MoBINo: An Integrated Mobile and Web Based Environment for Automatic SMS Notification

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Abstract: - The Mobile Based Integrated Notification (MoBINo) is a web-based environment for automatic SMS notification. It leverages the integration of the mobile telecommunications with the information technology in the context of push services. In a push service a user is interested in future events and when these take place, pertinent content is sent (pushed) to the end-user. In the following the specification and the development of the MoBINo platform is described in detail. The platform can be customized for the development of services or used as a middleware component in a distributed environment. The main features include its lightweight nature of the component and the programming hooks it offers.

Key-Words: - web-based environment, PHP, SMS notification, dynamic web pages, open-source, middleware

1 Introduction

The mobile telephone has been a significant factor in evolution of communication systems. One of the largest growth areas in communication is the Short Message Service (SMS) or text messaging as it is more popularly known [1, 2].

The most popular mobile application, Short Message Service (SMS), attracted 580 million users who sent 431 billion messages in 2002 [3]. In the first quarter of 2004 users sent 135 billion SMS messages [4] and predictions are that 94.9 million mobile commerce users in 2003 will grow to 1.67 billion users by 2008 [5]. SMS will account for the bulk of mobile telephone companies revenues from data services until 2006 [6, 7]. This high diffusion of SMS facilitates analyzing usage behaviour and hints at the commercial potential of future communication services. Multimedia Messaging Services (MMS), for example, will build on the success of SMS [8] but allow for richer content based on similar asynchronous, digital and interactive communication.

According to the above, there is much room for the introduction of the SMS and in general the push services in the versatile environments, in a systematic manner. These environments can pertain to business and organizations that request a direct and ubiquitous way to notify and communicate with their employees, entertainment such as TV channels that may want to offer personalized services or even the home environment where the end user wants to set his alerts and notifications.

In the context of these needs and taking into account the momentum of the mobile evolution, this paper presents a complete architecture of the components needed to support a push service. These components compose a middleware that can be used as an infrastructure in a service provision architecture.

Short Message – based Communication Services. They are 2-way services that support marketing campaigns and mobile advertising including mobile vote, competition, mobile information channel, sweepstake, quiz and download of ring tones and icons.

The automatic SMS exchange takes place The SMS with the use of specialized software protocols and applications [9]. The system architecture is based on the communication with a specialized SMS Center, which usually resides at the premises of the network operator. The communication is based on the binary SMPP (Short Message Peer to Peer) protocol implemented in the Gateways.

The characteristics of such services include the maximum sending rate, the period of validity of the message, the delivery notification report, the multiple access interfaces (HTTP - HyperText Transfer Protocol, SMTP - Simple Mail Transfer Protocol, Web, TCP/IP - Transmission Control Protocol/Internet Protocol). Other features include the real-time, web-based monitoring, the management of different application-level parameters and the access to analytic statistical elements (hits, participants, new participants).

Advantages of SMS Communication Services. The enterprises are realising that the speed and the low cost of sending an SMS message are combined harmonically and create a convenient and trustworthy way of communication with the employees, the customers and their partners.

They can take advantage of this direct and bidirectional communication and provide news notification, remind events/obligations (alerts), create communities, perform competition, and create interactive dialogue with the customers and their collaborators.

Specific advantages include,

- *Quick communication:* the telecommunications networks deliver the messages almost instantaneously.
- *Reliable communication:* the message is (almost) always being received. The SMS technology supports the proof of receipt of the message from the device.
- *Bidirectional communication:* it allows the recipient to reply.
- *Worldwide coverage:* the SMS service is supported by every GSM network around the world.
- *Industry standard:* the SMS protocol has been adopted by all the enterprises, and particularly by the mass media.

Related work. Several recent efforts have been proposed to address the issue of incorporating SMS capabilities for the remote monitoring, control of automation systems and automatic notification.

