WEB-BASED MOBILE SERVICE FOR POLLUTION MONITORING SYSTEMS

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Abstract: Mobile Web Services bridge the gap between the mobile world and offer the ability to deliver an unlimited range of mobile-value added services to subscribers. The paper presents the usability of wireless network services in Ecology. We've developed a mobile service that allows for online inserting and retrieving data from an Information System database that serves as a pollution monitoring system. The service works on a previously developed Information System for pollution monitoring of Lake Ohrid. The Application is created in a .NET environment, which gives us the possibility to "develop once" and serve any kind of mobile device.

Keywords: mobile, service, monitoring, wireless network, .NET, Information system

1 Introduction

Nowadays mobile devices are an essential part of our lifestyle and to most of the people it's impossible to do without. But we are also past behind the time when cellular phones were used for conversation purposes only. With the growing development of the Internet, we are facing the possibility of using our handheld mobile devices to connect to the Net. The mobile devices include Cellular Phones, Two Way Pagers, Palm Pilots, Pocket PC's, Auto PC's etc. All of these devices have small display screens with low resolution that don't allow us to present a large amount of data consisting of different formatted text, pictures, sound, video and other multimedia. They have limited amount of memory and processing power, so they require some special Mobile Applications with less complexity and with the least amount of data and logic flow. Mobile Applications are practically small and compact program logic designed for a specific task, and because of this it is more appropriate to call them service instead of application. As a service they can offer any kind of information to the mobile subscriber. There are many kinds of mobile devices and some support WML (Wireless Markup Language), others HTML (Hypertext Markup Language), and yet others support both.

This paper gives an overview of the Mobile Technology, and explains the specific design decisions that influence the development of a wireless mobile application. We present a strategy for developing wireless services using the .NET Mobile Internet Toolkit as a new revolutionary way of development. The .NET Technology (Mitreski

et al., 2003) gives us the opportunity to develop the wireless application without having to choose between WML and HTML. This approach will not only be explained in theory. We give an example of a possible use of this new technology by developing a Mobile Service for pollution monitoring systems. The service will be an upgrade to a previously developed Information System for pollution monitoring of Lake Ohrid (Mitreski et al, 2000). It will allow connection to this Information System by using a handheld mobile device.

During our research we checked the Internet for different Mobile Applications, and were pleased to see the growing use of the strategy we chose for developing our service. Wireless Mobile Services are used in both e-business where the Companies need to expand on this relatively new wireless field, and also by various institutions that are beginning to explore the possibility to deliver information via wireless mobile devices.

2 Mobile Technology

The wireless industry was at first headed on a proprietary line. So Ericsson®, Nokia®, Motorola®, and Phone.com® (now Openwave®) founded the WAP (Wireless Application Protocol) Forum in 1997 to unify wireless mobile access technologies. The WAP Forum has contributed to the adoption of WAP and WML as de facto standards. WAP is a suite of protocols that enable operators, manufacturers and application developers to meet the challenges of a wireless environment (IEC, 2003). Wireless specifications were needed because the current Web protocols TCP and IP are not well suited to mobile devices. They were designed for a continuous carrier over which small packets of information are transmitted.

But on a mobile phone network, the radio link frequently goes down temporarily. This could dramatically degrade the performance of a protocol such as TCP, which was built for hardwired networks with stable connectivity. When TCP detects that the link is down, it assumes that congestion has occurred in the network and responds by significantly slowing down the transmission rate. When it detects that the link is back up, it takes time for it to return to full speed. And if we add the limited bandwidth available to mobile devices, the TCP becomes unacceptable. That's why WAP had to come, so that we can use mobile devices in the full.

2.1 The WAP Standard

In the typical Web scenario, a user types a URL into the browser. The browser sends an HTTP request to the Web server, which interprets the request and determines which resources to retrieve or execute. If the URL specifies a file, the server sends the file to the client. If the URL specifies an ASP page, its code is executed before returning the results to the client. The browser interprets the response and displays the content to the user.

To access a Web site on a mobile phone, the user types the URL in the browser. The mobile phone browser creates an encrypted URL request that contains the subscriber's identification and sends it to a WAP gateway server in binary format, rather than text-

based format. Fig. 1 compares the typical server/Web browser process with a mobile Web application scenario.

