricted screen space leads to a lot of information being hidden from sight and only little information to be displayed on the screen at a time. Navigation places high demands on working memory in order to remember the correct buttons to press to reach the wanted functionality. This increases memory load since users have to memorize the location of the application within the interface. Users may not understand the organization of the applications/services within the device interfaces; this makes it difficult to build a mental representation of the space they are navigating because users often do not know where they are, where they came from, or where they have to go next. The study sought to identify the challenges encountered by older adults while navigating mobile device interfaces. A survey of elderly people in Nairobi - Kenya was conducted and it was realized that 55.6% of older adults experienced age related limitations that included decline in vision ability, poor memory and limited hand movements. It was further found out that older adults face challenges with the miniaturization of mobile devices.

Key words: mobile devices, phone navigation, mobile device user interface, elderly, Nairobi - Kenya

1. Introduction

Though mobile technology is one of the fastest growing technologies, usability challenges are still noted. Users mostly find difficulties and are weighed down using the technical devices and need to keep up with the sophisticated technology. The restricted screen space leads to a lot of information being hidden from sight and only little information is displayed on the screen at a time. Navigation places high demands on working memory in order to remember the correct buttons to press to reach the wanted functionality. This increases memory load since users have to memorize the location of the application within the interface. Users may not understand the features and the organization of the applications/services within the device interface. This makes it difficult for users to build a mental representation of the space they are navigating because users often do not know where they are, where they came from, or where they have to go next.

As mobile devices development advances there seems to be a striving for even smaller phones and at the same time increased functionality which as a result provides interfaces with numerous iconified applications of mobile services to the users. It is not easy to present the entire list of services on the small screen of a phone because they usually outnumber the lines on the screen. Therefore, some applications are hidden, and the users

must navigate through a series of screens to find a service. This demands users to memorize the function names and their relative location within the device [1], when people grow older, cumulative effects of several diminishing capacities will most likely result into a situation the elderly person cannot meet the imposed cognitive demands presented by an environment that has been designed for the young. The diminishing capacities (i.e. cognitive process, motor functions and spatial abilities) are all important factors in usability [2].

Some mobile handsets are further limited by their capacity to receive user input as compared to PCs. The keyboard and mouse functionality are notably absent and the mobile phone numeric keypad makes it extremely difficult for user to input large quantity of information [3]. From a mobile Internet viewpoint, these devices restrict input features to simple scroll and select keys that allow the user to scroll through menu lists and perform simple selections.

Elderly people are considered as non-technological, but they accept technology as long as it helps their needs; however they always keep some distance and never totally accept it in the same way as young people do [4]. Elderly people have reported fear of damaging current technical products in case of misuse [5]. This prevents them from exploring technical products by trialing which is mostly done by other users. A clear direct link between action and result may help them to operate the mobile phone. The bottom-line is to help users to locate information and services more effectively on the mobile devices with attempt to improve the efficiency of mobile features navigation.

2. Objective and Research Question

The objective for this study was:

- To investigate the kind of navigational challenges faced by elderly users with declining cognitive abilities when accessing mobile devices applications.

The research question for this study was:

- What kind of navigational challenges are experienced by elderly users with declining cognitive abilities when accessing mobile devices applications?

3. Development of Mobile Devices

The development of the mobile devices today is advancing rapidly and now at peak is the evolution of smart phones; the striving portable, easy to access anywhere and increased functions gadget. This is apparently the consumers' desire. However, a decrease in size and an increase in functionality lead to an increase in complexity of the device. This is a problem, not only for persons who lack an interest for or are unaccustomed to technology, but also for persons who have decline in cognitive load because a lot of memory work load is required in order to be able to navigate through the different functions of such a device. Navigation calls for explorations for experts and assistance to novice users; the elderly are considered to be non technological and are reported to as having fears of damaging the device in case of misuse during trial [6]; this calls for examination of the challenges faced by the elderly while navigating mobile device interfaces.

Assistive technology can assist older people with cognitive impairment in one or more of the following ways: (1) by providing assurance that the elder is safe and is performing necessary daily activities, and, if not, alerting a caregiver; (2) by helping the elder compensate for her impairment, assisting in the performance of daily activities; and (3) by assessing the elder's cognitive status. Studies have found out that the elderly people are faced with difficulties in understanding the structure of the mobile devices and therefore experience difficulties in navigation.

