Chapter 10
Context-Aware Mobile Interface Design for M-government

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1 Introduction

The 2010 United Nations E-Government Survey revealed that citizens are benefiting from enhancements to e-government services and advanced e-service delivery within their countries, allowing them to have better access to information and more effective interactions with their governments (United Nations 2010). As a result of the increasing use of information and communication technologies (ICT) general public or state institutions who are reducing their personal contact with citizens published a tremendous amount of information online. Many national governments went beyond basic websites providing national portals that serve as a major starting point for users to access government e-services in different ministries or government offices (United Nations 2010).

Most well-developed e-governments are now offering many advanced e-services to citizens related to (OECD/International Telecommunication Union 2011):

- General information (e.g., weather, tourism, public safety, contact information, regulations)
- Specific information (e.g., events, news, road closures, schedules, schedules, fee changes, account information, traffic, transportation schedules)
- Emergency and safety alerts (e.g., storms, tornados, terrorism, accidents)
- Notifications (e.g., traffic violations, registrations and renewals, deadlines, security notifications)
- Health services (e.g., fill-in forms, outbreaks, promotions and drives, prevention)
- Education services (e.g., admissions, exam results)

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Table 10.1 Mobile services evolution in key performance metrics (2008–2018)

Key performance metrics	1998	2008	2018 (Estimated)
Mobile penetration–global	5 %	55 %	96 %
High GDP per capita nations/ Total mobile subscriber base	75 %	24 %	15 %
Mobile data services revenues	4 %	19 %	40 %
Networks	1G & 2G	2.5G & 3G	5G & 6G
3G + Penetration	0 %	18 %	90 %
Network speeds	<50 kbps	Up to 2 Mbps	Up to 1 Gbps
Devices ASP	USD 200	USD 130	<USD 20
Smartphone penetration	<1 %	10 %	40 %
Average battery life	2 h	2.5 h	24 h

Source: OECD/ITU (2011)

- Security services (e.g., crime reporting, service requests, law enforcement, assistance requests)
- Filing claims and reporting problems (e.g., service disruptions, suspicious activity, voting, and complaints about officials)

By the year 2015, the United Nations expects that there will be over 358 "million cities" with one million or more people and 27 "mega-cities" with ten million or more, and much of this growth will occur in developing countries (Freire 2006). E-government is effective only when city infrastructures are capable of delivering timely information and services to citizens and when the citizens themselves have the means to access e-government resources. For some developing countries with limited ICT infrastructure, access to e-government services is still difficult in locations where most of the populace are poor and public resources are either insufficient or scarce; yet their mobile phone use is higher than Internet penetration (Molin-Juustila et al. 2008; Kumar and Sinha 2007). This growth in mobile usage can be seen worldwide, and in some countries it has been exponential (Table 10.1), where the young, old, rich, poor, male, and female all use mobile phones. In 2013, the number of active mobile subscriptions reached 6.8 billion, corresponding to a global penetration of 96 % billion worldwide, where more than 80 % of those users living in rural areas have access to mobile networks (OECD/International Telecommunication Union 2011; ITU 2013).

Mobile phones are becoming the fastest and most widely used technology in history due to their personalization and ease of use (OECD/International Telecommunication Union 2011). Due to their widespread use and with an abundance of Wi-Fi hotspots throughout the city, barriers for citizen participation are removed, empowering them to quickly and efficiently connect to e-government services including health, education, employment, and public safety options, financial and transportation information, legal issues, and much more (OECD/International Telecommunication Union 2011). Smart mobile devices can be perceived as sensor nodes and location-aware data collection instruments due to their increased capabilities of capturing, classifying and transmitting image, location, acceleration and other data (Till et al. 2012).

