

Creating Mobile Commerce Systems

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Abstract

Mobile commerce (m-commerce) is an emerging field in the business world. It depends on wireless networks for accessing the Internet from mobile devices and for exchanging data between such devices. Wireless technologies evolve rapidly and thus pave the way for the broad acceptance of mobile commerce applications. Moreover, factors such as the popularity of mobile devices, the bandwidth's improvement, the emergence of new technologies, help mobile commerce to gain popularity among the business world and users. Unfortunately, not all users are familiar with creating mobile commerce applications. Therefore, a system which can easily create mobile commerce systems can be proved very helpful. In this paper we present a system which can create mobile commerce systems in a rather friendly way. The system is supposed to be used in the mobile commerce market as a mean of creating hotel websites and mobile sites. It uses a simple form which facilitates the user to create fully functional websites and mobile sites. In this paper we focus our attention on implementation issues and we evaluate our system after testing it.

Keywords: applications and services, m-commerce, mobile devices, wireless applications, wireless devices.

1. Introduction

In the past few years we have experienced a dramatic evolution in the field of mobile technology. This has given the opportunity to millions of users of mobile devices around the world to access the Internet. Moreover, business is making advances towards the mobile commerce market due to a plethora of driving factors. Cellular phones and PDA's have become so popular that many businesses are beginning to use m-commerce as a more efficient method of reaching the demands of their customers. However, the content of most websites is such that does not allow users with mobile devices to access it easily, due to the restrictions which these devices have. Small screens, limited memory size, low calculating power and low data transmission are a few of the afore-mentioned restrictions.

Nevertheless many unique features of m-commerce like communication independent of the user's location, easier information access in real-time, receiving data easier and having accessibility anywhere and anytime make a widespread acceptance and deployment of its applications and services. Such services can be disposed to the public using wireless technologies, which have become a very important part of today's life.

But, what is m-commerce and with what does it deal with? Mobile commerce is any transaction, involving the transfer of ownership or rights to use good and services, which is initiated and/or completed by using mobile access to computer- mediated networks with the help of an electronic device [Tiwari et.al (2007)].

According to [Xiaojun et.al (2004)], there are different driving factors that encourage businesses to make advances towards the commerce market. M-commerce holds a promising future due to the penetration of the mobile phone market. Widespread availability of devices can be utilized by suppliers to directly communicate to existing and potential customers. Moreover, technology-related factors, such as improvement of bandwidth, development of wireless Internet and software, emergence of new technologies and so on, contribute to the development of m-commerce market.

On the other hand cellular phones and PDA's have become so popular that many businesses are beginning to use m-commerce as a more efficient method of reaching the demands of their customers [Senn et.al (2000)]. This ensures that commerce applications which target the needs of these customers will be acceptable by businesses and will replace obsolete commercial techniques.

Due to the afore-mentioned reasons, various companies started creating websites which are accessible from mobile devices. However, not all entrepreneurs are familiar with programming languages. Thus they cannot create websites that could advertise their products and services to the public which is this case is the mobile devices' users.

In this paper we present a platform which can create mobile commerce systems. As an example of our application we create a system which creates hotel sites. The sites which are created, both web and mobile, are not only user-friendly but also fully functional. The term "fully functional" means that in the created sites, both web and mobile, a user can navigate, see the hotels' prices, book in a hotel room. In section 2 general information are provided. Then we present the design issues for an m-commerce system and we describe its development. Finally we discuss the conclusions from our work and what future work can be done for further improvements.

2. Some General Information

2.1 Mobile Devices' Limitations

Compared to the devices which existed a few years ago, the latest mobile devices have on the one hand bigger capabilities in the content's appearance, but on the other hand have some limitations mainly due to their small screen size. These inherent limitations must be taken into account when developing and deploying content and user interfaces.

The mobility constraints can be broadly classified in 2 categories: technology- or user-related. Technology-related constraints can be further classified into communications- and device-related. Major communications-related limitations are higher error rates, more disconnections and dropped calls, higher noise, and relatively lower bandwidths. Device-related constraints include limited resources such as modest processing power, relatively small memory capacity, smaller display size, smaller-sized and fewer buttons, and limited battery power. User-related constraints include limited attention spans during mobility, changing locations and contexts, users' idiosyncrasies, and personal preferences [Subramanya et.al (2006)].