OPC (Object Linking and Embedding for Process Control) [10] is a platform that integrates IP networks with the Short Message Service (SMS), in order to deliver an integrated service for access to data sources conforming to Object Linking and Embedding for Process Control (OPC) standard specifications, through SMS-enabled mobile devices. The gateway supports pull and push services in order to support both request-based and alarm / scheduled - based notifications, respectively. It's architecture is based entirely on the ubiquitous HyperText Transport Protocol (HTTP), Simple Object Access Protocol (SOAP), Extensible Markup Language (XML) protocols, and the Global System for Mobile communication (GSM) network and thus exploits the network infrastructure already in place. The capability of accessing different types of OPC data sources (real-time and historical) by any SMS-enabled device consists of a highly flexible service, supporting mobility and event-based notification.

Furthermore, predefined events can cause notification alarms which are forwarded in the form of SMS messages to a mobile operator. Obviously, this approach fits into low cost applications with minor requirements regarding expandability and functionality [11, 12].

A System integration of WAP and SMS for home network system is responding to remote queries, the managed devices (e.g. home appliances or burglar alarm system) can actively sent alerting messages to a mobile terminal (laptop or phone) when an abnormal state occurs [13].

Viral effects exemplify transforming attention into action. Other intended consumer reactions to mobile advertising messages include following a link to a Web page, e-mailing the advertiser, purchasing a product, and placing a telephone call [14]. Compared to click-through rates of less than 1% for Web-based advertising [15], average clickand call-through rates for wireless devices are 19% and 12%, respectively. Well-targeted campaigns in Japan achieved click-through rates up to 33% [16].

Experts predicted a higher usage of mobile coupons – stored in the mobile phone's memory and therefore difficult to misplace or forget – compared to their paper-based equivalents [17]. Mobile coupons have at least three advantages: targeting based on mobile phone numbers, time sensitivity (e.g., receiving a 20% discount on purchases upon entering a shop), and efficient handling by scanning the coupon' s bar code at the point of sale.

In a Customer Relationship Management system, customers can receive free newsletters, pictures, ring tones, bonus points or coupons after joining a loyalty program. One expert, a mobile phone operator, plans to send clients SMS information on where to get the cheapest pre-paid phone cards when their credits run low. Sending SMS reminders to clients who fail to pay bills on time is another application popular with the interviewees.

Finally in Systems with Entertainment services, half of the experts noted that most people have a natural playfulness and therefore providing games and prizes via text messaging yields high participation and helps attract and keep customers. Research suggests that entertainment applications enhance customer loyalty among the ''generation @'' – young Internet users between 12 and 16 years old [18]. Television campaigns, such as Big Brother and American Idol where spectators vote for their favorites via SMS [19], as well as the

previously mentioned Warner Brothers and Wella campaigns, illustrate SMS entertainment services.

According to the aforementioned use-cases, the notification utilities can be used in a wide variety of systems, varying from industrial control systems to entertainment-related content provision houses.

Currently the notification is performed in a proprietary way, re-inventing the wheel in certain cases.

The next step could be to regard this functionality more as a value-adding utility than an autonomous system. The development in this area is expected to deal with the development of component - based infrastructures, supporting multiple notification and messaging channels such as SMS, MMS, email, or even ICQ and MSN. Such infrastructure can be provided as a building block to versatile services and systems. MoBINo is as an off-the-shelf package, pluggable in heterogeneous architectures.

Our Objective. To this direction, in our paper, we have defined the basic components of such a system and provided the functionality in an interoperable manner. We did not focus on the provision of a standalone, monolithic application, a task efficiently undertaken in the market, but have built a modular, notification platform.

This tool consists of a subsystem for event inserting, user profile management, SMS notification. Each user has a profile, where he inserts his personal information and configures the service. When the selected events take place the user is dynamically notified.

The implemented system uses reliable open-source components and commercial tools. Unlike the majority of the commercial, high-volume SMS services, our prototype system is lightweight, standalone and off-the-shelf without necessitating external resources i.e. the connection to an SMS Centre.

2 System Description

MoBINo is a web-based system that allows the online notification of events, to a dynamic list of recipients via SMS with dynamic content.