2 Research Objective

For the purposes of this chapter, a city is defined as any population-dense, integrated human settlement located within a limited geographic area with a population large enough to sustain a city government capable of providing an online version of government services and resources that support citizens' needs. Replicating the desktop experience of government e-services is, however, not sufficient in addressing the needs of the mobile user within the city, because the design of online e-government services does not transfer well to mobile devices—just as paper-based services do not transfer well to an online environment. Therefore, new practices are needed to accommodate the impact of users' behavior and their location on interactions with m-government applications. Unfortunately, while user interactions with mobile devices in the real world usually occur in context-rich environments (Barnard et al. 2007), many mobile applications are designed as though they will be used in traditional desktop settings (Savio and Braiterman 2007). In addition, their evaluation studies are conducted in static or ideal conditions (Barnard et al. 2007). As a result, the impact of the change in context on the user's ability to successfully interact with mobile applications is neither well understood nor analyzed (Barnard et al. 2007). Reviewing the literature reveals that research in the relatively new field of context awareness and designing mobile user interfaces concentrates on system-level development or context recognition, while human–computer interaction and usability issues have only seldom been explored and investigated (Häkkilä 2007). Context awareness, however, is a growing field and increasingly gaining applicability in interactive ubiquitous mobile computing systems (Musumba and Nyongesa 2013).

The objective of this chapter is to identify issues and raise awareness of potential challenges that user-interface designers need to consider while adapting the content of municipality and city e-government services and applications to the context-aware interactions of citizens with mobile devices. This chapter concludes with context-oriented best practice m-government guidelines that need to be considered when adopting applications which would help city governments in the delivery of more efficient e-services to mobile citizens.

3 Theoretical Overview

E-participation can be defined as the electronically supported methods that decision-makers use to interact and consult with citizens and nongovernmental organizations (Lahti et al. 2006).

Citizen participation consists of permitting those affected by a decision to contribute to that decision in the areas where they live and work (Suh 2005). Some of the advantages of citizen participation are as follows (Tang 2006):

- Revealing the interests of the citizens in proposed plans and giving them social legitimacy

- Empowering citizens in remote locations by allowing them to monitor corrupt or unauthorized decisions or illegal development in their neighborhoods
- Offering input regarding the validity of proposed neighborhood designs, as city residents know their neighborhood more intimately than city officials and planners and are aware of local issues that may affect design strategies
- Allowing new ideas to emerge from discussions with citizens of local communities

3.1 Mobile Governments (M-governments)

While web-based interactions between citizens and their city governments have proven to be reliable for many e-government systems, mobile-based interactions are far more complicated (Zefferer 2011). The fundamental difference between e-government and m-government is in their provision of services. While e-government involves the electronic delivery of information to geographically diverse but technologically homogenous ICTs, m-government involves interactions in which the users' contexts are unknown limiting the amount and type of information that might be located and accessed due to physical constraints in the environment while they interact with their mobile devices (OECD/International Telecommunication Union 2011). Context awareness becomes important when the citizens may have to provide, or be asked for, information about their present state such as collisions, traffic jams, fire, weather-related damage, riots, and other urgent situations (Ariza Avila 2006). The challenge is to allow citizens to respond instantly to such situations while they are in the right place and at the right time. That type of spontaneous and impulsive reaction can be seen as a new application area for citizen participation inside their community (Ariza Avila 2006).

M-government is a subset of e-government that utilizes mobile phones and wireless technologies like 3G, Bluetooth, GPRS, and Wi-Fi. Delivering these public services poses challenges with regard to both their implementation and their acceptance (Kumar and Sinha 2007). Still, city governments should invest heavily in m-government because it offers extensive possibilities for electronic interactions between citizens and local city authorities. However, spontaneous participation on the part of citizens involves two somewhat contradictory requirements (Ariza Avila 2006):

1. It is imperative to acquire information from citizens about their situations, which may be in the form of data submitted (pictures or messages) or contextual (time and location of the participation), so as to allow citizens to react appropriately, immediately, and in the right place and at the right time. This information can then be used to provide many useful new services for citizens.
2. Spontaneous and impulsive participation requires simple and easy-to-use interaction techniques in order to capture, attract, and maintain user engagement as much as possible.

Citizens as well as the municipality or the city government would benefit from using contextual information with regard to quickly resolving problems and simplifying the process for both citizens and governments, encouraging their participation by making it easy for them to access services (Ariza Avila 2006). Contextual data can be obtained from physical sensors, such as for temperature and pressure, from computed information such as time and date, or by being explicitly provided to the application in the form of user preferences (Mostéfaoui et al. 2004). Smart spaces are provided with sensors that acquire contextual information such as light intensity, noise levels, temperature, and location (Ariza Avila 2006). However, cities are not smart spaces and do not have an infrastructure for context sensing and acquisition; if some sensing devices do exist in cities, they are often inaccessible, obstructed, or unusable (Ariza Avila 2006). Urban sensing use embedded networked sensing in a real-world environment in the form of mobile phones (Till et al. 2012).