As far as device-related constraints are concerned, we can say that the relatively small screen size is one of the most important disadvantages for mobile content's presentation. Furthermore the low screen resolution may cause problems to the mobile users and may be an inhibitive factor for the use of video and bigger resolution images in the mobile devices. Modest processing power and small memory capacity bound the data storage of the mobile devices. Moreover, the operating systems which are recently developed for the mobile systems are not thoroughly tested and some safety issues may arise.

All these factors play a significant role to mobile commerce systems' design and were taken into account during our system's design and implementation.

2.2 Transition from E-commerce to M-commerce

The recent advances in hardware, networking and Web technologies rapidly changed the way companies conduct their daily business. The Web has evolved to become a promising medium for e-commerce activities [Medjahed et.al (2003)] and a broad spectrum of e-commerce applications is already available on today's Web, such as online banking and shopping. Moreover the exponential growth of wireless and mobile networks has brought vast changes in mobile devices, middleware development, standards and network implementation, and user acceptance. Driven by the success of e-commerce, m-commerce is rapidly taking place in the business forefront [Yang et.al (2003)].

M-commerce is the result of convergence of big sectors, such as the industry of telecommunications, the industry of mobile devices (including PDAs', PCs' and the biggest computer systems' manufactures), the content suppliers (e.g. those who offer

services of amusement such as ringtones or wallpapers for mobile phones, education and games) and the service suppliers (e.g. those who offer tourist services). Examples of m-commerce applications include mobile office (e.g. working while on the move), mobile advertising (e.g. location sensitive advertisements) and mobile financial applications (e.g. banking and payment for mobile users) [Yang et.al (2003)].

The emergence of protocols such as WAP or iMode and the use of Bluetooth technology, paved the way to help m-commerce become easily acceptable. Furthermore the development of user-friendly interfaces, the improvement in safety, privacy and quality issues and the GIS services were very important factors to the rapid spread of m-commerce. We should also mention the sophistication of mobile devices, which now have bigger screens, larger memory capacity and more powerful processors. All these factors helped to the transition from e-commerce to m-commerce systems.

2.3 Related Work

Lots of companies have been activated to the e-commerce field due to the Internet's evolution. Via their e-shops they can offer to their customers a plethora of products and services. In order to create these, companies have a lot of options. One of the easiest is the use of an e-commerce application platform, such as Microsoft Commerce Server 2007, osCommerce, phpAuction and Web Sphere. These platforms help someone to create e-commerce solutions and Web sites with high-performance, and they use familiar tools which simplify setup, management, and administration tasks.

Although a lot of application platforms exist for e-commerce solutions, this is not the case for m-commerce. This may be happening since m-commerce is a rather new field in the business world.

However, in the growing niche of the mobile market several companies started developing mobile content solutions. They did so, in order to expand their market share since the world of the mobile industry is rapidly deploying. In the last few years there have been developed some enterprise solutions which allow the automatic creation of mobile content. These mobile platforms provide tools for mobile advertising, marketing and content distribution. The tools include the creation and control of a wide variety of text message based services for use in mobile marketing and mobile subscriptions, easy to use software for creating mobile internet sites and features which allow mobile content's management and distribution (e.g. management and distribution of images, music, video, ringtones, wallpapers, games, handset applications). One known example of a platform which automatically creates mobile content is the mfinity mobile platform which was developed by iLoop Mobile [www.iloopmobile.com]. Despite the fact that Mobile platforms are in the nascent stage the solutions which have been developed allow the creation of mobile content.

Unfortunately there have not been developed a lot of platforms which allow the easy creation mobile commerce systems although there is a boom in the mobile web systems.

In our paper we present a user-friendly system which can create not only e-commerce but also m-commerce sites. Our system mainly depends on a form which a user fills in. With the term “user” we mean an intermediate user who uses the system and creates a mobile site. The system then uses these data and creates two sites (a website and an m-commerce site) according to the user’s preferences.