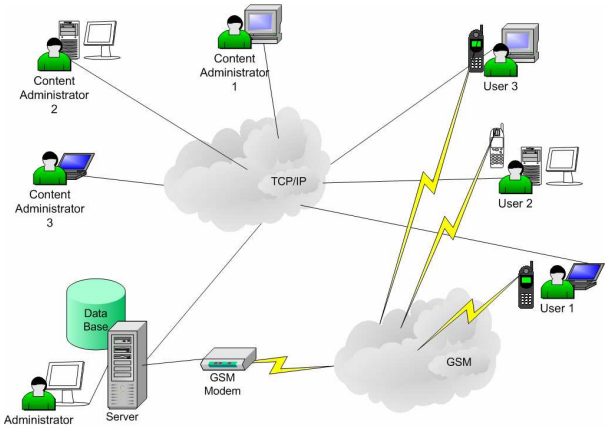

Fig. 1. The architecture of model

The system can cover any event category (e.g. athletics, TV schedule, alerts for unexpected events in the home or in the library environment, specific business needs e.g. communication with travelling employees in the case of the MMS).

There are three categories of users:

- *The system administrator:* he is in charge of all the system. He deals with the system parameterization, operation check and statistics reception, installation and maintenance of the network gate.
- *The content administrator:* he deals with the content import, management and event activation.
- *The final user:* he is interested in specific events and he gets notified of them. He manages his profile and interests.

The basic operations include:

- User registration
- User login and check
- Code access management
- Event registration / deletion and changes
- Message syntax and notification of interested users
- Collection of users preferences

User Registration. In order to achieve a certain level of personalization, the user details are stored in a database

- The user registers with a username and an access code with a specific format. We store the access code in an *encoded form*, for safety reasons.
- At the time of the registration, the user gives his/her personal details including name, surname, the email address for the electronic communication and the mobile telephone number.

- The user disconnects when he stops using the system. For the protection of the users there is a timeout mechanism.

Events, sub-events and auxiliary elements. The data categories, apart from the user details include:

- Actions of the content administrator
- Actions of the simple users.
- System or administrative data

The following operations are needed:

- The content administrators should be able to add new events, to correct the elements of events and to erase specific elements.
- The content administrator can manage events providing dynamically the notification text
- The users should be able to access the events, determining the ones of which they wish to receive notification
- The event details (e.g. the sub-event GOAL of a football match event can be header, shot, penalty etc) are stored.
- The system automatically logs the notifications.

2.1 Use cases

The use cases include:

a. **User registration:** The user provides personal details including the username and his password. He is informed of the successful registration and at any time he can alter his details.

b. **User authentication:** The user (content administrator or final user) provides his username and password and he is authenticated.

c. **Interest selection and arming:** The user selects from a list of events. He has already made registration in the system that means he has logged in. The system shows to the user a page that includes all the system events. The user checks new events.

d. **Content management:** The content administrator has already logged in. He can add new events or manage the existing ones, changing their status and activating the process of users' notification.

The use cases are depicted in the following diagram.

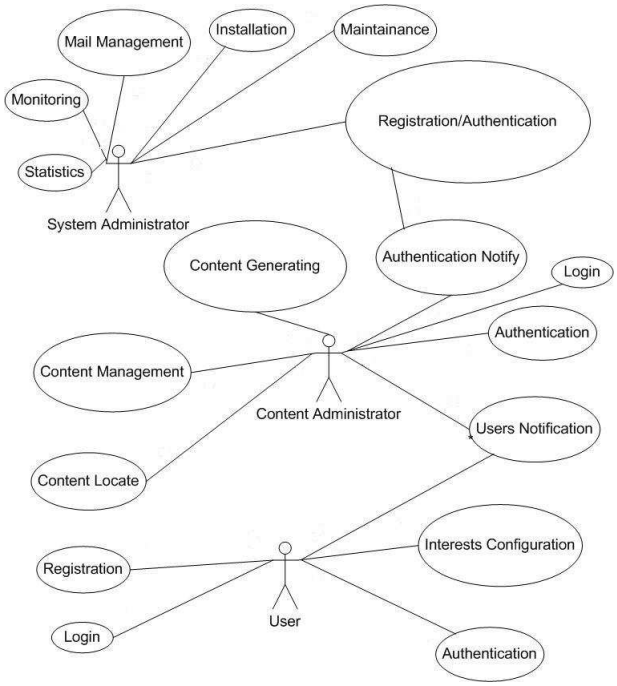

Fig. 2. The Use Cases

2.2 Main Features of the system

The application supports the dynamic creation of the content, the list of the recipients and the parameterized events.

