

Ten usability principles for the development of effective WAP and m-commerce services

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Keywords

Information technology, Mobile communications, Communications technology, Internet

Abstract

This paper reports on the results of a Wireless Application Protocol (WAP) usability study, which consists of a survey, an evaluation of two UK WAP portals and an experiment that was carried out between November 2001 and February 2002. A number of usability issues, which prevented the users from completing basic and common tasks, were identified. For instance, 70 per cent of the users were not successful in searching for a textbook on the Amazon.co.uk WAP site. Additionally, even experienced users were not immune to these problems. The general conclusion of the study is that WAP usability remains poor. We argue that this could have a negative effect on the future of WAP and m-commerce. Finally, we propose a set of ten principles, which are based on the findings of this study, and we believe will aid towards the development of more usable WAP and m-commerce services.

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Introduction

M-commerce combines the advantages of mobile communications with existing e-commerce applications to allow consumers to shop for goods and services from virtually anywhere. Furthermore, it makes possible the introduction of novel ideas, which are specifically designed for the mobile user, and takes full advantage of the distinctive characteristics of m-commerce.

WAP is one of the key enabling technologies of m-commerce as it allows mobile users to access the Internet from a mobile device. Consequently, the future consumer adoption of m-commerce relies heavily on how easy it is to use WAP in order to access and utilise these services.

Aims

This paper reports on the findings of a WAP usability study, which comprises of an evaluation of the usability of two UK WAP portals, a survey and a WAP usability experiment. The methodology and the results of the study are presented followed by a comparison of this study's findings with those of similar studies conducted by other researchers in the past. After that, we outline the ten usability principles that we developed as a result of this study, and we underline the main contributions that this paper brings into the field of WAP and m-commerce usability. Finally, we discuss the implications that these findings might have on the future development of WAP and m-commerce.

Materials and methods

Usability evaluation of portals

The purpose of this part of the study was to examine critically the usability of the WAP portals of the two biggest UK mobile operators: BTCellnet's Genie and Vodafone's Vizzavi. An emulator[1] of the Nokia 7110 WAP phone was used in order to access the two portals and evaluate the usability of some of the available WAP services. The use of the emulator was chosen over the use of a WAP phone. This choice was made because the

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main aim at this stage of the study was to test the usability of the WAP services without being distracted by other factors – such as the usability of the handset itself – that could influence the results.

The usability of the portals was tested against the five attributes of usability (Nielsen, 1993) and the “Eight golden rules of interface design” (Shneiderman, 1998). We wanted the evaluation to be as extensive as possible and therefore a wide range of WAP services were tested (e.g. news, weather, travel, etc.).

Survey

Two kinds of questionnaires were given out to more than 250 undergraduate and postgraduate students at Coventry University. There was one questionnaire for those students who did not own a WAP phone and one for those who did own one. The main reason for having two different types of questionnaires was that we wanted to capture the views of both groups of students. The current users of the service were given the opportunity to tell us what they thought of it, while those without a WAP phone were able to express their attitude towards WAP.

Participants

The participants for the experiment were selected based on their questionnaire responses. All of them expressed their interest in taking part in the experiment. A cohort of ten participants was chosen. Although this is a relatively small sample, research has shown that it is sufficient to identify more than 90 per cent of the usability problems (Nielsen and Landauer, 1993). Four of the participants were current owners of a WAP phone. The other six of them had never used a WAP phone before, although half of them did own a non-WAP mobile phone. All ten participants were undergraduate students between the ages of 18 and 26 and regular Internet users.

The experiment

The experiment was conducted from November 2001 to February 2002. The main purpose of this experiment was to evaluate the usability of a representative range of existing WAP services. The experiment measured the time it took participants to complete preset tasks and identified errors and difficulties involved in navigating the WAP sites and

utilising the available services. More specifically, this experiment set out to address the following issues:

- Does the design of WAP services contain major usability flaws that prevent completion of the most common tasks?
- What obstacles prevent completion of common tasks?
- Can users perform and complete common tasks within an acceptable amount of time?
- Is the design of WAP services a cause for frustration and errors?
- Can existing owners of WAP phones perform better than users who have not used a WAP phone in the past?

