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MULTIMEDIA GEOINFORMATION SYSTEM REGEO – BASIC CONCEPTS AND CURRENT STATUS

MULTIMEDIALNY SYSTEM INFORMACJI PRZESTRZENNEJ REGEO – ZAŁOŻENIA PODSTAWOWE I OBECNY STAN REALIZACJI

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Introduction

The aim of the paper is to present ReGeo project entitled *Multimedia Geoinformation for e-Communities in Rural Areas with Eco-Tourism*, its basic concepts and the current state of development. The ReGeo system is proposed as a regional information system based on a virtual geo-multimedia database, corresponding to the needs of customers and end-users in a rural area (Frech and Koch, 2003).

The system will be focused on tourism applications but will also supply geo-data for local administration in order to enhance their decision making and planning tasks. The system is expected to serve as a powerful marketing tool by providing regional small and middle size enterprises (SME) with an access to e-commerce market. Through the multimedia virtual database developed in the framework of the system a user will have access to geo-referenced information stored in local as well as in distributed repositories. One database will supply data for various online and offline platforms and will serve different applications. One of the most important requirements is to guarantee an open data exchange by use of international standards conforming to Open GIS Consortium (OGC) specifications. A financial concept for ReGeo marketing is also being developed within the project.

The main goal of ReGeo project was to design a modern tourist information system using the most recent concepts and technologies. Some innovative aspects of the systems are as follows:

- organisation of distributed information in rural areas
- geo-coding of all data
- use of open standards to keep the system flexible
- use of open source software to reduce costs
- one system for different platforms
- advanced visualisation of geo-multimedia content
- use of remote sensing data for visualisation of landscapes
- real time processing of map information
- tools for simple maintenance by 'anyone'.

The following regions were selected for testing of the system prototypes:

- National Park Thayatal – low mountain region in the north of Austria
- Narodni Park Podyji – river-valley landscape in the Czech Republic
- Kozienice Landscape Park – impressive flora and fauna in Poland
- Nature Park Thuringian Forest – nature park in Germany.

Since the system will be tested in varying infrastructures and regional conditions, the developed methods will be of a general nature. It will be possible to extend those methods onto other regions and applications (agriculture planning, environmental protection, etc). A tourist intending to visit a region where ReGeo system is activated will be able to find information concerning general tourism infrastructure, history and culture of the site by accessing the system through the Internet, palmtop computer or info-terminal. With the help of the system it will be possible to plan sightseeing, outdoor activities like hiking or biking, to choose the most suitable hotel or restaurant and to check the weather forecast. Moreover, SMEs will have the possibility of presenting themselves and their products in the ReGeo system. The main advantage of the system can be stimulation of both: eco-tourism and small business, in regions where rural areas are in the immediate vicinity of natural protected areas.

The project is carried out by a consortium of eight research institutes and enterprises from four countries: Austria, Czech Republic, Germany, and Poland. More details on the project organisation can be found at the web site address http://www.regeo.org.

A general overview of the system structure

The main idea of the project was to create a regional tourist information system which would derive data from a multimedia virtual database and present them on online and offline systems in an attractive and user friendly way. The core information resource of the ReGeo system is the Virtual Geo-multimedia Database (VGMMDB[1]) (Fig. 1). It stores non-geographic information such as text, images or movies and geographic information such as points, lines, etc. All kinds of information are geo-referenced. The word "virtual" in "Virtual Geo-multimedia Database" means that the information is stored in several repositories, that is, in both local and distributed data stores. Exchange Framework is the exchange point of the ReGeo communication infrastructure.

[1] Developed by Joanneum Research (JRS/IIS) from Graz, Austria

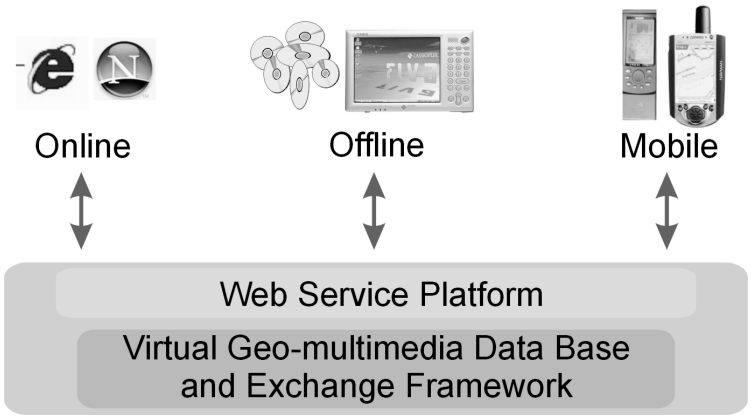

Fig. 1. General structure of the ReGeo system

Online and offline clients connect to the ReGeo database in different ways. Online devices, such as internet browsers or handheld devices are connected to VGMMDB permanently. For offline devices, such as information terminals, CD-ROMs and handheld devices it will be possible to update offline information via a temporary internet connection. User interface was designed in a manner which complies with the requirements of simplicity and user friendliness. It offers special searching methods and presents geographically oriented information as well as advanced multimedia visualisations regarding tourist objects.