The system consists of the following components

- The notification insertion and content provision module. Using this model the event generator, can connect to the MoBINo and asynchronously configure the notifiable events. These can extend from alarms in the home environment, to sports events, or even emergent situation in a location-based manner (accompanied with GPS functionality).
- The event handling utility, which provides hooks to the notification server. This utility can handle multiple event resources, operating in parallel and providing first-level notification in a bulk manner. The MoBINo can handle more than one event suppliers. The interaction is not restricted in a distributed computing environment but it can also handle remote transactions. To this end the functionality can be offered in an highly interoperable way, using Web Services.
- The User Profile handler, which accommodates the user preferences.

The components presented in our paper can operate as a server or a pluggable package. The implementation has proceeded in an onion-like manner. When interoperability is requested the Web Service - based layer is present offering

remote access and implementation transparency. In a local, self-package environment the implementation can be lightweight, offering direct access to the functionality.

For the validation of the system we have focused on sports events so the examples given are referred to football games.

Dynamic creation of content. When an event occurs, the content manager provides the text of the SMS, where specific fields can be pre-defined (e.g. the name of the team and the player of a football match event). The content administrator approves and finalizes the text.

Dynamic list of recipients. The application checks the database, where the users have declared their preference for the particular element of event (e.g. for the 3rd football match event the element GOAL). Then, the interested users receive the notification.

Events with parameterized fields. For each event, the application, offers to the users and the content administrators parametric fields including the event elements (e.g. GOAL, SUBSTITUTION, YELLOW CARD etc. for a football match event) and the actions (e.g. for the GOAL we have as actions the: HEADStrike, DISTANT SHOT, PENALTY etc.). The field content in the database is determined by the content administrator. The content admin can also contact the system admin via email in order to add new elements (e.g. an event, an element or an action).

3 Implementation

3.1 Components

Based on the requirement analysis and according to the system description in the following the components have been implemented are presented in the next flow chart.

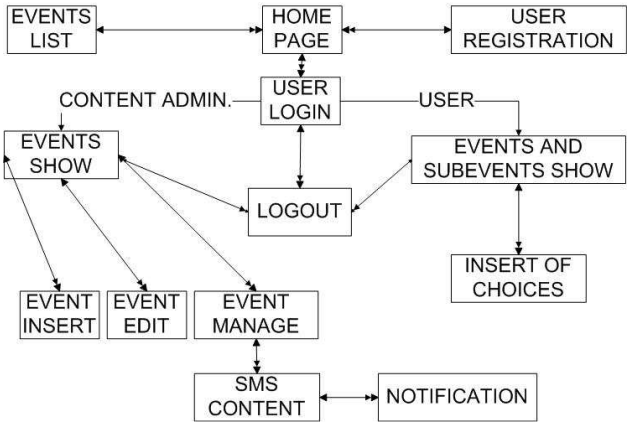

Fig. 3. Flow Chart of Application.

A functional module has been created for each of the above components. Some of the components need more than just one code script. Functionality has been also implemented for:

- The control of the identity of the user
- The storage of the events, elements of events and their retraction
- The connections to the Database
- The exit from the system

DataBase Handling. The database schema includes the user elements, the basic event elements, the elements of event development, the user preferences, the actions of the event development and finally the transactions. A user can be interested in multiple events while many users can have the same preferences. An event element can take place through many actions (e.g. Goal in the case of football game can be achieved with HEAD, SHOT e.t.c.). Finally, an event element can take place many times for the same event.

The following six tables are used:

- The table ***user*** includes the personal elements of the users.
- The table ***action*** includes the details of actions regarding the events.
- The table ***events*** includes the description of events.
- The table ***subevents*** includes the specific details of events.
- The table ***forumsevents*** includes the preferences of users for the elements of events that interest.
- Finally, the table ***transaction*** includes all the messages that have been sent.

3.2 Tools

In the following the basic frameworks and tools that have been used for the implementation are described.