Only one participant was tested per session. The duration of each session was approximately 40–50 minutes. The WAP phone used was a Trium Mars connected to the Vodafone network (GSM). The phone was bought pre-configured to dial into Vodafone’s own WAP portal, Vizzavi. All the other WAP sites (Genie, Guardian Unlimited, Thomas Cook and Amazon) that were used for the purposes of this experiment were set as bookmarks. Before being asked to carry out the preset tasks, the participants were shown how to use the navigation button and connect to the Internet. After all nine tasks had been carried out, each participant was asked to complete a brief satisfaction questionnaire regarding their perception of the usability of the WAP services. When appropriate, the experimenter asked the participants to comment on their performance.

The tasks

The nine tasks (see Table I) were split into two categories: the portal-specific tasks (1–5) and the common tasks (6–9). In other words, for half of the participants the first five tasks that they were asked to carry out were specific to the Genie portal, whereas the other half of the participants were asked to carry out tasks that were specific to the Vizzavi portal. Of course, the nature of the portal-specific tasks was the same. The reasoning behind this was that the researcher wanted to be able to identify any major differences between the usability of the two portals. Finally, all ten participants were asked to carry out four common tasks.

Table I The nine tasks

Task	Description
1	Switch on the phone and connect to the Genie/Vizzavi portal
2	Retrieve the latest world news headlines
3	Choose an option from the list of the world news headlines and read the corresponding article
4	Retrieve tomorrow's weather forecast for Birmingham
5	Retrieve tonight's TV listings for BBC1
6	Go to the Thomas Cook WAP site and find the details (airport, price, airline, etc.) of a flight offer to any European destination
7	Go to the Guardian Unlimited WAP site and retrieve the latest Net news headlines
8	Choose an option from the list of the Net news headlines and read the corresponding article
9	Go to the Amazon WAP site and find the price and availability of the set textbook of one of your modules

The preset tasks were compiled with three purposes in mind. The first was an attempt to provide the users with a wide range of tasks, which would include some of the most likely WAP services, that in our opinion, the users would use in a real life situation. The second reason was that we wanted to ask the participants to carry out tasks whose difficulty would increase gradually. For instance, the first task that each participant was asked to carry out was to turn the phone on and connect to the Internet. On the other hand, the last task was to connect to the Amazon.co.uk WAP site and search for a book. Finally, we wanted to be able to compare and contrast the results of this experiment against the results of other similar experiments, which were conducted by other researchers in the past.

Results

Survey

Out of the 208 students who returned their questionnaires, only 21.6 per cent of them owned a WAP-enabled phone. Moreover, almost half (49.4 per cent) of those without a WAP phone were not sure about whether they would like to have a WAP facility on their current non-WAP phone or not. However, the students who said that they would like to have WAP on their phones were slightly more than those who replied negatively. When asked to guess how long it would be before they got a WAP phone, the vast majority of them (39.6 per cent) replied that they did not know. Only 20.1 per cent of them said that

they would like one within a year, while 10.7 per cent of them indicated that they would never buy a WAP phone. When asked to indicate what kind of services they would want a WAP phone to feature, e-mail was the favourite choice followed by news, banking and sports results. Only 5.7 per cent of the students cited shopping as a service that they would like their WAP phone to feature.

When the current owners of WAP phones were asked to rank the services that they access through their phones in order of usage, news was the most frequently accessed service closely followed by sports results and entertainment. According to the student users of WAP, shopping was the least frequently used service. However, 32.4 per cent of the WAP phone owners stated that they had never used the WAP facility on their phones. Furthermore, only 21.6 per cent of those who owned a WAP-enabled phone said that they were making frequent use (one to six times/day) of their phones in order to access the available WAP services. When asked to indicate how much time they usually spend on the phone each time they use WAP, 88.5 per cent of the users said that they usually spend one to 10 minutes per session.