Virtual Geo-multimedia Database

The initial requirement for the ReGeo system architecture was the use of up-to-date technology e.g. OGC standards, Web Services, .NET technology and databases with spatial extensions. The Virtual Geo-multimedia Database and Exchange Framework comply with these requirements.

The main control system of VGMMDB is the Geo-multimedia Connector as it is schematically presented on Fig. 2. The Connector communicates with clients using a Web Service interface. Web Services implement Simple Object Access Protocol (SOAP) recommended by WWW Consortium (W3C). SOAP provides the definition of the XML-based messages which can be used for exchanging structured and typed information in a distributed environment. XML is a perfect choice because it can represent arbitrary data structures, it is programming language- and platform-neutral and it is easy to process.

Part of the solution is the Web Feature Server (WFS) which conforms to the Open GIS specifications. The WFS defines a set of operations that accept client query specified in Geographic Mark-up Language (GML), which defines XML encoding for the transmission and storage of geographic information, including both the geometry and properties of geographic features. WFS interprets the query and accesses all connected resources to calculate an answer. Subsequently the Geo-multimedia Connector creates a GML answer to the query and sends it back to the client. The client is able to specify which feature properties to fetch and is able to constraint the query spatially and non-spatially.

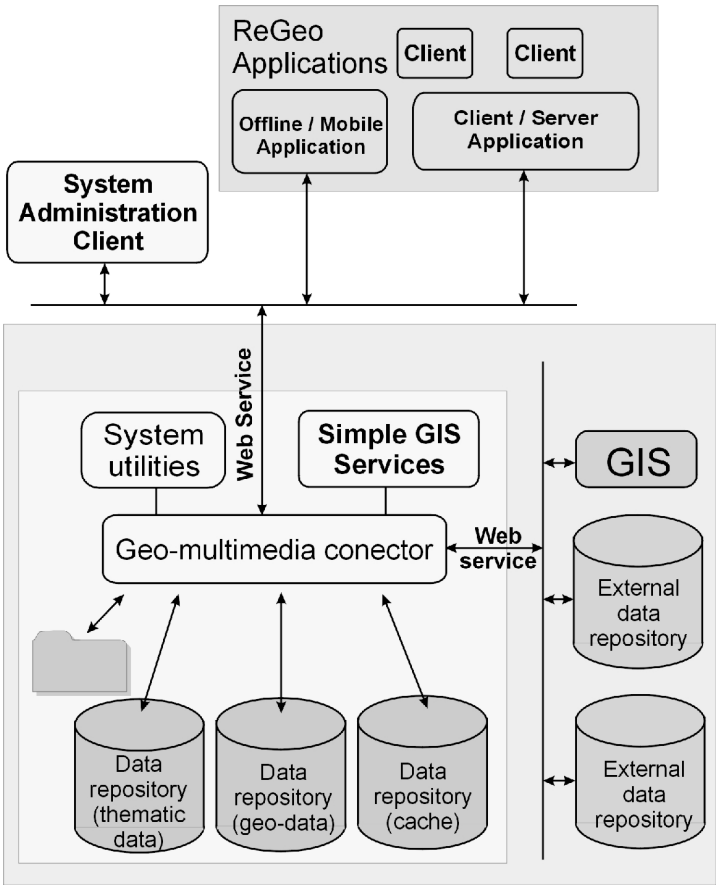

Fig. 2. The concept of the Virtual Geo-multimedia Database and exchange Framework

The generic interface is used to connect and retrieve data from external data repositories. The architecture of the ReGeo system is flexible and it supports a mechanism for adding new data resources. A local weather service provider can be taken as an example. If the local weather forecast is required by a client, the Geo-multimedia Connector sends the request to the weather service and gets the forecast back. Then the Connector sends this information together with other requested data back to the client.

Although the Virtual Geo-multimedia Database is not a GIS system itself, simple GIS services are also possible. These simple GIS features are built on the underlying database with spatial support. The prototype version of the system is based on Oracle 9i with spatial extension. OpenGIS Web Map Server (WMS) is used to produce maps of geo-referenced data.