3.2.1 PHP

PHP (Hypertext Preprocessor) is a widely used, open coded, generally aimed scripting language of planning-programming. It is suitable for the development of applications for the Web and can be incorporated into HTML. The code is executed in the server [20, 21].

In the present work the PHP code has been used to gather data and produce the dynamic content of pages. The PHP code implements the service logic that executes in the apache web server. Moreover,

the PHP code supports multiple RDBMS and the ODBC, the Open Database Connection standard. The registration, the connection, and the user profile management functionality, have been written in PHP, with the form of files or functions files [22, 23].

3.2.2 Apache

Apache is based on open source multi-platform web server. Apache has been the most popular web server on the internet since April of 1996 [24].

During the project the Apache server has been installed, on which the PHP and JavaScript code is executed. The communication with the clients takes place through port 80.

3.2.2 JavaScript

JavaScript is a scripting language that offers interactivity in the web pages. The JavaScript code is written in an ASCII form-code text and incorporated into the code of HTML. It can be executed immediately or at the time an event occurs. No compilation of the code of JavaScript takes place. JavaScript provides support for multilateral documents with frames, reloading of a part of the window and documents with interaction [25].

In the project, JavaScript has been mainly used for the opening and closure of secondary windows (Help), for the implementation of actions corresponding to a concrete event (reception and loss of focus of the object) and for specific calculations.

3.2.3 MySQL

MySQL is an open source RDBMS (Relational Database Management System).

We have used the MySQL to create the database schema of the application. The MySQL server checks the access to the data, so that a lot of users can work simultaneously, provides fast access and performs authentication and authorization [23]. In the PHP code the SQL commands have been executed, for the access and the changes of elements of the database.

3.2.4 NowSMS Gateway

The NowSMS Gateway is a tool for the development of SMS Push applications [26]. The gateway supports the transmission of SMS via one or more GSM modems (or GSM telephones that are connected through a serial or a USB port in a PC), or above TCP/IP connections using SMPP (Short Message Peer to Peer) [27], UCP/EMI (Universal Computer Protocol/ External Machine Interface) and/or HTTP protocols [28].

It supports Unicode formats (UTF-8), allowing the extension to multilingual environments. It has been used in the application for sending SMS message.

3.3 Operations

In the next part the Graphical User Interface is explained. The system is Unicode – enabled, supporting multi languages – the Greek version is presented herein.

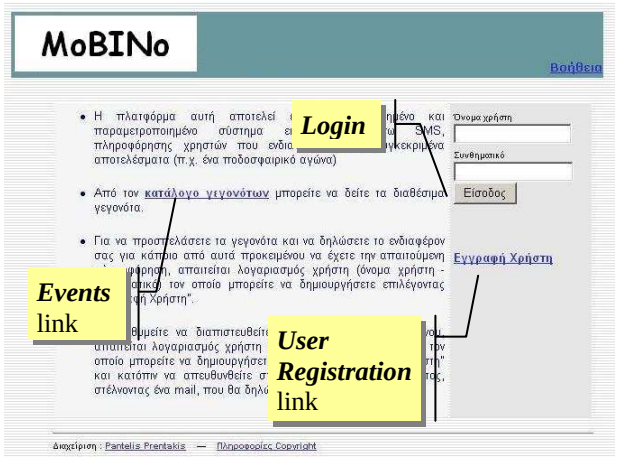

Fig. 4. Home page

The user accesses the home page and after inserting his credentials, he can manage his profile or access (directly) the list of available events. There are two cases, either the content provider, who is presented with enhanced features, or the end-user, who can handle his profile and the events of interest.

In the case of the content provider, the context-sensitive GUI forwards him to the content – administration page.

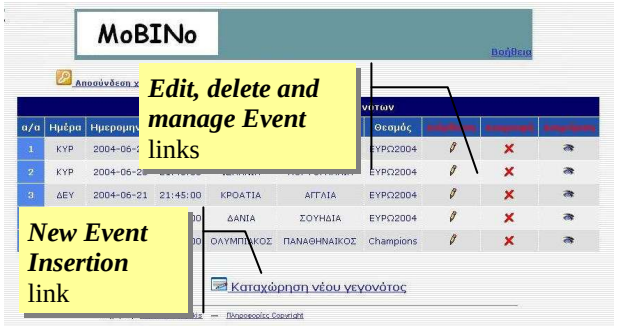

Fig. 5. Content administrator interface

The content administrator manages the events and the sub-events, inserting new or updating the existing ones.