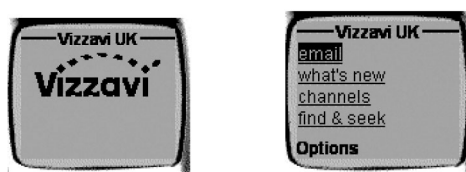
The speed of the connection was what 40.5 per cent of the users of WAP cited as the most disliked aspect of the service. Far behind that, the size of the screen and the overall ease of use of the WAP services got 14.3 per cent each. Moreover, 60 per cent of the students responded that the limited screen space is affecting their user experience in a negative way. However, the percentage of the WAP users who thought that the WAP sites are easy to navigate (30.7 per cent) was greater than the percentage of those who answered negatively (19.2 per cent). Finally, only 8 per cent of the users said that WAP had so far surpassed their expectations, while 28 per cent indicated that it had failed to meet them.

Usability evaluation of portals

The findings of the usability evaluation of the two UK portals fall under the following six categories:

- (1) *Unnecessary use (sometimes overuse) of graphics.* For instance, as Figure 1 shows, when a user connects to the Vizzavi portal she is greeted by a splash screen that displays the portal's logo. The user has to wait for the image to load before the next screen loads automatically.

Figure 1 Vizzavi's splash screen



Another example of bad and unnecessary use of graphics is shown in Figure 2. In that case, it is not a splash screen that takes too long to load but a section header that occupies a lot of the screen's real estate, which could be used otherwise. In fact, because of the presence of this header, the user can see only one or two of the several menu options that are available (not shown here). If the header were not there, all options would be able to fit on just one screen.

Finally, a case of clear overuse of the splash screen feature is presented in Figure 3. This is the Guardian Unlimited WAP site, which can be accessed via the Genie portal. As shown in Figure 3, the user is presented with a splash screen on arrival at the Guardian Unlimited site. After that, the main page of the portal loads automatically. The same splash screen reappears once the user "clicks" on one of the available menu options.

Figure 2 Unnecessary use of graphics

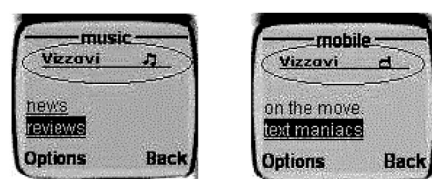
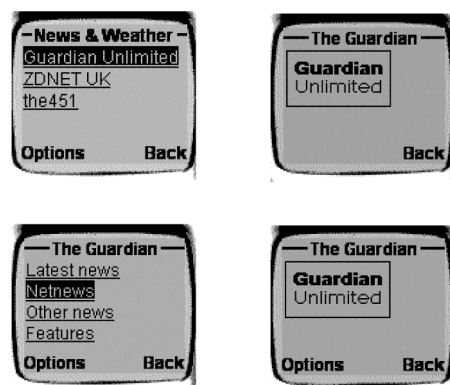


Figure 3 Overuse of the splash screen feature



- (2) *Long lists with no indication of the length of the list.* Studies, which were conducted back in the early days of the Web, found that only 10 per cent of the users would scroll down a navigation page to see any links that were not visible to them (Nielsen, 1996). The situation has improved since then, but there are still some users who rarely scroll and therefore it is generally suggested that all navigation options should be presented on a single screen (Nielsen, 1997).

When it comes to WAP, providing the user with a clear and highly structured view of all the available navigation options becomes even more crucial. Our findings suggest that most menus comprise of long lists, whose length is rarely being indicated.

Figure 4 presents one such case. These four screens make up Vizzavi's "channels" menu, which presents the user with all the different sections of the portal. All in all, there are 13 options on this list and therefore the user has to scroll through four screens in order to reach the last option. Moreover, there is no indication of the length of the list and therefore, it is not clear to the user that she is required to scroll down in order to view the remaining nine options.

- (3) *Poor task analysis.* Figure 5 shows the four screens that form Vizzavi's "local weather" menu. The user is asked to choose one of the 13 options, which represent different regions of the UK. Obviously, the list is too long and it implies that a user, who is interested in locating the weather for Wales, has to scroll all the way down in order to select the appropriate option. A more realistic