Zefferer provides a list of worldwide mobile service projects specifically targeted for students, farmers, or citizens for specific issues such as flood warnings for Venice residents (Zefferer 2011). A successful example is the US government's dedicated website (apps.usa.gov), which launched a variety of applications that allow smartphone users on the move to access its services, from finding the nearest location of interest to inquiring about the UV index in a given city (OECD/International Telecommunication Union 2011).

Over the last few years, some municipalities have capitalized on citizens' interaction with their mobile phones such as (Till et al. 2012): (1) The NYC311 service in New York City, which has an official iPhone app, allows residents to report various emergency local problems, uploading pictures of potholes or videos of damage or sabotage, for example; (2) Street Bump in Boston uses a mobile device's accelerometer to report street damage based on a driving vehicle's location and acceleration profiles; (3) PEIR, tested at the University of California, Los Angeles, is a system that uses GPS data from mobile phones and mathematical models and algorithms to determine the users' method or means of transportation and travel routes; (4) the CarTel project at the Massachusetts Institute of Technology uses location data from mobile phones as input to algorithms for traffic analysis, prediction, and accordingly provides traffic-routing suggestions. Cities are also using mobile devices to monitor ongoing programs such as a GPS-based system in the city of Auckland used to monitor its employees' activities and resources (Raja et al. 2012).

3.2 Mobile Phones and the User Experience

It is evident that mobile applications on smartphones are revolutionizing the entire mobile market by linking a hardware device to a content delivery platform enabling a powerful hardware/content combination (OECD/International Telecommunication Union 2011). Such a combination removes one of the main challenges within the industry of how to generate revenue using mobile applications and content (OECD/International Telecommunication Union 2011). The 2010 Adobe Mobile Experience

Survey measured mobile user characteristics, behavior, preferences, satisfaction levels, and other experiential factors across four key consumer categories: (1) media and entertainment; (2) financial services; (3) travel; and (4) consumer products and shopping (Adobe Systems 2010). The study surveyed 1,200 US consumers across different age groups and types of mobile device they own. The survey's key findings were as follows:

- Media and entertainment is the most penetrated category, both in terms of the number of users and in terms of time spent; consumer products and shopping is the category that is the least penetrated in terms of the number of users.
- Respondents generally favor the browser experience over downloadable mobile apps (applications), except when it comes to games, social media, maps, and music.
- Overall, respondents reported equal satisfaction levels with their browser and app experiences, spending nearly equal amounts of time interacting with each.
- Accessing maps and directions is the number one mobile activity (81 %), followed by three media-related activities: social networking (76 %), accessing local information (73 %), and reading news (68 %). The top mobile financial activity is reviewing bank account information (67 %).

The 2010 survey study conducted by Adobe concluded that mobiles are paving the way for the more widespread adoption of services and behavior that, until recently, have been the purview of desktops, and that learning how users are interacting with mobile devices is crucial (Adobe Systems 2010). The high demand for smart mobile devices with many features and the competition between hardware and software has driven the market at a fast pace, while research on the user experience has lagged behind. Media, entertainment, and social networking companies have the ability to invest in transferring their users' experiences from the web to a mobile environment since their reach may be in the hundreds of millions. For city governments, however, the cost may not justify such an investment due to limited technical know-how, limited user reach, limited funds, and a lack of usability specialists. As a consequence, city governments often simply transfer their web application to a mobile device interface in which users scroll up and down and right to left, filtering out unnecessary information. If we imagine an emergency situation in which citizens need to report a complaint or are in need of help, browsing the mobile app as designed for the a desktop device defeats the purpose of providing citizens with real-time data and information anytime, anywhere, and when they need it most.

User needs and preferences, quality and user-friendly applications are critical success factors for m-government and emphasize the fact that m-government applications should be driven primarily by the needs of the user (Zefferer 2011). As mobile computing grows more complicated for multiple-use contexts, user-interface designers have several unique challenges, as users may move between different platforms while carrying out different tasks in different environments (Eisenstein et al. 2000). User interfaces need to adapt to the user settings by presenting functionality and information that is relevant only in specific circumstances, thus reducing the demand for user interaction (Kjeldskov and Paay 2005).