3. Mobile Commerce System’s Implementation

3.1 Designing the Mobile Commerce System

As noted above, the restrictions imposed by the keyboard and the screen typically require a different approach to page design than for desktop devices. Mobile browsers often do not support scripting or plug-ins, which means that the range of content that they support is limited. Mobile devices typically have quite limited processing power which means that page rendering may take a noticeable time to complete. As well as introducing a noticeable delay, such processing uses more power as does communication with the server. Many devices have limited memory available for pages and images, and exceeding their memory limitations results in incomplete display and can cause other problems. In our system’s design all the aforesaid remarks were taken into account.

There are a number of different implementation models for designing mobile commerce systems. On the one hand, implementation may be quite simple and consist of determining the device type and choosing the most appropriate set of previously prepared content to match the device characteristics. At the other extreme it may be carried out in a completely dynamic way, with content formatted at the time of retrieval, taking into account not only statically determined properties, such as screen dimension, but also dynamically determined properties, such as the temporary attachment of a fully featured keyboard [Wang et.al (2005)]. Our implementation combines features from both cases, meaning that we take into account the device’s characteristics but our system is not exclusively applied in that specific device. Moreover our system is dynamic up to one point, meaning that some of the content is formatted at the time of retrieval but features such as images are not resized to fit to the screen’s dimensions. This characteristic may be implemented in the future.

A familiar design technique for websites is the pagination of their content in various ways corresponding to differences in device characteristics; therefore the navigation structure of the site may vary according to the device class that is being served [Wang et.al (2005)]. Our system implements two different navigation structures: one for the mobile sites and one for the common sites. In both cases the user’s navigation is very

easy. When we say “user” we mean both the end user who accesses the created mobile site and the intermediate user who uses the mobile commerce system to create a mobile site. The only difference is that in the mobile sites there is an extensive use of text links which are very directional (e.g. when an end user chooses to book in a room, there is a link in his mobile device which has the name “rent a room”; that link navigates the user to the appropriate page) whereas in the common websites the navigation process is based in images (e.g. when an intermediate user wants to delete an uploaded picture of his hotel there exists an appropriate small image).

Just as in the desktop world, there are browsers that do not respect the intentions of the content provider [Wang et.al (2005)]. There are differences in interpretation between browsers and there are also deficiencies in implementation. In our system we chose to mainly use text content and simple graphics in order to skirt round problems such as non-support of mandatory features of a relevant standard.

Typing text in mobile devices can be difficult, time consuming and prone to mistakes so it is expected to use alternate methods of obtaining user’s information [11]. We tried to eliminate the typing process by adding dropdown menus and checkboxes. Thus we reduce the chance of errors and we provide a more satisfactory end user experience. The only case where typing is required, is when the end user fills in the application form in order to book in the preferred hotel room.

The basic navigation which we provided in the developed mobile sites was placed in the top of the page. Any secondary navigational elements were placed at the bottom of the page when really needed. We followed that technique in order to help end users to be able to see page content once the page was loaded without scrolling.

Users of mobile devices may suffer undue delay and cost as a result of following links [Wang et.al (2005)]. It is important to identify where a link leads so end users can make an assessment of whether following it will be of interest to them. So in our implementation we used links with clear, concise, descriptive text which insinuate their use, such as “rent a room”, ”hotel’s main menu” etc.

If pages are too big they may take an unduly long time to load. On the other hand, if pages are too short then the end user will be required to make multiple requests to read the relevant information. This can lead to an unnecessary delay, since each request typically takes a measurable time to complete [Wang et.al (2005)]. The balance between pagination and scrolling is partly a matter of taste and partly a matter of necessity. Devices with severe memory restrictions can only have small pages delivered to them. Equally some devices offer a poor scrolling experience and a better page retrieval experience. We tried to balance between pagination and scrolling and offer user-friendly sites which provide a satisfactory end user experience. We achieved that by creating some essential mobile pages which depicted fundamental information for the end user. Balancing between scrolling and pagination is a rather

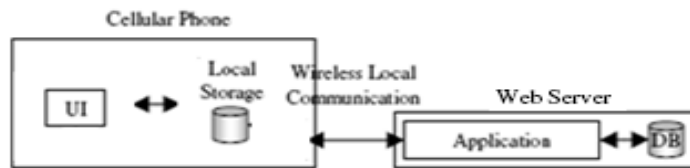


Figure 1. Architecture of a Real World Mobile Commerce System [Sogo et.al (2006)]

fixed relation, meaning that it's not adaptable at runtime. In order to avoid scrolling, we created more mobile pages.