Figure 4 Vizzavi's "channel" menu

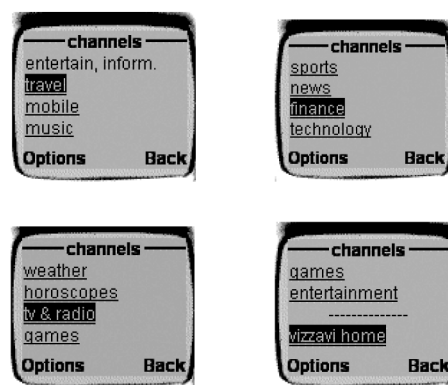
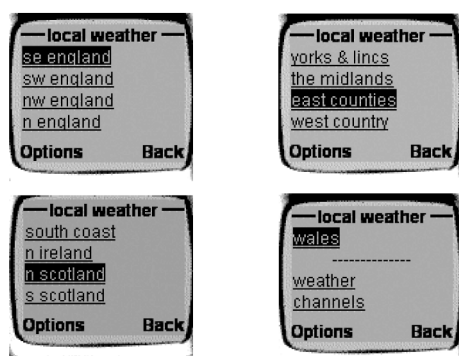


Figure 5 Poor task analysis



and usable approach would be to provide the user with a list of the four main regions (England, Scotland, Northern Ireland and Wales) before asking her to choose a sub-region. The restructuring of the menu would increase the speed of the interaction and would provide the user with a clearer choice of options.

- (4) *Error messages that are unclear and confusing.* Although there were no major problems with the two portals themselves, the Guardian Unlimited WAP site, which can be accessed through the Genie portal, provided us with a couple of bad examples of error handling.

For instance, Figure 6 shows what happened when we “clicked” on the “in the papers” option of *The Guardian’s* “latest news” menu. The error message does not provide the average user with useful information about what went wrong, or what to do next. Most users would not even know what wireless markup language (WML) stands for.

Another example of poor error handling is the process that Guardian Unlimited has put in place in order to encourage users to report any broken links that they may come across. The user has to go through a three-page form in order to complete 12 different text boxes (only two shown in Figure 7), which require the user to provide information such as “platform”, “ISP2” and

Figure 6 Error message

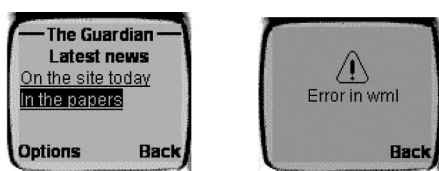
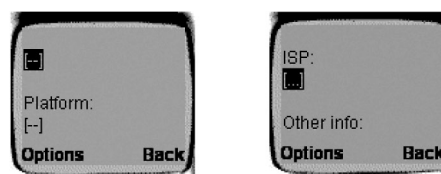


Figure 7 Reporting a broken link



“browser”. The information that is required is too technical for the average mobile phone user and therefore, most users would find this process too complex and long-winded and would rather avoid reporting the broken link.

- (5) *Broken links and dead ends that waste the users’ time and money.* Figure 8 illustrates two cases where a dead end was reached. The first example shows what happened when the “BBC” option, which appears on the Genie “News” menu, was selected. A message informed us that we had reached a site that was no longer there. The same happened when we tried to read an article on the Guardian Unlimited site. Even though the link to the article was still in place, the article itself was no longer available. Although this is a better and more informative way of letting the user know what went wrong than the one presented in Figure 6, it is not quite the right solution. The chances are that users will have spent two or three minutes in order to get to the site, which is the equivalent of 20 or 30 pence.
- (6) *Content that is not suitable for the WAP environment.* Figure 9 illustrates the process that a user has to follow in order to read a review on Vizzavi’s “music” section. When an album title is selected, the user is presented with a two-page review of the respective release (not

Figure 8 Two dead ends



Figure 9 Looking for a review



shown here). In order to examine the usability of this process let us consider the following scenario:

You are in a record store, browsing through the latest releases. You have picked up a couple of CDs that you are thinking of buying. However, you cannot afford to buy both of them. You use your WAP phone to connect to the Vizzavi portal. You locate the “reviews” menu and you “click” on “albums”. The titles of the two CDs that you are holding in your hands appear on the screen. You are ready to “click” on the titles in order to read the respective reviews, which will hopefully help you decide which CD to buy. However, you soon realise that you have to read through four pages of text on your phone’s tiny screen while standing in the middle of the record store. You give up, wishing that there was a faster way of finding out the reviewer’s opinion about the two albums.