Adapting the interface to its context facilitates the partial automation of trivial and repetitive tasks, enabling the system to react to contextual changes while increasing the security of data and of users (Kjeldskov and Paay 2005). Context-aware applications on mobile computer systems can discover and take advantage of contextual information, such as the user's location, nearby people and devices, time of day, user activity, in addition to light and noise levels (Chen and Kotz 2000). A recent study of m-government developed a measurement framework for the identification/categorization of m-government services; the sophistication stages of these services; and indicators to evaluate their progress (Stiakakis and Georgiadis 2012). This study found that modification in the sophistication model for e-services should be user-focused, in accordance with the personalized nature of services delivered through mobile devices (Stiakakis and Georgiadis 2012).

4 Challenges for Context-Aware Design

The "design challenge for mobile context is the artful combination of effective visualization of sensor information, user provided content (text, speech or photos) and easily selecting when and with whom you share what" (Mirisaee et al. 2011). User-interface designers of mobile devices must consider (1) the mobile device: content needs to adapt to screen resolution, color depth, and screen surface, and dialogues must adapt to network bandwidth; (2) usability and the user's experience: adapting to user skills, experience level, task experiences, and preferences; and (3) the interaction: methods that remember interaction techniques previously used, location, and windows sizes (Eisenstein et al. 2000).

Upon a review of the literature, it is clear that the challenges of the context-aware issues that designers face can be categorized into three groups: the mobile device and user behavior while using it, the usability of the design, and user interaction.

4.1 Context Design and the Mobile Device

Mobile technology has a rather complex system architecture with several underlying layers, such as sensor technologies, and inferred logic design (Häkkilä 2007). In addition to these technical challenges, there also exist user-related and context-related issues that affect the interaction design (Häkkilä 2007).

Designing quality mobile web applications is complicated because mobile user interfaces are a new paradigm for user interaction due to the following main differences between desktop and mobile platforms (Lentz 2011; Devlin 2011):

- Mobile device hardware is smaller with generally fewer hardware resources than desktops and laptops.
- Smaller screens generate different design challenges and considerations, limiting the information that can be legibly displayed (as depicted in Fig. 10.1).

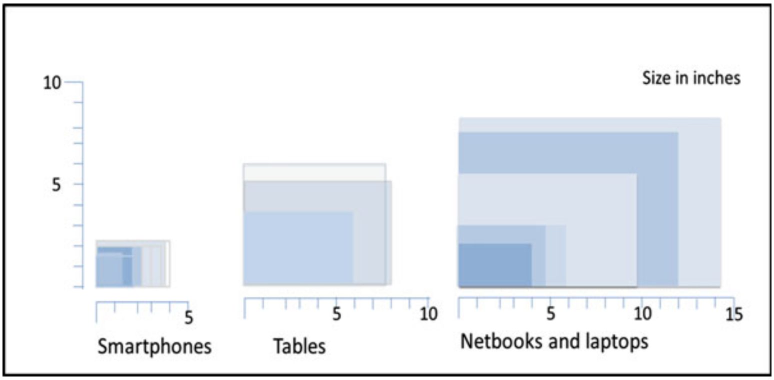

Fig. 10.1 Mobile device displays, relative sizes (Lentz 2011)

In addition, texts and images can quickly fill the limited screen space, causing a trade-off between content and user interactions.

- Touchscreens used for interaction with the interface introduces new interaction concepts that differ from traditional input devices such as the keyboard and mouse. They use bigger hit areas optimized for fingertips, making them easier to use yet, fingers and hands obscure more of the screen on a user interface than does a mouse pointer icon. While some mobile devices have a physical keyboard, most only have a virtual keyboard to handle different types of displays without overcrowding the screen or stretching the content by using more grid-based button layouts and presenting controls within the application that are similar to mobile apps.
- Internet connectivity for mobile devices is a concern because it is not always as reliable as a hard-wired broadband connection, which means data transfer is significantly slower.
- Operating system diversity in mobile devices determines the following:
  - *Navigation*. For example, Blackberry phones uses gestures, widgets, and hardware buttons for the menu and for escaping, while Android phones use gestures, widgets, and hardware buttons for home, back, menu, and search.
  - *Control implementation*. The operating system relies heavily on software control features like virtual buttons. Both Blackberry and Android devices may have physical buttons for navigating back to the previous screen and for opening option menus. In iPhone and iPod Touch applications, tab buttons are placed at the bottom so that the users can easily glide over the screen using their thumb.
  - *Visual style*. An aesthetic choice through color themes, icon styles, and metaphors.