Images that are used indiscriminately can lead to content that is hard to view, particularly with the limited contrast often found on mobile devices and in the hostile viewing conditions in which mobile devices are frequently used [Wang et.al (2005)]. Thus in our implementation we did not use any background images in order to ensure that our content was readable for all devices and to minimize the page load.

It is inevitable that, on occasions, a mobile user will not be successful in accessing the content or information he sought [Wang et.al (2005)]. Providing easy navigation away from the error is particularly important in the mobile arena, where browsers may not have an easy-to-find "back" button and where re-entry of URIs as a means of error recovery is particularly difficult. In our implementation we developed some clear and concise error messages and we embodied appropriate links which made it possible for the end users to escape the error condition.

Figure 1 shows the architecture of our m-commerce system. The user interface (UI) draws text and images on a mobile phone's screen (or on another screen such as a PDA's screen) and receives user input. The data which the user has entered are sent to the web server and appropriate scripts are executed.

As an example for our implementation we used a system which creates sites (both web and mobile) for hotels. The first part of our application is a tool for the intermediate users and the system's administrator. The intermediate users have the ability to navigate through the system and access tourist information. They can also fill in an application form for their hotel so in the future they can create a site (either web or mobile) for it. Furthermore registered users can alter the data which they have inserted to the system. System's administrator has the afore-mentioned abilities but he can also alter and delete whatever hotel he decides. In addition, all system's intermediate users can access the sites (both web and mobile) which have been created from other intermediate users. The second part of our application is addressed to those mobile devices' end users who have access to the Internet. The content here, which is actually sites concerning hotels, can be accessed from any browser, but it is specifically designed to correspond to mobile devices' restrictions (such as limited

screen size, limited memory etc). An end user besides from navigating through the created hotel site, can book in a hotel room with the use of his mobile device.

The design of this system makes it clear that we have an application which inserts information about hotels in a user-friendly way and this information is afterwards accessed in an also user-friendly way from a mobile device.

3.1 Implementing the Mobile Commerce System

Our system consists of four modules: 1. a database, 2. an interface to administrate the database, 3. a central server and 4. the created sites. The database is implemented using mySQL, the interface is mainly written in php and HTML but also has parts written in javascript, AJAX and HTML-MP which serve specific operations. The central server is a php program and the created sites are HTML programs.

The central server validates the data which the intermediate user has filled in the form. If all the values are correct, it creates an entry to the database for this intermediate user otherwise it prompts the intermediate user to re-enter his mistaken data. Furthermore, the central server allows a registered intermediate user to alter his data, upload pictures of his hotel and allows a system's administrator not only to alter other intermediate user's data but also to delete a database's entry (which is actually an intermediate user's hotel). The central server is also responsible for the creation of the intermediate user's sites (both web and mobile).

The created sites are fully functional, meaning that anyone who accesses them either by using a web browser or a mobile device's browser can actually book in a hotel room. The templates which are depicted in the created sites depend on the intermediate user's selection during the filling in of his registration form. Apart from booking in a hotel room, an end user can navigate to the created site and see much information such as the hotel's prices for the winter period or photos.

Along with the database, we implemented an interface for the administrator to be able to supervise the operation of the whole system. The system's administrator has the ability to insert, alter and delete the information which other intermediate users have inserted into the system's database. We implement these functions by executing appropriate queries with our database. As soon as these queries are executed our system prompts appropriate messages.

4. Testing the Mobile Commerce System

In order to test our system, we first created an administrator user which could handle the whole platform. The administrator, as it has already been said, is the most privileged user since he can add, alter and delete other intermediate users. Moreover we created some other intermediate users, uploaded some pictures for their hotels and we created their sites (both web and mobile) with our system. In order to test the

administrator's capabilities we altered some of the other users' data and we deleted some of the afore-mentioned intermediate users. The operation of creating a mobile

