Context and Capability: The Future of Small Screen Research and Development in Africa

Olalekan Samuel Ogunleye

Meraka Institute, Council for Scientific and Industrial Research (CSIR)
P.O Box 395 Pretoria, 0001, South Africa
+27 (0) 12 841 2676
e-mail: oogunleye@csir.co.za, web page: http://www.meraka.org

Abstract: *This paper, present four research directions that point toward increasing the importance of mobile research and development in the Africa's developing countries and countries where people use devices more than desktop computers. These directions however point to a future in which the gap between the user and the desktop is even wider than today. The proliferation of mobile technology is increasing everyday with millions of people getting access to them. And even further in the society and computer use is more intermittent in a greater variety of contexts than the current user models accommodate. The implications of these are that mobile devices (i.e. Mobile phones) should be made more available and accessible to every category of people and they must be designed for situational impairments and incurred from on-the-go use. They must also adopt flexible and rapid input mechanism as well as the models that describe them must be revamped to accommodate mobile use and behaviour. There are also opportunities for using mobile devices in education, health care, governance, and in Africa's developing nations where mobile devices are more common than desktop PCs.*

Keywords: Mobile devices, development, research, application, handheld.

1. Introduction

The adoption of mobile technologies in Africa in the last decade has seen a surge in the off-desktop applications. Such technologies include PDAs, handheld communicators, pocket music players, two-way pagers digital Cameras, small watches, GPS units, medical and factory devices, and mobile phones. There also exist several hybrid devices that combine two or more of these devices into a single unit. Along with the introduction of these devices has come a outbreak of research topics on handheld web browsing (Lam & Baudisch, 2006; Jones, Marsden, Mohd-Nasir & Boone, 1999), interfaces that extend from devices to desktops (Myers, 2001), mobile input devices (MacKenzie & Sourkoreff, 2002), adaptive mobile interface (Nichols, Myers & Rothrock, 2006), sensing devices (Hinckley, Pierce, Sinclair & Horvitz, 2000) and lots of new mobile applications (Karlson, Bederson & SanGiovanni, 2005). However, large research in the mobile world has focused mainly on the devices themselves: how to design faster input mechanism (MacKenzie & Sourkoreff, 2002), how to make devices smarter (Baudisch & Lam, 2005), how to create more reliable communications (Nichols et al, 2006), how to accommodate small screens (Jacobs et al, 2006), etc. At this stage in the mobile research world, we have come to the point where we can no longer afford to think about mobile devices in isolation. Rather the larger social use of mobile devices and the contextual factors that surround its usage must be put into consideration. Like in the last decades when desktop based applications research goes beyond the GUI, we must also take mobile development research beyond the devices.

Four important research directions in society and technologies that have direct and immediate impact on mobile developments have been identified. These are:

- ✓ Improving the level of mobile device accessibility.
- ✓ Increase in the amount of personal mobile computing.
- ✓ Increasing the capabilities of small screen devices, and most importantly
- ✓ The convergence of computing capabilities onto small mobile devices (i.e. Mobile phones).

Combining all of these together, means that mobile development research should be considered as context and capability.

In the sections that follow, I discussed these directions and how they impact positively in the mobile development research by providing examples of projects that can be done in each area. However, I discuss my own research focus in related areas and finally draw some conclusions.

2. Research Directions

2.1 Direction #1: Improving the level of mobile device accessibility

The current population of the world is approximately 6.7 billion people. By 2050, this number is expected to swell to 9.5 billion. By percentage, Africa as a continent has 14.95% of the total population (GeoHive 2009; Population reference Bureau, 2005). This is an increase of nearly 52% in only 41years. Of the current population of Africa, 28% are aged 65 or over, and this number is projected to increase to 26% by just 2030 (Kinsela & Phillips, 2005). This means that the elderly are fast becoming a crucial demographic factor and one for whom current mobile interface may not be suitable. In essence the rapid aging of the population has many implications for mobile devices' accessibility, which means that as people grow older, they incur various impairments including loss of visual acuity, pain in their finger, wrist, or other joints as well as strength. Also, most of these apply to people with one disability or the other. Although numerous efforts have been made in order to make desktop more accessible but the fact is that little or no efforts have been made to improve mobile device accessibility. (Topical exceptions to this are Blair, 2005 and Wobbrock, Myers & Kembel 2003).

However, the main challenge is that the approaches that have been taken traditionally to improve desktop accessibility are not likely to work on mobile devices. This is majorly due to the fact that the interaction with a desktop PC is mediated by the mouse and keyboard while none of these exist on a mobile device – although there exist the QWERTY keyboard but it was too small to accommodate users' fingers. Therefore, since mobile device interaction is with the fingers or pen, the idea of emulating input devices with accessible hardware or software like mouse or keyboard may not be easily applied to work on mobile devices. This is an indication that new approaches to providing accessibility on mobile devices are required.

A suggested aspect of research in this area is that the design of mobile devices should be improved, not only for those with physical impairment but for everyone (Steinfeld, 1994). This is more important because all users have different types of impairment when using mobile devices on-the-go.

2.2 Direction #2: Increase in the amount of personal mobile computing

The proliferation of mobile devices made it to infuse people's lives and due to this, there exist greater opportunities for interactions with computers while being absent from the desktop computers. An example of this is in Africa where mobile devices are seen as people's desktop computers. However, the context of these usages are far more varied and compromised than the context in which people interact with the desktop computers. For example, consider a user using mobile devices while walking in the sun in Durban, South Africa may find it difficult to read the device's screen due to the glare that may be caused by a bright sunlight, while a user with gloves in his/her hand may not be able to press the keys accurately. This however is a situational-induced impairment (Sears & Young, 2003) and (Sears, Lin, Jacko & Xiao, 2003). Although this has been mentioned in the literatures, the fact remains that no studies have been carried out in the mobile world to find out how users are affected when they are using mobile devices.