4.2 Context Design and Usability

The key potential usability risks for designing the user interface of a mobile, context-aware application are (Dey and Häkkilä 2008):

- Uncertainty in context recognition can be caused by different factors including inferring logic, detection accuracy, or information fusion, as it affects the selected features as well as their functionality and accuracy. Features such as the proactivity level may be designed differently, in practice, if the confidence level in context recognition can be correctly estimated.
- Application complexity grows the more functions are added, causing a potential risk for context-aware applications, as they use a greater number of information sources than traditional mobile applications.
- The absence of standardization in this field results in poor interoperability of services and applications and it limits the application design, available services, and the seamless interaction that is anticipated across a wide range of devices and users.
- The subjective understanding of context attributes and measures such as light intensity or noise level in everyday life creates a problem for user-interface design, as these attributes are not commonly understood by end-users.
- Context-triggered actions when executed proactively may easily result in a lack of user control with mobile device automation.
- The constant mobility of the user creates problems related to user focus and interaction, which are prone to error and accidental selection.

4.3 Context Design and Interaction

Due to the context of use and given the interactional perspective, successful mobile interactions are expected to be different from the desktop experience, as proposed by the theory and practice of human–computer Interaction. Table 10.2 presents the differences between the user experience for mobile and desktop uses (Lentz 2011).

In particular, the problems that developers face regarding context design for interaction are listed below (Savio and Braiterman 2007; Dey and Häkkilä 2008):

1. All mobile interactions are user-driven. The most successful strategy so far has been entertainment content, such as video clips, ring tones, wallpapers, games, and social networking.
2. Context often derives from devices that developers have little experience with, unlike their experience with the mouse and keyboard.
3. Raw sensor data must often be abstracted in order to be transformed into a useful context; otherwise, the data may not directly be useful to an application.
4. Context comes from multiple distributed and heterogeneous sources, which often need to be combined to produce useful data.

Table 10.2 Mobile and desktop experience differences

Mobile	Desktop
Short, focused interactions	Continuous interaction for a single task
Ex: Responding to a tweet or SMS	Ex: Writing notes
More disruptive interruptions on device	Less disruptive interruptions
Ex: Receiving a call while reviewing mail on smartphone	Ex: Having a phone conversation while checking e-mail on a laptop
Constantly changing environmental context	Infrequently changing context
Ex: Using a phone during travel	Ex: Using an application at a desk
More transactional interactions	Supports non-transactional interactions
Ex: Checking weather forecast	Ex: Composing a document
Viewing dominates interacting	Balanced viewing and interacting
Ex: Looking at photos	Ex: Editing photo
Page loads are more disruptive	Page loads are less disruptive
Ex: Mobile Web-browsing experience	Ex: Desktop Web-browsing experience
Simplicity of experience	More tolerant of complexity
Ex: Reading an e-book	Ex: Using a word processing application
Relatively poor response time	Good response time
Ex: Map updating	Ex: Highly immersive gaming
Relatively poor response time	Good response time
Ex: Map updating	Ex: Highly immersive gaming
More social	Less social
Ex: Relative importance of phone, texting, and social network applications	Ex: Relative importance of office productivity applications

5. Context, by its very nature, is dynamic; changes in it must be detected in real time. To provide a positive experience for users, applications must adjust to these constant changes.
6. New mobile experiences compete with well-known user models. As mobile services expand, design must take into account customers' dependence on user models that are based on prior technologies. On the web, ease of use is vital and can be accomplished by limiting choices and guiding navigation. On a mobile phone, adjustments must be made for background noise, interruptions, environmental distractions, and many usage contexts that often require single-hand operations.
7. Mobile devices are in closer proximity to users for more parts of the day than are personal computers, and they compete with many other demands on users' attention.
8. The device is a continuous companion that offers a realm of mobile experiences of different intensities and durations, such as text messaging and playing games.
9. Mobile interactions can extend beyond the device. Some users tend to access information on the web from a personal computer and see the results displayed on a mobile phone.
10. Mobile interactions are often small, and many interactions must be intuitive and rapid. For example, when searching for an address to avoid being late for an appointment, there will be a low threshold for learning or registering.