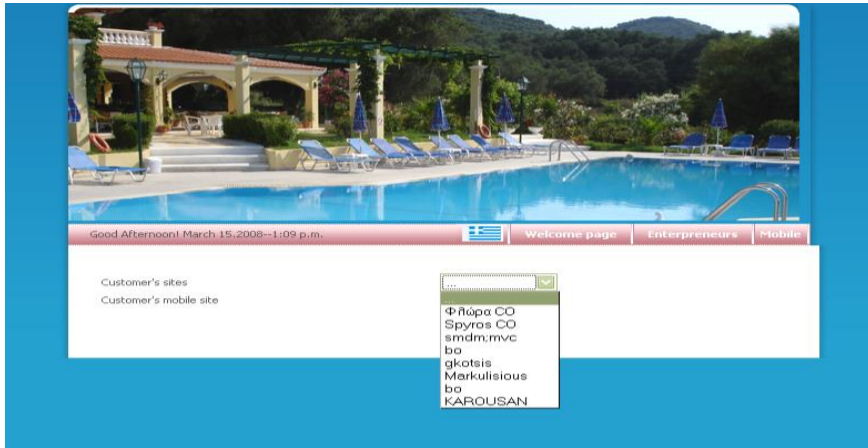


Figure 2.A *Snapshot of the Created System*

site is depicted in Figure 4. One someone finishes filling in the form, he presses the submit button and a mobile site and a website have been created. In Figure 2 an end-user can select among the created sites. The system carried out these operations successfully.

The final step of our testing was to see if the created sites were fully functional. First, we tested the created websites and afterwards the created mobile sites. In both cases, the created sites were user-friendly and fully operational meaning that a user could navigate through them and see information about a hotel, book in a room and receive appropriate messages from the system.

Figure 2 shows a snapshot of our system. We have created three intermediate users (one of them is the administrator) and we want to access their mobile sites. We select which mobile site we want to access by clicking a hotel's name on the appeared dropdown menu.

In order to test the mobile part of our simulation, we primarily used the Openwave v7 Simulator and then we used a PDA device. The PDA device which we used was the Fujitsu Siemens Loox n560. The specific device has the Microsoft Windows Mobile 5.0 Premium Edition Operating System, an Intel® Xscale PXA270 624 MHz processor, an 64 MB RAM memory and an 128 MB ROM memory. The results which are depicted in Figure 3 are from the Openwave v7 Simulator and have almost the same representation with those who were depicted with the use of a PDA. Figure 3 shows snapshots of a created mobile site. In the leftmost image an end user chooses



Figure 3. An Example of a Created Mobile Site

the site's language. In the next image the end user chooses a room type and in which period he wants to book in that room. Finally, in the rightmost picture the user fills in a form with his personal data (name, phone number etc) in order to book in the selected hotel room. The system will check if that hotel room is available, if the end user's data are valid and it will prompt appropriate messages to the end user.

We tested our platform in a small group of users, who played both the role of intermediate and end users. The respondent group includes 20 23-40 year-old expert Internet users. They were occasional mobile Internet users, with varying experience in using Internet services such as search and navigation maps. This variation enables breadth in data collection and provides multiple interpretations about the system's quality.

The users were asked to create a mobile site with the use of our system and assess it afterwards with the use of the Fujitsu Siemens Loox n560 PDA device. The results of our testing are depicted in Table 1 and Table 2.

The results indicate that our system is user-friendly one since the majority of users, both intermediate and end users, managed to navigate through it and perform some basic functions. Of course there is room for further improvement since there was a minority of end users who didn't manage to book in a hotel room or a minority of intermediate users who couldn't alter the data who had inserted for their hotels.

5. Conclusions and Future Research

In this paper we presented a platform which creates mobile commerce systems in a rather easy way. Since companies make advances towards the m-commerce market, we provide a system which is very user-friendly and creates fully functional sites.

Our system receives intermediate user input and stores these data in a database. The data are then retrieved from the database and are used in order to create the mobile

Table 1. Results of our System's Evaluation

Question	Very Easy	Easy	Not Very Easy	Difficult
System's Navigation	17%	66%	17%	0%
Filling in the form	66%	17%	17%	0%
Navigation to the Created Mobile Sites	33%	66%	0%	0%

Table 2. Results of our System's Evaluation

Question	Yes	No
Altering Inserted Data in a Easy Way	66%	33%
Booking in a Hotel's Room with the Use of the PDA Device	83%	17%

sites. An intermediate user does not have to be familiar with programming languages, such as php or HTML. All he has to do is to fill in a form and then choose the template for his site. Consequently, our platform resembles an e-commerce platform but it is used to create mobile sites. Furthermore, our platform is very user-friendly, with simple operations which do not confuse an inexperienced intermediate user and creates sites which are fully functional.