All database schemas are defined using XML. XML schema offers facilities for describing quite complex data models. Since there are no general schemas for hotels, restaurants, tours, etc., they had to be defined by the ReGeo consortium as the result of the analysis of various queries scenarios.

In order to facilitate administration of the information contained in VGMMDB a special management tool has been created. It provides a facility for inserting, updating, and exporting

data to/from the repository, e.g. points of interest can be marked on a map and the selected coordinates will be stored in the database. The screen shot (Fig. 4) shows a preview release of the REGEO Management Tool prototype. The tool supports a raster map viewer (right side) with several functionalities like pan, zoom in/out or delete and provides an editing tool for different themes (left side).

Client-server application

The web server application[2] (Schorr et al, 2003) is a stand alone application which serves http requests from clients. If necessary, in turn it then requests data from VGMMDB using the SOAP, WMS and WFS protocols. The responses are processed for end use and then sent back to the client through the web (Fig. 3). However, the web server application is able to serve user requests without necessarily having to query the VGMMDB. It acts as a cache for the data stored in the VGMMDB.

Fig. 3. Overview of the Regeo components interfacing with the web server application.

The main window of the user interface (Fig. 5) always contains the following two links:

- Map and Text
- Map Only

When the option "Map and Text" is chosen, the main window displays a text area in the middle and a map in the right part of the screen. The option "Map Only" produces a large map in the middle of the window, without an associated text field. The prototype application offers the following map functionality:

- query by clicking the map,
- zoom in and zoom out,
- full extent,
- panning the map with arrow keys.

The navigation tree displays the available themes and the associated entries "overview" and "details". When a theme in the navigation tree is selected, a separate window containing general information about the theme appears in the main window. Clicking on the "Overview" link produces a list of available items, and adds the corresponding symbols or lines to a small map.

The site offers a general search function that allows the user to search for all objects (accommodation, tours, etc.) within the application web site. The action box contains the actions that may be performed by the user, depending on access privileges. The anonymous

[2] Developed by geo-konzept GmbH from Adelsschlag, Germany

guest user is prompted to “Join” and become a member, or to “Login” if he or she already has a valid membership account.

The prototype of the web server application is now being tested in four regions.

Offline applications

The offline systems component of the ReGeo project encompasses various devices such as CD-ROM, info terminals and PDA which operate without connection to the Internet. Offline systems will perform similar functions to their online counterparts, with the exception that they will work with local databases. Each device has its own specific features from hardware and software points of view, thus the different applications are being prepared for them.

The aim of the CD-ROM application is to provide an easily disseminable source of information about a region and about the ReGeo project itself. CD-ROMs will contain a user friendly interactive presentation of the region and its attractions. In addition the CD-ROM will contain some information about the ReGeo project and other regions supported by ReGeo products.

PDA devices will be used to create an electronic guide for the region. They will help tourists visiting various places in the region by supplying them with interactive, rich information, supported by multimedia effects, thus delivering it in the most efficient manner possible. PDA devices may be used in connection with GPS receivers for tracking, for example roads while driving a car, paths while hiking or biking, etc.

The prototype of the PDA offline application[3] is designed to conform to the Pocket PC GUI design guidelines. The application displays descriptive data, simple geometries and multimedia data. Data storage is divided into three parts: descriptive data, geographical data (geometry) and multimedia files. The PDA application uses the SQLite database engine to store descriptive data, while other data types are stored as regular files in the system. Multimedia files are all kept in the file system, while the detailed information about these files is stored in the SQL descriptive database.

All data incorporated in the ReGeo off-line systems has been originally obtained from the VGMMDB and transferred to PDA or CD-ROM. This is not, however, a direct process, because the data require formatting and proper storage before they are available for use within the application.

One of the main goals is to provide the user with a similar “look and feel” for all ReGeo applications. As a result, the general GUI design for the offline system is based as closely as possible on the web version of ReGeo. Examples of the user interface elaborated for PDA devices are presented on Fig. 6. The menu is the most important tool for navigating through the application screens (Fig.6a). After the application is opened, the user is able to access a list of all regions available in the database on the device. After selecting one of the regions, the user has access to geometric and descriptive data as well as multimedia files catalogued according to the presented themes. The map component provides useful tools for map navigation and basic operations (Fig. 6c). The user-friendly browser provides easy access to picture, sound and movie files (Fig. 6b).