There are also other obstacles to retrieving data and locating a destination compared to those on the web.

11. Peer-to-peer is the most trusted form of mobile marketing. Mobile phone users are more likely to respond to messages they received from friends. Mobile social networks facilitate decision-making in many locations and contexts, creating new “mixed realities” and blending virtual and in-person realms.

5 Recommended Design Guidelines for M-government

Users see mobile devices as communication and leisure tools for fun and entertainment more than for serious activities, but government business requires a series of tasks involving difficult choices that could be life-threatening (OECD/International Telecommunication Union 2011). So, in order for designers to utilize such technology in the face of these significant challenges, they transfer online applications using automated tools called “mobile site builders,” like WIRENODE, MobilePress, WP-TAP, WP-TOUCH PRO, Mobify, and MoFuse, that enable websites to be responsive to any device, whether mobile, tablet, or iPad. However, without designer involvement in reducing and redesigning content, the use of mobile builders can be the worst option for users. Only a few of these tools allow designers to actually pick elements to be displayed, while the rest automatically create the mobile version, without any designer contribution adding insignificant elements for a mobile version.

With a lack of expertise within the municipality and lack of funding to have professionals redesign their websites, this research recommends different options that developers have when planning to redesign their e-city websites to accommodate mobile usage. These recommendations may not address all the challenges but could reduce them considerably. The website needs to be prepared to be transformed by following guidelines for content, browser-to-device compatibility, screen size, and links to context awareness.

5.1 Content

Two of the technical and policy considerations related to m-government are content and presentation management. By utilizing content management systems (CMS), a formal structure to the content will be added in order to adopt enterprise-wide web and content design standards (Hassan et al. 2009). The management application must be able to communicate with other applications using open standards (e.g., Web Services, CORBA, Java RMI) to allow the use of the contextual information (Ariza Avila 2006).

In addition, location awareness and personalization techniques ensure delivering the right service to the right users by selecting only the most necessary services, such as reporting and receiving warnings, alerts, health emergencies, and payment for urgent violations, while routine information and forms should be reserved for the desktop (Hassan et al. 2009). A careful analysis of what types of services should be offered should be conducted for each municipality on an individual basis; one size does not fit all because each city has its own unique character, challenges, resources, technical infrastructure, and digital culture, all of which affect the types of services that should be provided on a mobile device. Therefore, designers need to have a logical architecture for governmental location-based services to maximize the ultimate effectiveness of m-government services and to enable matching the best service options with the targeted user (Hassan et al. 2009).

5.2 Browser Support

There are three main options for supporting mobile browsers (Sanderson 2011), which are listed below.

- *Option 1*. The cheapest option for implementation and maintenance is to simply create a standard, desktop-based web application using mobile builders and rely on mobile browsers to render it. This would be the worst end-user experience because users will still be forced to zoom and scroll horizontally and vertically to access the content on a small screen.
- *Option 2*. With the careful use of markup, styles, and scripts, it is possible to adapt the interface to whatever browser is running and optimize rendering for the specific device in use. This option easily allows sharing of server-side logic across all device types with minimal duplication of code or effort. But it provides no support for varying server-side logic and workflows for different devices, and it may not be possible, for example, to implement a simplified shopping cart checkout workflow for mobile users. In addition, with inefficient bandwidth use, servers may have to transmit the markup and styles that apply to all possible devices, even though the target device will only use a subset of that information.
- *Option 3*. If the server knows the characteristics of the device it is accessing, such as its screen size and input method, it can run different logic and output different HTML markup. The server need only transmit the markup and styling information that the target device is going to use thus providing maximum flexibility and efficient bandwidth use. However, it sometimes forces repetition of effort or code, and device detection is not trivial because it requires a list or database of known device types and their characteristics; which may not always be current and not guaranteed to accurately match every incoming request.

5.3 Screen Size

In a typical desktop website layout, the interface would have content and navigation objects, where the primary navigation is presented on top and a secondary navigation is a list of options in the left-hand column of the page. For a mobile device, the navigation panes need to be reduced to a single navigation column to avoid as much as possible scrolling left to right and up and down. The top part of the screen is prime real estate on a mobile phone and should be reserved for the most important content, while navigation elements should be placed on the lower part of the screen.