This realistic scenario shows that WAP content should be created and presented according to the distinctive characteristics of the mobile environment and the specific needs and expectations of the mobile user. For instance, some sort of rating (e.g. 7/10 or “good”) could be provided in order to give the user a quick indication of the reviewer’s opinion. Alternatively, an informative summary of the review (no more than a screen) could be displayed when the user selects an album title. In both cases, an option to read the full review could be given, indicating the total number of pages that the user would have to go through in order to do so.

In fact, there are some WAP sites that do indicate the total number of pages to the user. Figure 10 shows a screenshot of

Figure 10 Sportal



an article displayed on Sportal’s (a sports portal) “News” section. The length of the article is clearly indicated to the user.

Experiment

The most striking finding of the experiment was that overall there was not a significant difference between the performance of those participants who had used a WAP phone in the past and those who had not used one. In fact, the current WAP users performed equally well, or worse compared with those participants who had not used a WAP phone before. In terms of successful completion of tasks, between them, the four participants who had used a WAP phone in the past failed to complete 11 tasks, which is exactly the number of tasks that the six participants who had not used WAP before failed to complete.

Generally, the completion rates of the portal-specific tasks were satisfactory, with eight out of the ten tasks having a completion rate of 100 per cent (Tables II and III). In one occasion, when a participant connected to the Vizzavi portal and tried to retrieve the weather forecast for Birmingham (Task 4), the system returned a “page not available” message. The participant tried again without any success. He gave up after 2 minutes 53 seconds. The same participant attempted to retrieve the TV listings for BBC1 Midlands by connecting to the Vizzavi portal (Task 5). He received an error message saying that the connection had timed out and that the page that he was trying to access was not available. He gave up after 4 minutes 27 seconds.

Table II Vizzavi results

Task	Completion rate (%)	Minimum time	Maximum time	Mean time
1	100	0 min. 53 secs	1 min. 24 secs	1 min. 03 secs
2	100	1 min. 00 secs	1 min. 20 secs	1 min. 06 secs
3	100	2 min. 04 secs	6 min. 00 secs	3 min. 24 secs
4	80	1 min. 14 secs	2 min. 06 secs	1 min. 37 secs
5	60	1 min. 15 secs	2 min. 14 secs	1 min. 41 secs

Table III Genie results

Task	Completion rate (%)	Minimum time	Maximum time	Mean time
1	100	0 min. 39 secs	1 min. 49 secs	1 min. 01 secs
2	100	0 min. 48 secs	1 min. 53 secs	1 min. 16 secs
3	100	2 min. 08 secs	4 min. 05 secs	3 min. 02 secs
4	100	0 min. 43 secs	1 min. 19 secs	0 min. 58 secs
5	100	0 min. 39 secs	1 min. 37 secs	1 min. 01 secs

In contrast, the completion rates of the common tasks were far less acceptable (Table IV). None of the participants managed to complete Task 8. All ten participants got the same error message when they tried to carry out this task – the page was not available. Furthermore, only 30 per cent of the participants were successful in searching for a textbook on the Amazon.co.uk WAP site. In fact, only one of those students who had used a WAP phone in the past managed to complete this task. The main factor, which prevented the participants from completing the task, was that the “Go” option was not visible to them once they had input their search criteria (Figure 11). As a result, most of the participants ended up staring puzzled at the screen without knowing what to do next. Eventually, some of them scrolled down and found the “Go” option, whereas others just gave up.

Looking at the mean times that the users took to perform the preset tasks we can see that, on average, it took the users 3 minutes 24 seconds to read a news article on the Vizzavi portal and 3 minutes 2 seconds in order to carry out the same task using the Genie portal. Many users pointed out that with the same amount of money that they spent on reading just one article on the WAP phone, they could have bought a newspaper. Apparently, reading four or five pages of text on the tiny screen of a mobile phone is a

process that takes a long time and causes frustration to the users.

According to the results, it took the users less time to retrieve the news headlines from the Guardian Unlimited WAP site than it did from the two portals. Moreover, the participants who used the Genie portal performed four out of the five portal-specific tasks faster than those who used Vizzavi. However, all times were subject to the quality and the speed of the connection and therefore they should be considered with caution.

