

**PROCEEDINGS OF THE 29-th INTERNATIONAL SUMMER SCHOOL
'APPLICATIONS OF MATHEMATICS IN ENGINEERING AND ECONOMICS'**

**Organized by the Faculty of Applied Mathematics and Informatics
Technical University of Sofia**



EDITORS: MARIN MARINOV and GEORGI VENKOV



BULVEST 2000

Application of Mathematics in Engineering and Economics

Proceedings of the 29th International Summer School

June 2003, Sozopol – Bulgaria

Editors: Marin Marinov and Georgi Venkov

**Faculty of Applied Mathematics and Informatics
Technical University of Sofia**



**Bulvest 2000
Sofia, 2004**

ISBN 954-18-0329-4

Published by
Bulvest 2000 Ltd.
13 Serdica Str., BG-1000 Sofia, Bulgaria
e-mail: bulvest@internet-bg.net

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ISBN 954-18-0329-6

Printed in Bulgaria by INVESTPRESS, Sofia

Preface

The present volume of proceedings consist of papers which were presented at the 29th International Summer School 'Applications of Mathematics in Engineering and Economics' held in Sozopol, Bulgaria, in June 2003. The Summer School is organized every year by the Faculty of Applied Mathematics and Informatics in the Technical University of Sofia.

The aim of the Summer School is to bring together young researchers and senior scientists from the fields of Applied Mathematics. Researchers from Bulgaria and abroad contribute with their scientific results in areas such as Algebra and Differential Geometry, Mathematical Analysis, Differential Equations, Mathematical Modeling and Simulations, Probability and Statistics, Informatics. Thus, the Summer School provides with a perfect ground for the cultivation of new ideas and the development of new initiatives in the fields of Applied Mathematics. In the Summer School the participation of young researchers, as well as Diploma and PhD students is especially encouraged.

All participants have submitted their papers prior to the Summer School, those are reviewed and finally the papers are delivered to be included in this volume. The Organizing Committee, expressing the feelings of all the members of the Faculty of Applied Mathematics and Informatics, wishes to take this opportunity to thank once more all the speakers in the Summer School for their efforts that led to the achievement of a high scientific level in it and to its widely recognized success in general. We are also indebted to the Rector of the Technical University of Sofia, the Section for Scientific Research and the Section 'Technologies' for their financial support, which made the 29th International Summer School and this volume possible.

Sofia, April 2004

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Municipal System For Informational Services

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Abstract: The municipal system for informational services is developed for use by Municipalities but also can be useful to different other organizations. Its main goal is to deliver Municipal information to the citizens using Internet. For its development PHP/MySQL are being used. In Relative Database Structures (MySQL) is kept the information about the Municipality that should be accessed by the citizens. PHP scripts are responsible for the visualizations of the information through Internet pages and thanks to them the officials have a user-friendly interface that allows them to change the information in the database. Thus every official can update the database being responsible for a special part of it and not needing any other qualification. This can save time and money to the Municipal and the information can always be up to date.

Key Words: Municipal, informational, system, web, server, PHP, MySQL, programming

1. Introduction

In our Internet era the people more and more rely to the World Wide Web to receive interesting and useful information. For that reason the commitment of such information is a very important task not only for the great but also for the middle and for the small companies. Giving information is essential to the public organizations such as municipalities.

In Bulgaria there are 263 Municipalities that are on different stages of building up their informational systems. Usually, the informational system should be responsible for informing the citizens about the services performed by the Municipality as well as giving additional knowledge on the way some particular services can be obtained. But although it is the most important information, it isn't the only one.

The informational service should give different information connected to the municipality and the other structures of cultural, historical, economical and other significance, situated on its territory as industrial enterprises, commercial organizations, financial institutions, possibilities for investment, tourism, etc. Moreover, it should be able for return connection of the citizens with the Municipality as well as up-to-date informing of the citizens through SMS or e-mail. Thus created WEB server gives the officials the ability to exploit the system, adapting it to the needs of their organization even with basic computer literacy.