[3] Developed by Taxus Information Systems Ltd. from Warsaw, Poland

Presentation and visualisation techniques

One of the main objectives of the REGEO project is to present geographically-oriented tourist information in an interesting and appealing manner. Therefore ReGeo presentations are based on the latest 2D and 3D visualisation techniques (Almer and Stezl, 2002). A general overview of the visualisation methods applied in the ReGeo system is illustrated mainly by presenting objects prepared for Kozienice Landscape Park[4] .

Cartographic layers are needed as a background for 2D presentations of features related to various tourist information themes. Digital cartographic raster layers are provided for Kozienice Landscape Park in the scales of 1:50 000[5] , 1:100 000, 1:200 000 and 1:500 000. In order to keep the background content simple, not all available map layers have been included. The user will have the possibility to combine different tourist themes such as hiking, cycling or accommodation. The maps therefore have to be simple to obtain a "readable" result when points and lines representing different themes are overlaid on them. Thus, layers that include shading or isolines are not used.

Beside modified topographic maps also satellite images and aerial photographs can serve as a background for tourist information. Aerial photographs[6] have been geocoded and orthorectified before composing a mosaic covering the whole region of interest. The orthophoto mosaic has been resampled to two different resolutions: 1m, and 2m, which can be used at the appropriate map scales. A colour composite derived from georeferenced multispectral Landsat ETM image acquired on the 6th of May in 2002 can be also used as an alternative background. This composite was created by data fusion of the panchromatic channel (15 meter resolution) with the multispectral data (30 metre resolution). Another possibility is to use a land use / land cover thematic map as the background map at lower scales.

3D visualisations always need a digital elevation model (DEM) as the basis for further processing. DEM for Kozienice Landscape Park has been prepared from aerial stereo pairs by photogrametric analysis. 3D models (Almer et al, 2002) with natural textures are calculated by combining processed aerial (Fig. 7a) or satellite images (Fig. 7b) with the DEMs. A precondition for this data generation is the exact geometric concordance of previously geocoded images and the DEMs.

In the case of 3D models with artificial texture, artificial 2D and 3D objects are used instead of aerial or satellite images. Usually, an extensive object library is needed. Such a library contains a variety of classes like trees, fields or buildings with each class containing several objects. These artificial objects must be positioned within the 3D model. The location of different objects can be controlled by raster or vector GIS datasets. An example of 3D model prepared with artificial texture is presented on Fig. 7c.

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[4] The pre-processing of remote sensing data, DEM and 2D-maps have been done by the Institute of Geodesy and Cartography (IGiK) in Warsaw, Poland. The 3D-visualisation applications like flyovers, panoramas and real time models have been calculated by JRS/DIB based on the data produced by IGIK.

[5] Topographic maps in a scale of 1:50 000 can be used within the ReGeo project according to the permission No *ZG-8040/46/1137/03* received from the Centre of Geodetic and Cartographic Documentation of the Polish Main Office of Geodesy and Cartography.

[6] Colour aerial images in a scale of 1:26 000 can be used within the ReGeo project according to the permission No *ZG-8040/46/1137/03* received from the Centre of Geodetic and Cartographic Documentation of the Polish Main Office of Geodesy and Cartography.

3D models have been used to create virtual flyovers and virtual panoramas. In order to generate a virtual flight, many single images must be rendered and combined to form an animation file. The single (real or virtual) images are combined to produce a panorama file. Single 3D views must be rendered from the same camera position but different view directions covering the whole area of 180° or 360°. The names of villages have been included in the panoramas and flyovers.

The integration of ReGeo themes into the 3D model can be achieved by the user in real-time. When choosing a theme in the online or offline application, a request is sent to the database and the necessary information (point or line information) is loaded. These data are displayed as 3D symbols or 3D lines in the 3D model.

The ReGeo system can also offer attractive presentations of highly-detailed 3D object models. The 3D model of Wartburg Castle in the Thuringian Forest may serve as an example of such presentation.

Conclusion

A regional system created within the framework of ReGeo project will introduce users to the assets of the region, particularly to its nature and tourist attractions, by integrating data from scattered data bases. Tourists will be provided with an attractive visual presentation of the region and its offer.

Regeo will contribute to strengthening the local economic infrastructure including eco-tourism aspects as well as regional economic issues and will support access of SMEs to the e-commerce sector. The local administrations will be able to use geo-data from their region stored in REGEO virtual database.

According to the business plan developed within ReGeo project, the system will be available on the market after the completion of the project which is scheduled for the autumn of 2004. The system is designed as an open system and can be easily extended to new file formats and interfaces.