Finally, most of the participants were in agreement when they were asked to state what they did and did not like about their WAP experience after the end of the experiment. They indicated that they found the WAP services convenient and were positively surprised by the amount of information available. On the other hand, the speed and reliability of the connection along with the size of the screen were the most commonly mentioned disliked aspects.

Comparison with other studies

We know of three other WAP usability studies that were carried out by other researchers in the past. The first one was conducted by Ramsay in the autumn of 2000 (Ramsay, 2001), the second was carried out by Heylar in January of the same year (Heylar, 2000) and the last one was conducted by Buchanan and other researchers at Middlesex University (Buchanan *et al.*, 2001). A description of each study’s methodology is provided in the respective paper.

Table V presents a comparison of the mean times measured in this study and the one carried out by Ramsay. More specifically, we compare the average times that users took to carry out four tasks, which were common across the two studies.

Table V Comparison of mean times

Task	Condos	Ramsay	Ramsay – one week later
Retrieve news headlines	1 min. 16 secs	1 min. 16 secs	1 min. 03 secs
Check local weather forecast	1 min. 37 secs	2 min. 42 secs	1 min. 55 secs
Find television listings	1 min. 41 secs	2 min. 44 secs	1 min. 37 secs
Find headlines from <i>The Guardian</i>	0 min. 41 secs	0 min. 53 secs	0 min. 47 secs

Table IV Common task results

Task	Completion rate (%)	Minimum time	Maximum time	Mean time
6	80	0 min. 41 secs	2 min. 18 secs	1 min. 10 secs
7	90	0 min. 29 secs	0 min. 54 secs	0 min. 41 secs
8	0	N/A	N/A	N/A
9	30	1 min. 22 secs	4 min. 46 secs	3 min. 09 secs

Figure 11 Amazon.co.uk



The second column of Table V shows the mean times measured in this study. The third column shows the mean times recorded at the beginning of the study conducted by Ramsay. Finally, the fourth column shows the mean times measured in the same study, after the users had had a week's experience with using a WAP phone.

Just by looking at Table V, we can make the following three observations. First of all, the mean times measured in this study are generally better than the ones recorded by Ramsay at the beginning of his study. This might be due to improvements in the design of these specific WAP services and/or the speed and reliability of the network. As we mentioned earlier, the study by Ramsay was conducted in the autumn of 2000, whereas this study was conducted a year later. Therefore, one could reasonably assume that some improvements have taken place since then.

On the other hand, it is very likely that the difference in average times is due to the methodologies that were used in the two studies. For instance, Ramsay's user sample consisted of 20 people who had never used a WAP phone before. The user sample of this study consisted of ten people, four of whom were current users of WAP. However, regardless of what caused this difference in the average times that were recorded in the two studies, we can clearly see that even though the situation might have improved slightly, it still took the users a long time to complete some of these basic tasks.

The second observation that can be made is that the average times recorded in this study are closer to the ones recorded by Ramsay in the last part of his study.

Finally, looking purely at the results of Ramsay's study, we can see that although there is an improvement over time, it still took the users a substantial amount of time to complete the tasks. This supports our finding that even experienced users find it difficult to use WAP.

Although average times might be a suitable measurement to compare, they only provide us with quantitative information that does not tell us what exactly went wrong. Furthermore, as we said elsewhere in this paper, the average times recorded in this, and indeed in other studies, were subject to the quality and speed of the connection and should, therefore, be considered with caution.

A more meaningful and extensive display of the main findings of the four studies is presented in Table VI. This time, instead of mean times, we illustrate the actual issues that were identified in each study (the qualitative data). As we can see, some studies identified more issues than others. This should not be seen as a weakness of the studies that identified less issues. This was mainly due to the diversity of methodologies that were used across the four studies. Moreover, each study set out to address different issues and fulfil different aims: thus the variation in the range of findings.

Clearly, some of the issues, such as the size of the screen and the problematic navigation, are common across all four studies, whereas others are unique to one study or the other. This shows that each study not only verifies, but also complements the findings of the other three studies. Therefore, one should consider the information presented in Table VI as an almost complete list of the usability issues, which are involved in using a representative number of WAP services over a GSM network.