During the exploitation of the developed informational service, the officials can support and update the information, connected with their actual job daily, thus saving the work of specially trained experts. This leads to saving of time and money and also to keeping the information fresh and the system manageable. A special technology has been developed that gives different access to the officials during the process of updating, dividing them to administrator groups. During the development PHP technologies were used for creating dynamic WEB pages. A MySQL server for organizing databases with dynamically changing information is used. This method was used for achieving easy adopting of the system to the needs of the different municipalities.

2. PHP And Database Structures

What does the Web developer need if he wants to perform easily managed contents to the users with information ordered to their own taste or if he wants to make visual only that information for which the user had requested? And if the developer decides to give fresh information such as news, weather forecasts, etc. Then he will realize the need of constantly kept and structured data.

The constant storage may be in an ordinary text file from which the information will be extracted through PHP script. For more basic applications this could be enough, but if we really want to use the advantages of a dynamic Website then we should think of relative database. Usually this means we will use SQL database, in its core the standard language for requests is released, known in the modern database as SQL. In the relative database the data is kept in groups of tables. Every table consists of one or more columns that describe the data attributes and every line is a copy of the data.

The structures for managing the relative database are being used for many years for business and academically purposes and are proven and stable. They have solid base from methods and techniques that help to every developer in the creation of database corresponding to his needs. Moreover, we have to mention the structures for managing of Object oriented Database, which are very manageable and almost always correspond to the structure of every data. In them the data is put in as objects with properties and methods that may be used. There are many hopeful developed Object Oriented Databases that could give us the same level of capsulation and modulating that the Object Oriented Development gives to the developer. Anyway, they can be bettered in the sense of presenting the data and connections between and also in bettering the productivity. And if the algorithms for relative databases are studied and optimized, those for Object Oriented Databases are still developing. There are some structures that have the characteristics of the Object Oriented and of the Relative Databases called sometimes Expanded Relative Databases but are better known as Object Relative Database, PostgreSQL for example, which is also been supported by PHP. The need from Database is not raised only by the necessity of supporting dynamically created documents, but also from the arousing daily need from access to up-to-date information through simple and

standardized interface. With a well-configured Web server, Database server (for example MySQL) and basic knowledge in PHP, the only thing that the user will need is a Web browser.

The conclusion that we can give is that if there is a need from dynamic information in a Website, a certain web application based on Database should be developed. With the use of Database in a given Website, it will be with one level more complex and manageable, a level in which the data is generated and is being used and the information is useful to the users without being boring. The most popular language for developing of interactive and dynamic Websites is PHP. This is not just a statement but also a real fact according to research teams. It is manageable, compact, and easy for study and usage and gives all the abilities for creation of dynamic, up-to-date site, satisfying and the most pretentious. But the greatest power of the language is its ability to support database. It supports MySQL, PostgreSQL, Oracle, Sybase, mSQL, etc. The relations with the database and the work with it are easy and allow the development of effective dynamic sites. It's impossible to imagine a modern and highly functional website without database structure in it. Most of the functions that make the pages attractive could not exist - services as online payment, shopping and even simple ordering of the information are unthinkable without certain database. We would not go into technical and terminological details but will say that one of the most popular in Internet system for managing database is MySQL. More for the system itself can be found on this site: <http://www.mysql.com>. The base version of the system is free regardless of the usage - commercial or educational. As this is the main reason for its wide spreading. This does not mean that its capabilities are limited - it can carry out the request of unlimited number of users, supports up to 50 million records, gives easy to use system for limiting the access of different users and processes the requests very fast.

3. A Concept For Internet Application Based On PHP и MySQL.

From the users' viewpoint there is no difference between HTML and PHP pages. Anyway his computer receives HTML code that the browser processes and shows. The difference is in the way the browser works. Instead of just sending HTML documents through WWW to the client, it has first to generate it interpreting PHP code. In order to receive the bigger part of the information PHP communicates with the MySQL server, demanding the information from it.