When an event takes place the content provider configures the notification messages and inserts the pertinent text. The list of the interested recipients is automatically populated based on the user preference data. The notification utility can be triggered manually or it can be configured automatically (taking into account the potential delay – latency, e.g. in sports events).

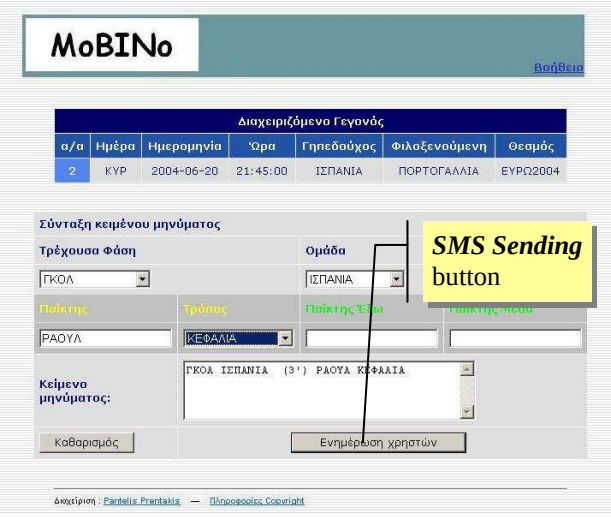

Fig. 6. Event management

The end-user is presented with a user-friendly interface, where he can set his preferences and the interesting events. He may also configure the notification preferences (e.g. text only, link, WAP message).

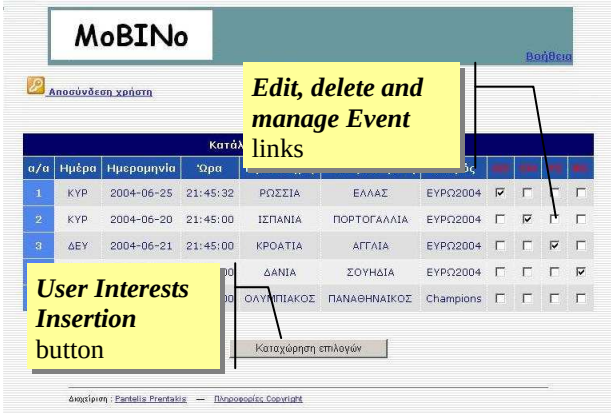

Fig. 7. End-User interface

4 Conclusions

The system development followed the basic conventions in web-based application development towards usability, security, user-friendliness and an open architecture. The system is simple and easy to maintain. The overall architecture has been primarily based on open source tools.

Contrary to the commercial systems that are offered as monolithic applications, our MoBINo platform has been a multi-tier architecture. It has been built upon the concept of the framework, which accommodates the components implementing the necessary functionality. We have attempted to leverage the well-defined, standard-based functionality of each component, in order to achieve implementation transparency. This is valid for the notification utility and the data persistence. Furthermore the requirements and a basic structure of the data, relative to this family of services have been described as well as the workflow and the functionality.

Our work demonstrates in a simple but concrete manner, how using basic components a powerful push architecture has been built and how it can be enhanced.

Critical points in such architecture are the following

- the notification volume that can be served (sms per minute)
- The metadata that accompany the content and allow the user to easily choose the interests and arm the notification events
- The latency of the system in the case of an event firing–how quickly the system reacts when an event is available
- How easy it is for the content provider to provide content and the notification events, probably in a programmatic environment
- The monitoring and management of the system

In a next phase the system could cover the three categories of users in both networks: the TCP/IP with email and the GSM with SMS.

Another extension could be the submission of MMS along with SMS. In this case we could also send multimedia as e.g. video, images and sound. This particular extension also requires other tools (e.g. adaptation of video, picture and sound).