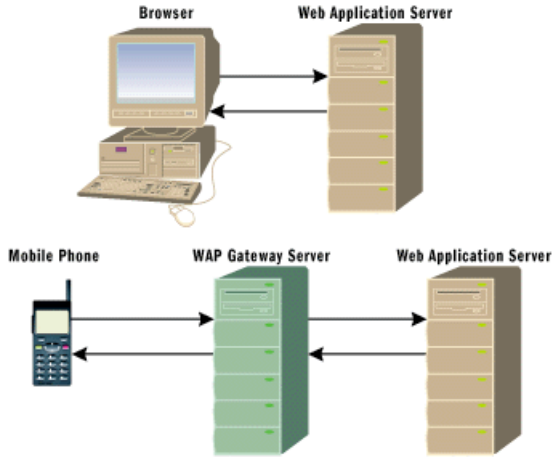

Fig. 1: Desktop versus mobile

Web protocols such as HTTP have been designed to be human-readable and this makes them too big for the wireless world. That's why WAP works with binary data, making the amount of data transferred much smaller. The WAP gateway handles the translation between text and binary. It interprets the request, translates it into a conventional HTTP request, and sends it to the Web server. After receiving the request, the Web server interprets it and determines which resources to retrieve or execute. The result is sent to the WAP gateway server. In this scenario the returned content must be in the form of a WML document. The gateway server removes the unnecessary headers, translates the WML document into binary, and sends the response to the mobile phone browser. The browser interprets the WML and displays it to the user.

2.2 NET Solution

The .NET Mobile Internet Toolkit provides a way to build mobile applications easily using a rich set of user interface components. It gets enclosed within the Visual Studio.NET and gives an opportunity for object-oriented development of mobile applications. Furthermore, the wireless service developed this way can intelligently render itself based on the device capabilities. If the service was being requested by a mobile phone, the server returns content in WML. If a pocket PC requested it, the code will be in HTML. We don't need to develop the Mobile Service in WML and HTML. We only need to create the ASP.NET page by using any .NET-enabled language like Visual Basic.NET or C#.

3 Analysis and design

Our work can be seen as a functional upgrade tool of previously developed software. The Institute for Computer Science and Informatics at the Faculty of Electrical Engineering from "Sts Cyril and Methodius" University in Skopje in cooperation with the Hydrobiological Institute from Ohrid developed a Web-based information system for pollution monitoring of Lake Ohrid (Mitreski et al, 2002). This application is based on pollution data acquisition unit, database processing sub-system, and GIS processing unit (Mitreski et al, 1997). In this way, the data and analysis is performed on one place and are available to any user having only a web browser.

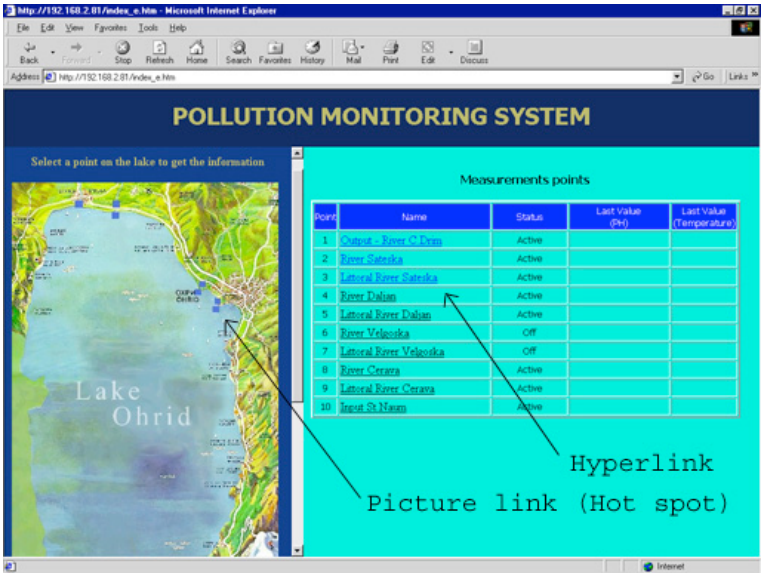

Fig. 2: Web-based information system for pollution monitoring of Lake Ohrid

The task in front was a development of a wireless network service that would allow users to use the Information Service by means of mobile devices. This service has to give us the possibility to retrieve the same wealth of information as the previously explained application. The service has to be composed of two parts. The first part would be a tool allowing authorised personnel to insert new data to the IS database, and the second part would allow any user to read data from the IS database.

There are ten monitoring stations placed on different locations on Lake Ohrid. They present sampling stations that investigate the pollution by retrieving data on a number of parameter. According to the OECD standards the lake should be monitored at least once per month (OECD report, 1982). During the summer season the monitoring should be performed twice a month. Parameters include temperature, reaction of water, phosphorus, nitrogen etc. According to all checked legislation (EU Water Framework Directive 2000; Low on Waters 2003-Republic of Macedonia) the chosen 30 monitoring parameters are sufficient to express the ecological and biological dynam-

ics in the lake in monitoring period (WFD Guidance Document, 2002). They can also present the intensity of anthropogenic pressure coming from the major tributaries in a more frequent manner. The measured data is inserted in the IS database and can be analysed by the application. A user can specify a parameter to be analysed, a location for the parameter as well as a period of time for analysis.

4 Implementation of the Mobile Service

As previously stated, the service is composed of two parts. The first part can be used by authorised personnel only and it gives them a means to insert data to the IS database. Before using this tool, the user must provide a username and password that are checked against the database, and the software performs authorisation by granting or denying access to this resource. After acknowledgement, the service takes us to a page where the users can choose a parameter to insert, including the parameters value, monitoring station as well as the date and time of measurement. Fig. 3 shows a list of possible parameters to insert, as well as an example of insertion of one such parameter.