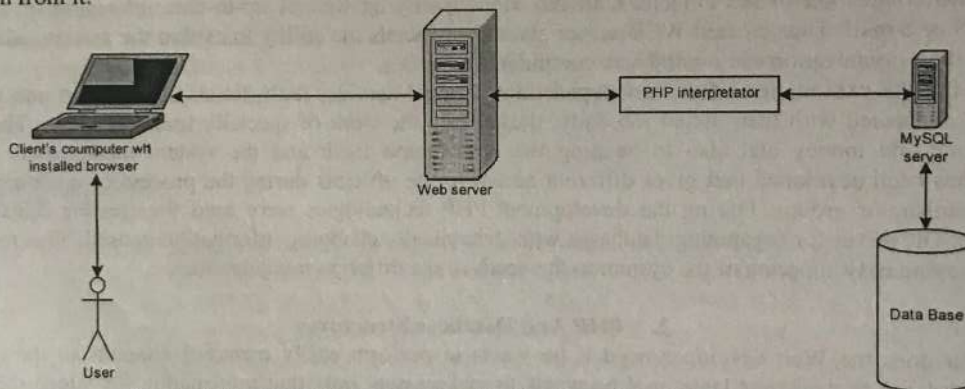


Fig. 1. A Concept For Internet Application Based On PHP and MySQL

4. Systemizing the information

The municipalities according to their authorities and obligations on the strength of the active law system are doing a number of specific services for the citizens, the companies and for the other institutions. The commitment of the dozens of services is connected with presenting the corresponding request and some additional documents that the receiver should give to the municipality. In order to ease the users, the municipality should give some information in advance about the sort of the documents and the services, the dead-terms, where should the documents be given, what will be the charge, etc. It would be more convenient if a person could receive such information outside the municipality. Having in mind the necessity of periodical updating, the most convenient way of doing this is through WebPages. Except this, the municipalities give another type of information that is not connected with certain services but gives publicity to the decisions taken and the normative documents accepted by the municipal council, helps business development, attracts the investors, presents the cultural life, etc. One part of this information is relatively stable in time as that about the commercial organizations, functioning on the municipals' territory. The other part as advertisements for vacant working places, renting of municipal buildings and places, privatization procedures or coming cultural events of local, regional or international character are actual for a short period of time. All this forces the creation of WWW server that would allow far and immediate access to the information that the Municipality gives to the public.

5. Architectural designing of the server

On fig.1 the basic elements from the architecture of the developed system can be seen. A 3-layer system has been used (application layer, information layer, client layer). The application layer consists of Web server that processes the HTTP request from the browsers. The Web server communicates with the PHP interpreter that works

on a demand processing a corresponding PHP code and returning HTML. Authorized officials use a specially designed Web interface to administrate the contents of the database so the WebPages should be always up-to-date. The PHP interpreter executes PHP scripts in which there are requests to a SQL server and extracts, adds or updates records in SQL database. A MySQL server has been used. The system administrator as well as the officials through the special Web software can correct the database that results directly to the WebPages. So they can change the contents or add new pages.

The information layer consists of SQL server and relative database. In order to show only the information in which the citizen is interested or has chosen to receive, SQL database is used.