4. Methodology

The study adopted a qualitative research approach. A random sample of older adults, those above the age of 45 years, in Nairobi was selected based on probability. Existing documentation about the subject, interviews, and direct observation were used to gain an understanding of the phenomena [7]. A questionnaire was distributed to the sampled participants to collect data pertaining to the research questions.

5. Results and Discussions

5.1 Age related limitations

The age related limitations that were found are as indicated in Table 1. More than 50% of the respondents indicated that the experienced age related limitations while navigating mobile device interfaces.

Table 1: Age related limitations

	Percent	**Valid Percent**
Yes	55.6	55.6
No	44.4	44.4

The regression graph(s) for the age related limitations is as indicated in Figure 1. The limitations are observed with the onset of older age and become more pronounced with the passing of time.

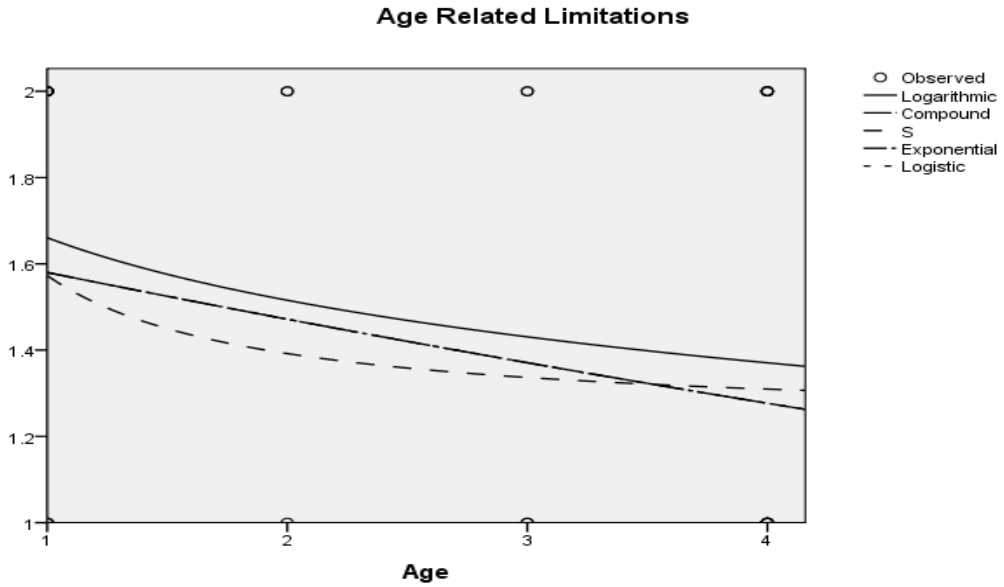

Figure 1: Age related limitation

5.2 Kind of Age Related Limitations

The kind of age related limitations that were experienced among the older adults are as shown in Table 2.

Table 2: Kind of Age Limitations

	%	Valid %	Cumulative %
Decline in vision ability	29.6	29.6	29.6
Poor memory	14.8	14.8	44.4
Poor memory and decline in vision ability	7.4	7.4	96.3
Poor memory, limited hand movement and decline in vision ability	3.7	3.7	100.0

The majority of the respondents, at 29.6%, indicated that they experienced decline in vision ability. 14.8% of them experienced poor memory while 11.1% experienced a combination of several age related limitations. Users' age has been shown in many studies to affect navigation performance [8] [1]. The elderly performance has been found to be consistently lower, compared to that of younger adults, when maneuvering through the technology devices. Elderly experience greater difficulties during navigation, spent more time on accomplishing complex task, and they wander off within the menu than did younger users. Their lower performance can be associated to the general age-related decrease of sensory, motor, and cognitive functioning [9].

High influence on performance outcomes has been propagated by users' spatial ability. In previous studies, users with high spatial abilities demonstrated considerably higher effectiveness and efficiency when using different technical devices compared to users with low spatial abilities [10][11][12][13][14]. Memory and spatial abilities have been found to decrease over the life span[15] [16], this may be credited to be the cause of reduced performance in older users.