Table VI Main issues identified in the four studies

Issue identified	Condos	Ramsay	Helyar	Buchanan <i>et al.</i>
Confused mental model			✓	
Computer terminology	✓		✓	
Cumbersome navigation	✓	✓	✓	✓
Inconsistent navigation	✓		✓	
Screen size	✓	✓	✓	✓
Site structure	✓	✓	✓	✓
Input methods	✓	✓	✓	✓
Poor connectivity	✓	✓		
Error messages	✓	✓		✓
Labelling	✓	✓		
"Back" button	✓	✓	✓	
Reading text	✓	✓		
Use of graphics	✓			
Long lists	✓	✓	✓	
Poor task analysis	✓	✓		
Broken links/Dead ends	✓	✓		
Unsuitable content	✓	✓		
Low WAP penetration	✓			
Low WAP usage	✓			
Cost concerns	✓	✓	✓	
False expectations		✓		
No help facility		✓		
Poor prompting	✓	✓		

Usability principles for WAP services

Based on the findings of this study, we have developed a set of principles that will aid towards the development of more usable WAP and m-commerce services:

- (1) *Make careful use of graphics.* Although graphics, such as a corporate logo, can differentiate a WAP site from that of a competitor, or make it aesthetically pleasing to the eyes of the users, their use should be considered carefully. If not used appropriately, they could end up occupying screen real estate that could have been used otherwise, or could result in pages that take too long to download. In any case, the designers should ask themselves if the deployment of an image would add anything positive to the user experience. In other words, would it make the service easier to use, or would it simply make the WAP site look better? Obviously, if the former is the case, the designers should use the image. However, they should still consider the consequences of doing so. For instance, would the image hide important options from the user? Would it require the user to scroll down another two or three screens in order to find the option that they are looking for? Would it cause the page to take more time to load? These are all important issues that should not be overlooked.
- (2) *Avoid long lists and indicate the length of the list.* As it was discussed earlier, it is a well-documented fact that there are some users who rarely scroll down a navigation page to see any options that might not be directly visible to them. That is not mainly due to the fact that users are too lazy to scroll down, but because they are not aware of the fact that there are more options available to them. Therefore, designers of WAP services should generally avoid long lists when possible. In all cases, when the number of the options in a list exceeds the maximum number of options that can be displayed on the screen, the length of the list should be indicated to the user in a clear way.
- (3) *Make important options visible to the user.* An extension of the above principle is that options, such as “submit order” and “start search”, which are vital to the successful completion of a task, should be directly visible to the user. In other words, the user should not have to scroll down in order to view the option in question. If, however, the latter is not achievable, the designers should make sure that the user is made aware of the fact that they should scroll down in order to view an important option.
- (4) *Provide clear, helpful and meaningful error messages.* Designers should make every effort to minimise the occurrence of errors. However, not all errors can be foreseen and therefore prevented. For this reason, the designers of WAP services should make sure that when an error does occur, the user is presented with a meaningful and, more importantly, helpful message. Consequently, clear and informative language should be used and jargon must be avoided. Finally, the error message should inform the user about what went wrong and what the user should do next.
- (5) *Avoid dead ends.* Allowing the user to navigate towards an item that is not available should be avoided, as it is a process that wastes the user’s time and money without providing any satisfaction. In fact the arrival at a dead-end, after the user has been through a series of menus, might frustrate, or even anger the user. Therefore, links to pages that are no longer available should be removed.
- (6) *Format and present content appropriately.* WAP content should be designed and formatted according to the particular characteristics of the mobile environment and the expectations of the mobile user. Short and informative summaries should be deployed to let the users know what lies beyond.
- (7) *Offer consistency in navigation and naming of menu options.* Designers of WAP services should make sure that the users are presented with navigation options, which are consistent throughout the site. This would make it easier for the users to find their way around and would increase the learnability and predictability levels of the interface. A special case of this principle is the use of the “back” button, which when pressed should take the user to the previous page and not one level up.

Options, which when selected lead to the same site, should be given the same name throughout the site. Consequently, options, which would take the user to different sites, should be named differently. The opposite would confuse the users, as they would not be able to predict the system's responses.