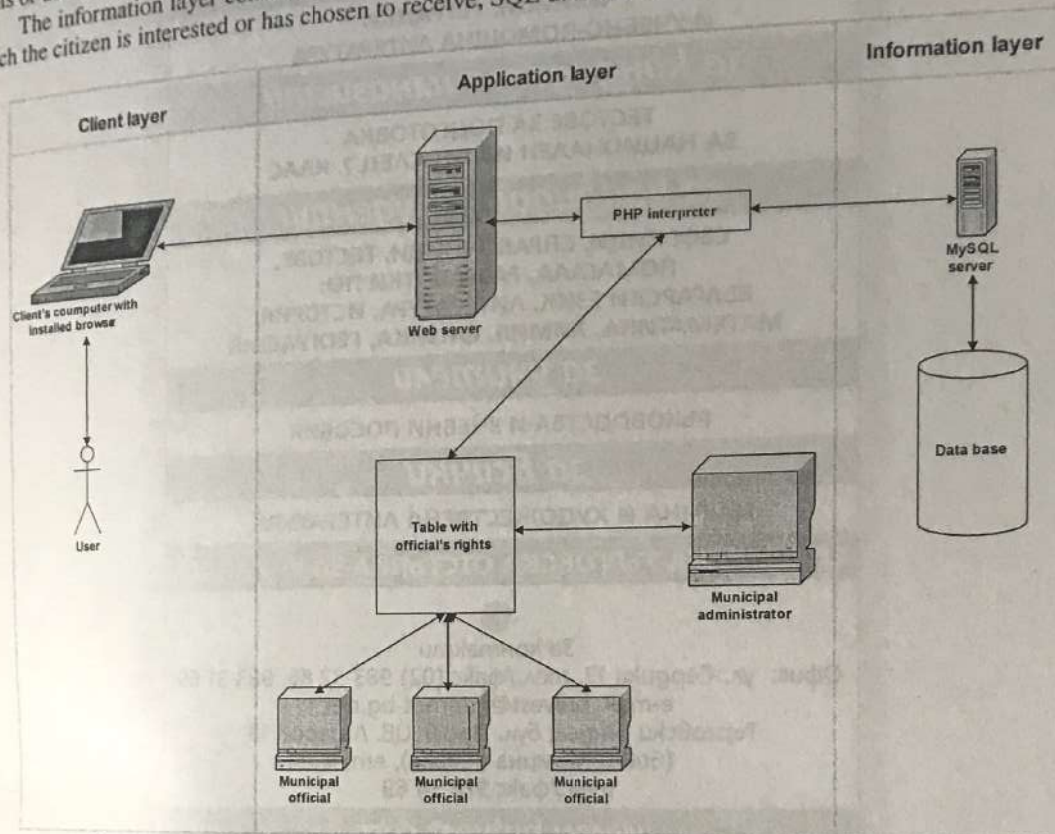


Fig.2: Basic elements from the architecture of the developed informational system

In the relative database the data is kept in groups of tables. Every table consists of one or more columns that describe the data attributes and every line is a copy of the data. The server executes the SQL requests received by the PHP interpreter and return tables with the result from this execution and gives a pointer to the interpreter.

The developed Web interface allows the system administrator of the WWW server and other authorized officials from the Municipal administration to accomplish the initial building as well as making following updates of the database. So the officials could update the data on the Web server and support the information fresh on their own. The client layer consists of browser that sends requests to the server through HTTP protocol. The user receives access to the information services of the server through the browser. He can receive, examine and sometimes print the information, if needed. The whole information received by the user is in HTML format or DHTML. This layer is divided in two parts. The first is for the citizens that examine the information in the system, and the second is administrative, to which only the authorized officials have access. The user part looks and behaves as an ordinary HTML page so it has no much interest for us. The administrative part, although looking the same way, has more different functions. Through it the officials can fast and easy to change the user part - from the information to the outside look. From the administrative part messages to the mailing list can be sent as well.

References

1. Castagetto, J., H. Rawat, S. Schumann, C. Scollo, D. Veliah. Professional PHP Programming. Wrox Press, 2000.
2. Greenspan, J., B. Bulger. MySQL/PHP Database Applications. M&T Books, 2002.
3. todo's web, <http://todos.zonebg.com/>.
4. Dark Light's Project 2003: <http://free.top.bg/darklight/>.
5. Internet: Short Introduction for Novices: http://www.math.bas.bg/~keleved/int_98.html.
6. C. E. G. WEB: http://www.comexgroup.com/software/programming/web_programming.htm.
7. PC World: PHP: <http://www.idg.bg/pcworld/php/>.