5.3 Aging cognitive decline

Cognitive psychologists have established that as the brain ages, certain types of cognitive capacities do indeed decline. They include:

- *Working memory:* working memory is the capacity of the mind at any given moment to manipulate different types of information/perform complex tasks. The age-related decline in working memory affects the use and integration of new information with previous information [17]. Excluding irrelevant information or materials from the interface design is one way to reduce the burden on working memory.
- *Speed of processing:* Burke and Mackay mention that the formation of new memory connections is impaired with age. Older adults take longer to recall information and complete tasks. Numerous studies have found that older adults, generally defined as mid-60s or older, are slower at processing information.
- *Cognitive flexibility:* the ability to change decisions when given additional information that might otherwise alter your opinion. Older adults are less able to engage in "divergent thinking," which is the ability to generate alternative explanations or solutions to a problem.
- *Ability to focus*: Increased age often means increased difficulty in focusing on specific information and eliminating distractions. Some researchers theorize that it is this inability to rule out irrelevant details that clutters the working memory, described above, and lessens one's capacity to process information.

Processing speed is related and varies with age where by advancement in age contributes to slower responses and longer reaction times.

The processing speed decline could as well be explained by other age-related cognitive differences including attention and working memory. In computer-related tasks, processing

speed affected older adults in finding information, keeping track of where information is, and sorting out relevant information.

When conducting tasks, different levels of attention are required for allocation and directing of cognitive resource. Age-related differences in performing cognitive tasks increase during dual task conditions[18]. The increased memory demands in attention leads to older adults performing slowly when switching between different tasks.

The increase of cognitive demands contributes to the age-related decline of working memory. It becomes more difficult for older adults performing an on-going task demanding integrating old and new information and processing simultaneously. Older adults weaken in attention, working memory, and this inhibition mechanism, and, therefore, amount of task-irrelevant information increases in working memory. Spatial abilities are cognitive functions that enable people to apprehend relations and orientation of objects in space.

Mobile devices are acquired by a widespread population of users who will probably not receive any formal training in operating them[19]. Furthermore, device vendors consolidate multiple functions into a single device and the mobile user has to handle interleaving of multiple activities previously unknown when only a landline or a stationary computer was used. Social isolation and diminished access to productive (predominantly younger) mobile phone users together with the mental effects of aging justify the need to assist older adults in mobile devices navigation.

5.4 Navigational Challenges

The navigational challenges are as indicated in Table 3. At 22.2%, the majority of the older adults experienced a combination of challenges while navigating mobile device interfaces that included small screen sizes, small font sizes and difficulties in using the touch screens. Some had challenges in locating essential features and applications in addition to the screen sizes being too small to output all the necessary and required information at once.

Table 3: *Challenges faced while navigating mobile device screens*

Challenges faced while navigating mobile device screens			
	%	Valid %	Cum. %
Small font size	14.8	14.8	14.8
Difficult in using the touch screen	11.1	11.1	25.9
Small font sizes and difficult in locating essential features and applications	11.1	11.1	37.0
Small screen sizes, small font sizes and difficult in using the touch screen	22.2	22.2	59.3
Small font sizes, difficulties in matching images and their functions, arrangement of applications on mobile device interface, difficulties in using the touch screen	3.7	3.7	63.0
Small font sizes, limited input features, difficulties in matching images and their functions, difficulties in locating essential features and applications, arrangement of applications on mobile device interface, difficulties in using the touch screen	3.7	3.7	66.7
Small screen sizes, limited input features, difficulties in locating essential features and applications	3.7	3.7	70.4
Limited input features, difficulties in matching images and their functions, difficulties in locating essential features and applications, difficulties in using the touch screen	3.7	3.7	74.1

Small font sizes, limited output features, difficulties in locating essential features and applications	3.7	3.7	77.8
Small font sizes, difficulties in using the touch screen	3.7	3.7	81.5
Limited output features, difficulties in using the touch screen	3.7	3.7	85.2
Small screen sizes, small font sizes	3.7	3.7	88.9
Small screen sizes, limited output features	3.7	3.7	92.6

The length of using a mobile device determines the kind of navigational challenges experienced. The regression graph(s) in Figure 2 shows that older adults experience more challenges while navigating mobile device interfaces.