A suggested aspect of research in this direction is that it should be feasible to design devices and interfaces that can automatically adjust themselves to better accommodate situational impairments. This is in line with the work of Hinckley et al, 2000. For example if a devices is aware of low, light level, cold temperature and a user that is wearing a glove, then the device should be able to adjust its contrast, enlarge its font and soft buttons so as to make use of stylus unnecessary, also, it should be able to adjust its speaker volume in the event that a noise is detected at anytime. This will form an indication that understanding of situational impairments will provide opportunities for improved accessibility and adaptive user interfaces.

2.3 Direction #3: Increasing the computational power of mobile devices

There are many news devices in the market with millions of people acquiring and getting access to them every day. However, it can be frustrating to learn new ways of operating the devices such as new input technique when encountering new devices. For example the Graffiti on the palm PDA which later became Graffiti2, the jot on the pocket PC and the glenayre Access Link II on the two way pager (www.glenayre.com), which uses four arrows

for directions and a SELECT keys. However, IPod and iPhone now offer a scroll ring but with no text input, a feature that is wished for or required by many users who may have thousands of files (Such as mp3) and would like to search through or move down the long list as quickly as possible. Mobile phones offers different methods for text input, most commonly multitap and T9. However, users are usually familiar with the former and also find it difficult initially to use the latter.
Nowadays, non-computerised devices are being equipped with computing capabilities, mainly of which needs at least minimal input capabilities. Examples of these are wrist watches which were usually mechanical devices but now have the full fledge capabilities of PDA, like the fossil wrist watch PDA (www.fossil.com). However, few users want to learn new input techniques for every new device they acquire. This is even the case with new desktop applications. Therefore, there is need for input techniques capable of being used on multiple devices as well as different forms of input or sensing mechanisms. This should however be consistent in the conceptual model presented to the users. This means that people can learn once and write anywhere and that more powerful techniques would have to be designed for users to utilize on any device they acquire.

2.4 Direction #4: Education, Health, Government and Finance on mobile phones: Africa as a Case Study

The dominating mobile platform in the mobile world is the mobile phones. And Africa is now the world's fastest growing market for mobile phones (BBC, 2004). There are more people in Africa using mobile phones than using conventional fixed landline telephones. This is an indication that mobile phones are more common than desktop PCs in Africa.
However, the growth of mobile phone usage in the industrialized and developing nations has not been fully exploited by mobile development researchers. Mobile phone still encounters unreadable fonts, confusing user interface, bad input techniques, low resolutions etc.
Besides improvements on these problems, however, is the opportunity for mobile development researchers to rethink computing on a new platform apart from the desktop.
A site for which this rethink may be exploited is Africa. The adoption of mobile phones in Africa provides opportunities for computerized education (MobiLED), computerized Health (MHealth), computerized government (MGov) and computerized finance (MFin) (Brown, 2005). Typical research questions that may be asked in these regards are: how can we use mobile phones to support education in the classrooms, whose students have not been exposed to desktop computers but have mobile phones in their pockets? What kind of phone based application could be developed to help learners with maths, science, writing or reading etc.? How can we use mobile phones to help patients in taking their drugs regularly and how can medical practitioners benefit from using mobile phones in delivering medical health and information, especially in the rural areas. Medical practitioners should be able to use their mobile phones to store and retrieve histories of patients without the need to have bulky and power consuming laptops. How the government can brings the dividends of democracy to the citizens through the use of mobile phones? How can applications such as mobile voting, crowdsourcing crisis information be developed for mobile phones? How can we use mobile phones as a tool for financial transactions by developing applications such as swapping airtime for goods and service especially in the rural areas? This can actually encourage mobile network operators and financial services institutions to work together to address how users can transfers credits into cash.

However, the social, economic educational, medical, governmental and financial issues needs to be understood before applications can be developed or user interfaces designed. This is considered as huge tasks but the benefits to Africans cannot be over-estimated.

3. My Own Contribution to Mobile Development and Research

I have worked on different projects that are relevant to the issues I have raised in this paper. First, I have worked on the development environment to support mobile application developers in creating rich content applications for mobile devices. This technique was demonstrated in a prototype called **MobiNets** which featured techniques such as using Cascading Style Sheets (CSS) to design application interface that appeal to users for mobile devices.

My works have focussed on the use of mobile devices (PDAs, mobile phones etc) for activities such as learning, medical, financial and governmental through the development of applications such as Igloo, which is part of the MobiLED platform. Igloo aims to support educator with a mobile application that can be used to facilitate and support pedagogic practices in formal and informal learning scenarios and also providing educators with a tool they would be able to use for data gathering using mobile technology.
I am also researching on m-Health, a tool which was aim at supporting users by prescribing drugs and solution to patients who are down with little sickness such as pain, cold, flu etc. I have also focussed on how government and political leaders can use mobile phones to deliver the dividends of democracy to citizens. This technique was demonstrated in a crisis crowdsourcing short message service.
My most recent work focuses on new ways in which mobile phones can be used as tools to promote distance learning.

5. Conclusions

Significant research directions are in progress concerning the proliferation and how mobile devices are being used. Although, the desktop computer will still be with users for many years to come, however, mobile devices, particularly mobile phones have proven to represent the even larger portion of research in the future. New research opportunities exist for improving mobile device accessibility as well as understanding sensing and being able to respond to situational impairments by finding a way to invent new input techniques that can be used across multiple devices. Above all, deploying new applications for education, health, and finance sector and also applications that can be used by government in the developing countries to bring the dividends of democracy to its citizens. All these exciting efforts await researchers skilled in mobile developments and also in meeting the needs of the real users.

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