An upgrade to our system would be to insert video and more images to the created mobile sites. Furthermore, we could embody maps and thus help an end user see what exists in his hotel area. All these of course, require the use of advanced mobile devices which integrate large screens, adequate memory and powerful processors.

Αναφορές

1. <http://www.iloopmobile.com>
2. <http://www.w3.org/TR/mobile-bp/>
3. B. Medjahed, B. Benatallah, A. Bouguettaya, A. H. H. Ngu, and A.K. Imagarmid (May 2003), *Business-to-Business interactions: Issues and enabling technologies*, VLDB J., vol. 12, no. 1.

4. James A. Senn (Dec. 2000), *The emergence of M-Commerce*, IEEE JNL, Volume 33, Issue 12, pp. 148-150

The screenshot shows a web form for creating a site. The form is titled "Αίτηση εγγραφής στοιχείων" and includes a header with "Καλό απόγευμα! Πέμπτη, 16.2.2006-2:25 π.μ." and navigation tabs for "Αρχική", "Τεχνολογίες", "Για επιχειρήσεις", and "Νέοι".

The form contains several sections:

- Αίτηση εγγραφής στοιχείων:** A section with a sub-header "Συμπληρώστε τα προσωπικά σας στοιχεία και τα στοιχεία της επιχείρησής σας στην παρακάτω φόρμα. Τα πεδία που σημειώνονται με (*) είναι υποχρεωτικά. Πάτηντας **Εγγραφή**, ο διακομιστής της εφαρμογής θα λάβει και θα στείλει την αίτησή σας.
- Προσωπικά στοιχεία:**
 - (*)Όνομα χρήστη για την εφαρμογή:
 - (*)Κωδικός χρήστη για την εφαρμογή:
 - (*)Επίθετο:
 - (*)Όνομα:
 - (*)Όνομα Επιχείρησης:
 - (*)Δ.Φ.Η. Επιχείρησης:
 - (*)Διεύθυνση Επιχείρησης (Όδός, Αριθμός, Περιοχή) :
 - (*)Τοχ. Κώδικας:
 - (*) Γεωγραφικό Διαμέρισμα:
 - (*)Τηλέφωνο:
 - Fax:
 - (*)E-mail:
- Περιγραφή για το ξενοδοχείο:**
- (*)Αριθμός δωματιών ξενοδοχείου:**
- (*)Υπηρεσίες ξενοδοχείου:**

Below the form, there are two preview sections:

- (*) Επiloγή template:** Shows three preview images of website templates. The first is a simple layout, the second is a more complex one with a "Green Park" header, and the third is a large image of a beach with palm trees.
- Buttons:** At the bottom, there are two buttons: "Εγγραφή" (Registration) and "Καθαρισμός φόρμας" (Clear form).

Figure 4. Filling in the Form in Order to Create a Site

5. S. R. Subramanya, Byung K. Yi (April 2006), *User Interfaces for Mobile Content*, IEEE, Vol. 39, No. 4, pp. 85-87
6. Takushi Sogo, Yuichi Koike (2006), *LightHolder: A Platform for Real-World Mobile Commerce*, CEC/EEE 2006: 74
7. R. Tiwari, S. Buse (Jan. 2007), *The Mobile Commerce Prospects: A Strategic Analysis of Opportunities in the Banking Sector*, Hamburg University Press, pp. 33.
8. J. Wang, Z. Song, P. Lei, R. Sheriff (Oct. 2005), *Design and Evaluation of M-Commerce Applications*, R.E, Communications, 2005 Asia-Pacific Conference, pp. 745-749
9. Ding Xiaojun, Iijima Junichi, Ho Sho (2004), *Unique Features of Mobile Commerce*, Journal of Business Research, Elsevier Inc, Dempsey
10. Xu Yang, Athman Bouguettaya, Brahim Medjahed, Hao Long, Weiping He (Nov. 2003), *Organizing and Accessing Web Services on Air*, IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans, 33(6), pp. 742-757