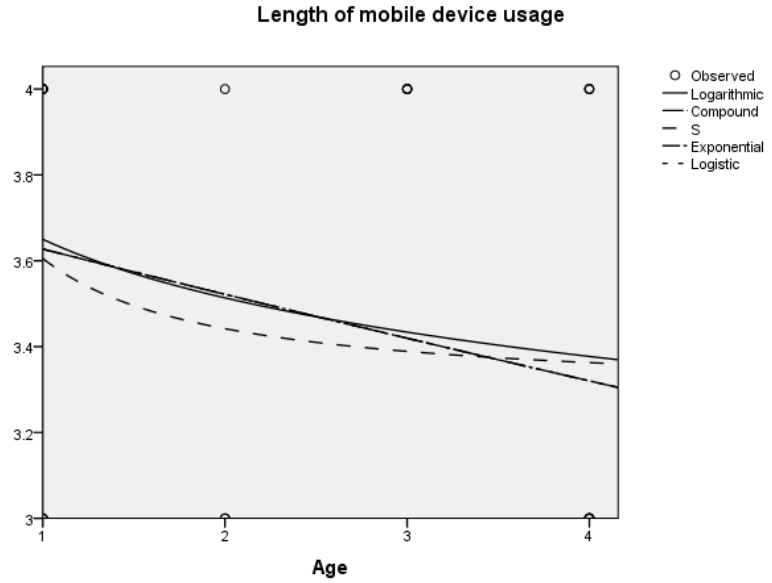

Figure 2: *Length of mobile device usage*

Fewer navigational challenges are experienced at the onset of older age and those challenges become more pronounced with the advancement of age as depicted in Figure 3. The results of the kind of challenges faced show that 22.2% of older adults experience a combination of navigational challenges; this is depicted in Figure 4.