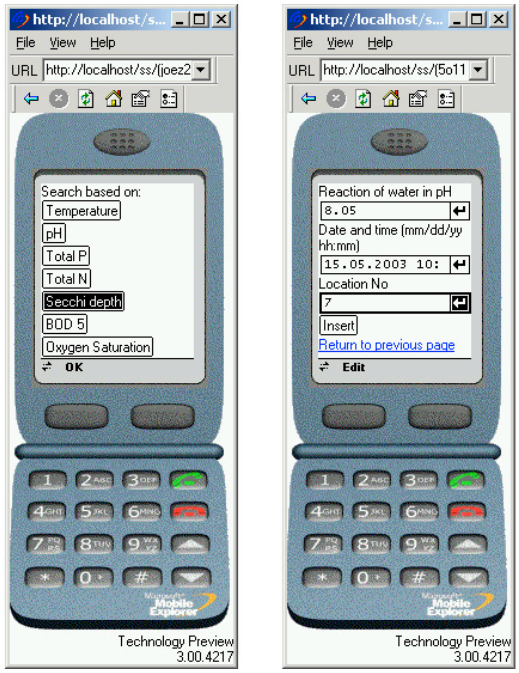

Fig. 3: Insertion of parameters to the database information system

The other part of the service allows users to read and analyse data from the IS database. This part is to be used by any user who wants to monitor the pollution of Lake Ohrid in real time environment. Anyone can access the database and be informed with newly measured and collected data. The database can be queried on any parame-

ter, for any of the monitoring stations, as well as for a wanted period of time. The service will provide the user with the mean value for the parameter with the specified conditions. Mobile subscribers can access the same wealth of information from their pocket-sized device as they can from the desktop. Fig. 4 shows an example of a query for temperature in a period of few months as well as a screenshot of how it would be done in the IS desktop application.

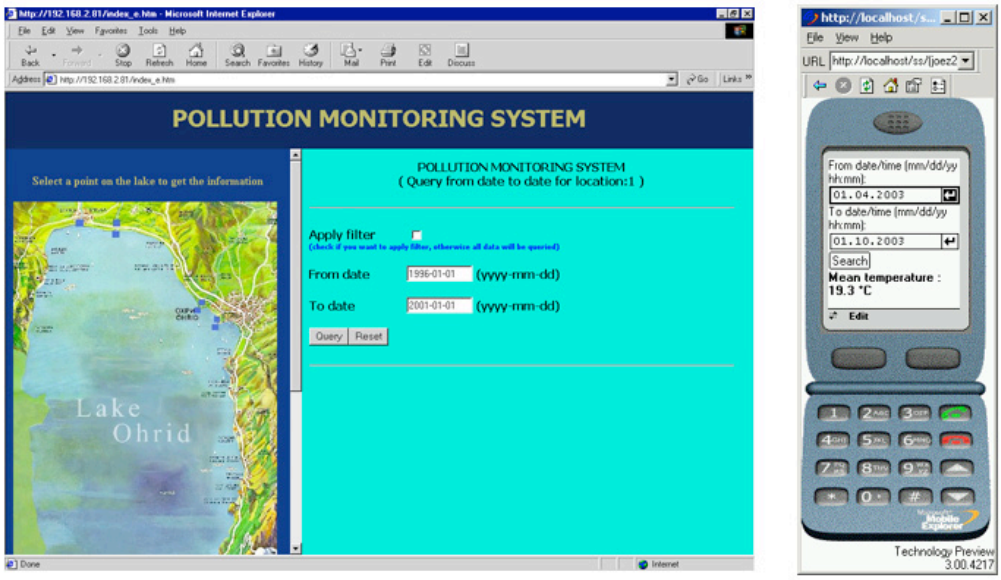

Figure 4: Presentation in the desktop application and the mobile service

Adding different possibilities for querying the database, as well as presenting other information for monitoring can enhance the service. Of course, one has to keep in mind the limited capabilities of mobile devices, so the service mustn't be too complicated for use.

5 Conclusion

Mobile Services can provide an interface for a number of different activities: weather information, banking, markets, and Intranet information such as corporate database access or even entertainment through handheld devices like mobile phones.

In the paper we present a web-based Mobile Service, developed as an upgrade tool on a previously developed Information System for pollution monitoring of Lake Ohrid. It allows users to access the same amount of information by means of mobile devices. The Mobile Service was developed using the .NET technology. We chose this strategy for developing wireless applications because of its open possibilities for accessing the service from a number of different devices like cellular phones or mobile PC's without having to worry on whether the device supports WML or HTML. Developing

mobile applications is much faster and easier using the .NET Mobile Internet Toolkit because it allows object-oriented web programming included with a rich set of user interface controls. The service is highly scalable, because adding other capabilities to it is very simple – by adding new mobile web pages.

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