Because typing while on the move is prone to error, it should be minimized. Users are best served by being able to choose options and have their data stored in their accounts (Warsi 2011). Furthermore, the most common difficulty with interaction with small touchscreens is in selecting, and in particular, tapping small text links accurately, because fingers tend to be too thick to hit a small link accurately; and it is easy to accidentally tap the wrong choice if there are two or more links in close proximity (Warsi 2011).

5.4 Links to Context Awareness

Häkkilä (2007) examined situations and needs in which context-awareness phenomena can assist in overcoming several challenging issues that relate to user interaction with mobile handheld devices (Table 10.3).

Table 10.3 Phenomena and their links to context awareness (Häkkilä 2007)

Phenomenon	Consequence	Link to context awareness
Increasing complexity of the devices	An increased number of applications while device settings get more complex	There is a need to quickly access applications and menus and to simplify setting structures and automatic configuration of settings
Small device size	Limited input and output functionality	There is a need for more efficient input methods due to slow input techniques and long navigation paths. Content has limited space, and the device should be able to decide what is relevant to display
Computing and battery power are limited	A limited number of actions or processes can run simultaneously	There is a need for appropriate device resource management according to the user's situation
A growing number of mobile services	The possibilities for device usage can be multiplied	There is a need for users' ability to select only relevant services and to use them efficiently
Unpredictable human behavior	The device should support users' fallible memory and their and dynamically changing intentions	There is a need for memory aids, reminders, and prescheduled actions to support flexible management of actions

6 Conclusion

Technology support for nonprofit or government sectors is an important yet relatively new field of research due to the increased significance of citizen participation in the political process driven by the power of social media and the use of mobile devices. In order to design appropriate technological support for such settings, it is important to understand their structure, work practices, traditional platforms for communicating with the public, and current popular technological usage trends.

The aim of every city government should be to remove barriers and empower citizens to quickly and efficiently connect to their e-government for services such as health, education, employment, public safety, transportation, and legal issues. Mobile devices have become common tools for service delivery because of their ease of use, their wider reach, and the lower cost of handsets. City governments continue to explore and invest heavily in m-government services and applications by utilizing mobile phones and/or wireless technologies to deliver e-services more efficiently. This offers extensive possibilities for e-communication between citizens and city authorities. Replicating the desktop experience for e-government, however, is not sufficient for accommodating the interaction s of the mobile user, because user interactions with mobile devices in the real world usually occur in context-rich environments; therefore, new practices are needed to understand the impact of users' location and behavior on interactions with m-government applications.

Media, entertainment, and social networking companies can invest in transferring their users' experience from the web to mobile devices, as their reach may be in the hundreds of millions. For city governments, however, the cost may not justify such an investment, due to the limited technical know-how of their developers, limited user reach, limited funds, and a lack of usability specialists. So, the most common practice of municipalities of simply transferring web-based e-government services to mobile devices is considered inefficient because the capabilities of mobile devices differ from those of desktop environments and because users' preferences for using their devices vary.

Due to issues of context, the purpose of this research is to alert m-government user-interface designers and developers not to simply use mobile builders to transform an existing website into a mobile version; they must fully understand the usability risks and challenges involved in providing users with an efficient and comfortable experience. Designers and developers need to follow best practices and software engineering lifecycle methods in designing applications by prototyping and conducting testing with users for different mobile platforms. Although the target users of e-government and m-government are the same, their interactions with the applications and their context of use are completely different. They therefore require a completely dedicated, user-centered design approach for building applications for mobile devices and context of use.

This chapter presented the design challenges involved in building e-government applications for mobile use that far exceed those of desktop websites applications. By following these proposed guidelines for content, browser-to-device compatibility, and screen size, designers may not solve all problems encountered but can reduce them considerably.

As much as context awareness can help in overcoming several problematic issues that relate to user interaction with mobile devices, context-awareness information about the user, the environment, and the device is still prone to error and unreliable and should be used only when absolutely necessary. Mobile technology, in the meanwhile, is growing rapidly, and city sensory data can provide necessary context-aware data for mobile services. The challenge that remains for designers of mobile apps is to integrate context data and tools in a way that is easy for users on the move to learn and use in a smart, interactive city.

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