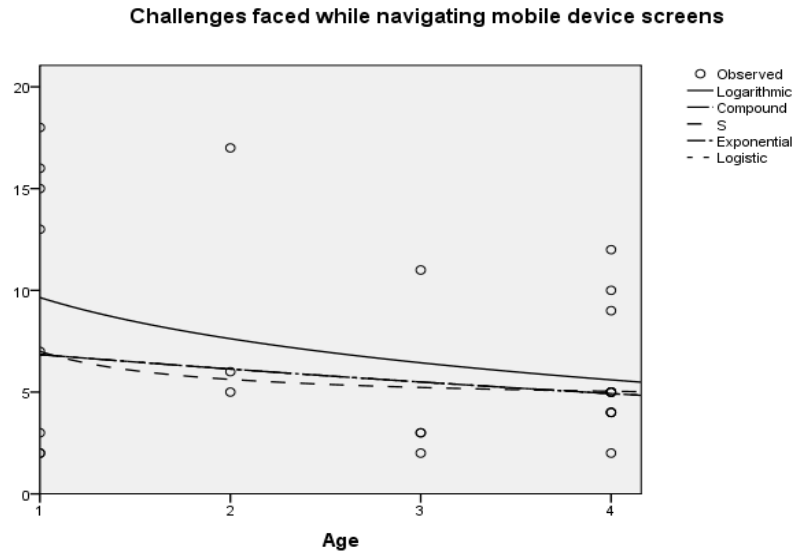

Figure 3: *Challenges faced while navigating mobile device screens*

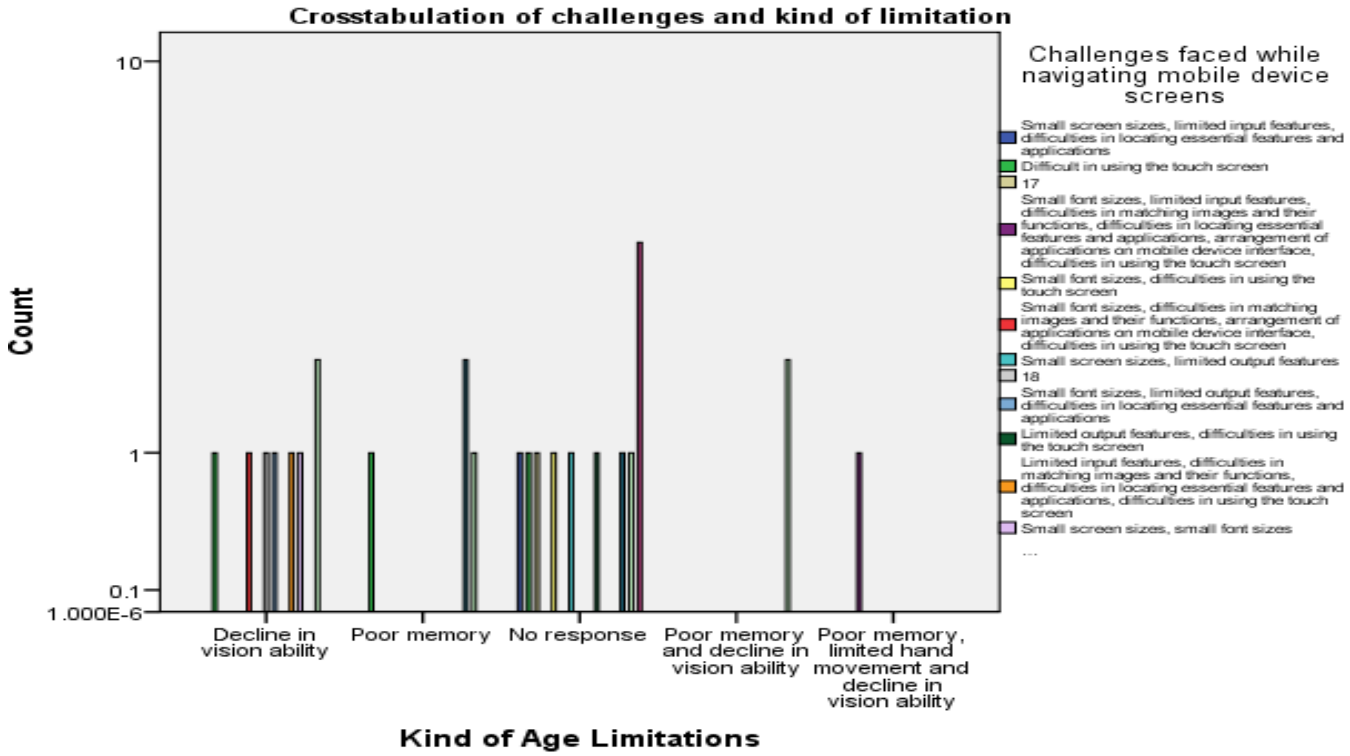

Figure 4: *Challenges and kind of limitations*

Mobile devices design provides interfaces with pool of icons representing the applications/services to be used by the users. Presenting all the applications on the small screen of the device is not easy because they usually outnumber the lines on the screen. Therefore, the icons become crowded, and the users must navigate through a series of screens to find a service. This process calls for the users to recall information across the screens during the navigation leading to increased memory load [20]. Three causes of usability problems during mobile navigation include: (a) discrete selection action in the form of button presses instead of direct and constant selection by mouse or touch screen, (b) a small screen that can display only a limited number of items at a time, and (c) lack of standards in hardware supporting the navigation, such as button layout and function. To minimize the navigation problems caused by these factors, the user interface of a mobile device should be simple, be well organized, and conform to the users' mental models and expectations [20].

6. Prototype

To address the challenges found out, there is need to adopt assistive technology (AT) to help individuals with declining capabilities perform functions that might otherwise be difficult or impossible. Assistive technology can include mobility devices such as walkers and wheelchairs, as well as hardware, software, and peripherals that assist people with disabilities in accessing computers or other information technologies. Assistive technology can assist older people with cognitive impairment [21] in a number of ways that include:

i. Providing assurance that the elder is safe and is performing necessary daily activities, and, if not, alerting a caregiver; i.e. assurance systems aim primarily at ensuring safety and well-being and at reducing caregiver burden, by tracking an elder's behavior and providing up-to-date status reports to a caregiver.

ii. Helping the elder compensate for her impairment, assisting in the performance of daily activities; i.e. Compensation systems provide guidance to people as they carry out their daily activities, reminding them of what they need to do and how to do it.

iii. Assessing the elder's cognitive status; i.e. Assessment systems attempt to infer how well a person is doing what her current cognitive level of functioning is based on continual observation of her performance of routine activities.