References:

[1] Xristine Faulkner, Fintan Culwin, When fingers do the talking: a study of text messaging, *Journal of Interacting with Computers*, Vol.17, 2005, pp. 167-185

[2] Arno Scharl, Astrid Dickinger, Jamie Murphy, Diffusion and success factors of mobile marketing, *Journal of Electronic Commerce Research and Applications*,

Vol.4, 2005, pp. 159-173
[3] TTI, Mobile Messaging: Which Technologies and Applications Will Succeed? (Executive Summary), *Telecom Trends International*, 2003. Available from: <www.telecomtrends.net/>.
[4] Cellular Online, Latest Mobile, GSM, Global, Handset, Base Station and Regional Cellular Statistics, 2004. Available from: <www.cellular.co.za/stats/stats-main.htm>.
[5] TTI, Mobile Commerce Has Taken Off, *Says Telecom Trends International, Telecom Trends International*,2004. Available from: <www.telecomtrends.net/pr_MIIS-1.htm>.
[6] M2 Presswire, Arthur D. Little and Exane Report Predicts Continued Revenue Growth for European Mobile Operators, 2004. Available from: <www.presswire.net/>.
[7] Netsize, The Netsize Guide 2004 – Developing the Multimedia Mobile Market, 2004. Available from: <www.netsize.com>.
[8] M2 Presswire, Nokia Launches its Latest Research on MMS Usage, 2003. Available from: <www.presswire.net/>.
[9] G.Peersman, P.Griffiths, H.Spear, S.Cvetkovic, C.Smythe, Tutorial overview of the short message service within GSM, *Computing and Control Engineering Journal*, Vol.11, No.2, 2000, pp. 79-89
[10] V.Kapsalis, S.Koubias, G.Papadopoulos, OPC-SMS: a wireless gateway to OPC-based data sources, *Journal of Computer Standards and Interface*, Vol.24, 2002, pp. 437-451
[11] Falcom GmbH, Falcom A2(D)-3 User Manual Firmware GPS/ ALARM, http://www.falcom.de.
[12] Klinkmann Automation, GSM-Control Software User Manual, http://www.klinkmann.fi.
[13] Chi-Hsiang Wu, Rong-Hong Jan, System integration of WAP and SMS for home network system, *Journal of Computer Networks*, Vol.42, 2003, pp. 493-502
[14] S.J. Barnes, Wireless digital advertising: nature and implications, *International Journal of Advertising 21*, 2002, pp.399–420
[15] Windwire, First-to-Wireless: Capabilities and Benefits of Wireless Marketing and Advertising Based, *First National Mobile Marketing Trial*, 2000. Available from: <www.imapproject.org/imapproject/downloadroot/public3/ftw_report.pdf>.
[16] T. Natsuno, The i-mode Wireless Ecosystem, Wiley, Yokohama, 2003.
[17] M. Raskino, Mobile coupons will reach right into your pocket, *GartnerGroup Research Note*, 2001. Available from: <www.gartner.com/>.
[18] J. Hartmann, R. Buppelmann, Siemens End-User Survey Europe, *Siemens AG*, 2001.
[19] H. Nysveen, P.E. Pedersen, H. Thorbjornsen, Using mobile services to strengthen brand relationships: the effects of SMS and MMS channel additions on brand knowledge, satisfaction, loyalty and main channel use, SNF-Report No: 22/03, 2003, p. 131.
[20] http://www.php.net/docs.php
[21] http://www.zend.com/zend/aboutphp.php
[22] George Schlossnagle, *Advanced PHP Programming*, Developer's Library - Sam Publishing, 2004
[23] L.Welling, L.Thomson, *PHP and MySQL Web Development Power Programming*, Sam Publishing, 2002
[24] http://httpd.apache.org/
[25] Thomas Powell - Fritz Schneider, *The Complete Reference JavaScript*, Mc Graw Hill – Osborne, Second Edition, 2004
[26] http://www.nowsms.com/
[27] http://www.smpp.org/
[28] J.Kurose, K.Ross, *Computer Networking – A Top Down Approach Featuring the Internet*, Addison Wesley, 2001.