- (8) *Provide the user with sufficient prompting.* The users should be provided with clear and sufficient information that would enable them to carry out tasks successfully and efficiently. For instance, the interface should indicate to the users how to select options, such as textboxes.
- (9) *Minimise user input.* Owing to the apparent difficulties, which are involved in entering text by using a mobile phone's keypad, WAP sites should be designed in a way that minimises the need for user input. Alternative ways, such as preset choices, should be deployed in order to capture user input.
- (10) *Structure tasks to aid the user's interaction with the system.* Information should be designed in a way that provides the user with a clear, logical and highly structured choice of options. In other words, the designers of WAP services should make sure that basic and common tasks can be completed with the minimum amount of interaction (i.e. scrolling, typing, etc.). In order to achieve this objective, the method of task-analysis should be deployed in order to identify the steps that the user is most likely to follow in order to complete a task.

Main contributions

The main contribution of this paper is the development of the ten usability principles for the WAP and m-commerce environment. These principles cover a wide range of usability issues, which were exposed during the course of this study. The main strength of this set of principles is that it is backed up by a number of quite detailed examples, which illustrate the need for each individual principle and suggest ways in which each principle could be applied in order to improve the usability of the interface.

Another significant contribution of this paper is the identification of the fact that even existing, and therefore, more experienced,

users are having trouble with using WAP. In fact, the four current users of the service who took part in our experiment failed to complete exactly the same number of tasks (11) that the six novice users did. This is a very interesting finding indeed as it suggests that some of the usability problems of WAP cannot be overcome even by users who have been using the technology for quite a while. Moreover, the inclusion of both groups of users (current and potential) in this study, responds to the criticism that some similar studies received in the past. The potential users of the service were given the opportunity to express their perception of and future attitude towards WAP, whereas the existing users of the service had the chance to tell us what they did and did not like about it based on their experience so far.

Finally, another contribution of this paper is the comparison of the main findings of the four WAP usability studies that we know of, and the development of Tables V and VI, which provide an easy-to-read summary of these findings. Both tables, especially Table VI, could form a good starting point for a researcher who is just starting in the area of WAP usability, or for someone who is looking for a comprehensive summary of what has been achieved so far.

Conclusions

The overall usability level of WAP remains poor, resulting in users who, although impressed by the amount of information available, found it difficult to get any real satisfaction out of using a WAP phone. The reliability of the connection along with poor interface design prevented users from completing the most basic and common of tasks, such as reading a news article or checking the local weather forecast.

Additionally, even when the users managed to complete a task successfully, the time that it took them to do so was such that it caused concerns about the cost of running a WAP phone. These concerns turned into frustration when a dead end was being reached after a considerable amount of time – and money – had been spent on getting there.

The users made it clear that reading large pieces of text on the tiny screen of a WAP phone is not usable. They were not impressed at all by the fact that they had to go through

four – or sometimes even ten – pages of text in order to read a news article.

Evidently, even those participants who had used a WAP phone prior to the experiment were not immune to the aforementioned problems. Perhaps that is the reason why so many of them do not use the WAP facility on their phones on a regular basis – or even at all.

The effect that all these issues could have on the future development of WAP and the consumer adoption of m-commerce is quite significant. If the users do not feel comfortable with using the technology in order to perform trivial tasks, such as retrieving the news headlines, then it is quite unlikely that they will use WAP in order to make a purchase. The fact that seven out of the ten participants failed to find a book on the Amazon.co.uk WAP site supports this argument. Searching for and finding an item are essential to placing an order. If these two first steps cannot be completed successfully then an order will never be placed. Even those who managed to locate the item that they were looking for had to spend 3 minutes 9 seconds (average time) in order to do so.

The gradual upgrade from GSM to GPRS and eventually to 3G will solve some of the technical problems described above (e.g. speed and reliability of connection). However, it is unlikely that the HCI-related issues will be resolved. A more fundamental change is needed in the way that WAP sites are designed and content is presented to the users. The ten principles, which we have

developed based on the findings of this study, will aid towards the development of usable WAP and m-commerce services.

Note

1. Deck-it – <http://www.pyweb.com/tools>

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