This study considered a compensation systems as the assistive technology; assisting the elderly users in navigating mobile devices user interface applications using a predictive algorithm to capture/monitor tasks performed, store data on common tasks, track frequency of access to each task, prioritize task depending on frequency and also randomly suggest to the user the less frequently accessed services. The goal was to provide an adaptive user interface that does not demand the user to remember the process of accessing particular tasks thus resulting to ease of navigation, especially to persons with declining cognitive abilities. The prototype was based on a user defined predictive algorithm to simplify the mobile device user interfaces. Figure 5 shows a graphical representation of the simplification process.

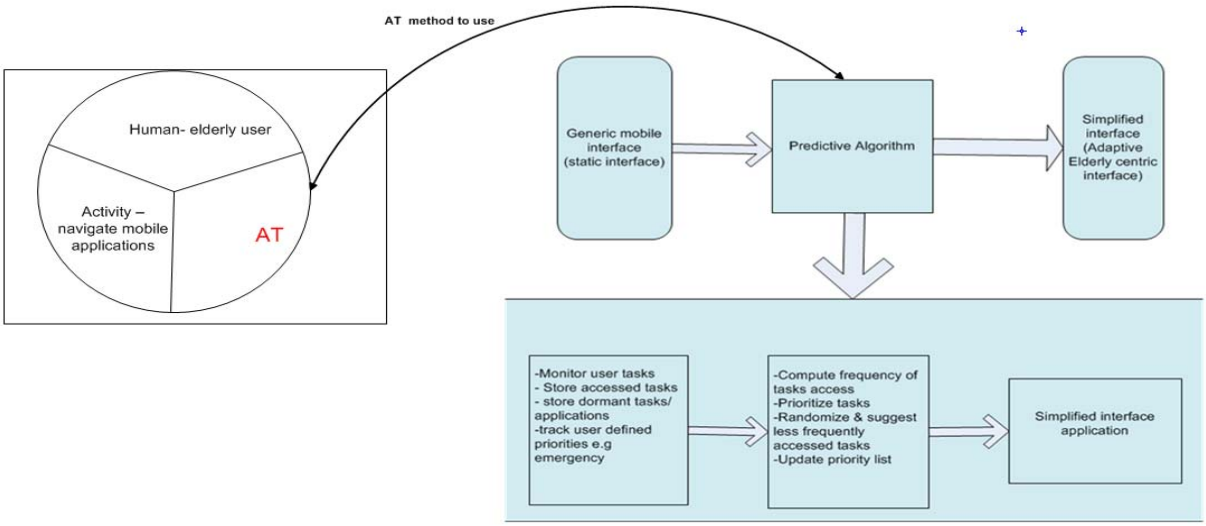

Figure 5: *Prototype for simplified mobile device user interface*

7. Industrial, Economic and Societal Significance

Besides the elderly, people with poor eyesight and declining memory load, for example, stand a big chance of benefiting from the assistive technology, since the world is busy going digital and useful information is being availed to people in mobile devices that are miniaturized. Mobile phone application companies and developers require the theoretical inspirations and the research findings in this paper to align mobile devices to inform their design philosophies for mobile device user interfaces for different target groups and markets.

8. Conclusions and Recommendations

Usability challenges are still noted in mobile technology usage. In this paper research finding, elderly users do indeed face various challenges when navigating mobile device user interfaces. Again the findings bring to attention that, a big percentage (55.6%) of older adults experience age related limitations that include decline in vision ability, poor memory and limited hand movements. Some mobile devices have restricted screen space leading to a lot of information being hidden from sight and only little information is displayed on the screen at a time. Navigation places high demands on working memory in order to remember the correct buttons to press to reach the wanted functionality, especially for older adults. This increases memory load since users have to memorize the location of the applications within the interface. Users may not understand the features and the organization of the applications/services within the device interface. This makes it difficult

for users to build a mental representation of the space they are navigating because users often do not know where they are, where they came from, or where they have to go next.

It is recommended that age related limitations and challenges be taken into consideration while designing mobile device interfaces for older adults, and there is need to classify those challenges. Furthermore, assistive technologies, in particular compensations systems, should be used to address the challenges the elderly and people with declining cognitive abilities face while navigating mobile device user interfaces. From the findings, there is a need for the industry to re-focus the design philosophies for mobile device user interfaces to cater for different markets. There are also great opportunities for collaborative research between mobile application firms, application developers and cognitive psychologists; this will help in informing mobile application developers and companies on the design philosophies for user interfaces to avoid blocking out people with limitations from using technology.

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