Acknowledgments

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STRESZCZENIE

Artykuł przedstawia projekt **ReGeo** *pt. „***Multimedialny system informacji przestrzennej dla wspomagania rozwoju obszarów wiejskich poprzez promowanie ekoturystyki**"*. *Jest on finansowany ze środków 5 Programu Ramowego Unii Europejskiej w ramach bloku tematycznego Technologie Społeczeństwa Informacyjnego (IST). W projekcie realizowanym od 2002 roku bierze udział 8 instytucji naukowych i firm komercyjnych z Austrii, Niemiec, Republiki Czeskiej i Polski. Głównym koordynatorem projektu jest Uniwersytet Alberta-Ludwiga z Freiburga, a polskimi uczestnikami są Instytut Geodezji i Kartografii w Warszawie, firma Taxus SI z Warszawy oraz Kozienicki Park Krajobrazowy.*

Celem projektu jest utworzenia multimedialnego systemu informacji turystycznej, który ma służyć integrowaniu regionalnych serwisów turystycznych i systemów informacji przestrzennej, także tych które nie są skierowane bezpośrednio do turystów. W ramach projektu ReGeo planowane jest stworzenie takiego systemu, który upowszechni wiedzę o regionie oraz szczególnie uwypukli jego walory przyrodnicze i turystyczne. Jednym z celów projektu jest zaktywizowanie terenów wiejskich o wysokim poziomie bezrobocia poprzez rozwój ekoturystyki. System będzie także pełnił rolę pośrednika w kontaktach, promocji i wymianie informacji dla różnych grup użytkowników: lokalnej administracji, inwestorów, przedsiębiorców.

Prototypy systemu ReGeo są testowane w regionach, gdzie tereny wiejskie sąsiadują z obszarami przyrody chronionej. System zaprojektowano dla regionów o różnym charakterze przyrodniczym, infrastrukturze i regionalnej specyfice kulturowej. Wspólną cechą wszystkich regionów są szczególne walory krajobrazowe i przyrodnicze, a także możliwość uprawiania czynnej turystyki, które mogą być podstawą rozwoju tych obszarów.

System będzie wdrożony na terenie czterech parków narodowych lub krajobrazowych i ich najbliższego otoczenia. Parkami tymi są:

- *Park Narodowy Thayatal w Austrii,*
- *Park Narodowy Podyji w Republice Czeskiej,*
- *Park Krajobrazowy Thüringer Wald w Niemczech,*
- *Kozienicki Park Krajobrazowy w Polsce.*

W przyszłości system będzie można z łatwością zastosować w innych regionach o walorach turystycznych.

Ważnym atutem tworzonego systemu będzie możliwość jego instalacji na różnych urządzeniach, tak aby turyści i inni użytkownicy mieli do niego wygodny dostęp: poprzez internet będzie można skorzystać z systemu o każdej porze i w każdym miejscu, a będzie on również udostępniany w trybie „off-line" na płytach CD, a także na urządzeniach przenośnych (typu PDA). System ReGeo może być instalowany na infoterminalach w kioskach informacyjnych, siedzibach parków, punktach informacji turystycznej.

Jednym z podstawowych założeń projektu było utworzenie otwartego systemu z zastosowaniem nowoczesnych technologii informatycznych. Podstawą systemu ReGeo jest zdecentralizowana, wirtualna, multimadialna baza danych odniesiona przestrzennie. Dostęp do repozytoriów danych jest zapewniony przez usługi sieci internetowej, a środowisko wymiany danych zostało zbudowane zgodnie ze standardami Open GIS Consortium.

W ramach systemu opracowano atrakcyjną formę prezentacji jego zasobów. Zastosowano zaawansowane techniki wizualizacji z przejrzystą szatą graficzną. Oprócz prezentacji na dwuwymiarowych mapach podkładowych oraz mapach satelitarnych i ortofotomapach wprowadzono wizualizacje trójwymiarowe wraz z symulacjami przelotów nad najbardziej atrakcyjnymi terenami, panoramy możliwe do zaobserwowania z punktów widokowych, panoramy miejskie i wirtualne spacery po zabytkowych obiektach. Szczególny nacisk położono na takie opracowanie prezentacji multimedialnych, aby były one realizowane w czasie rzeczywistym.

Obecnie prototyp systemu jest testowany w czterech wybranych obszarach, a także jest opracowywany plan wprowadzenia systemu na rynek. Po zakończeniu projektu, które jest przewidziane na jesień 2004 roku, będzie można zakupić system oraz uzyskać pomoc przy jego wdrażaniu. Szczegółowe informacje na temat projektu i dostęp do testowego prototypu systemu można uzyskać pod adresem www.regeo.org .

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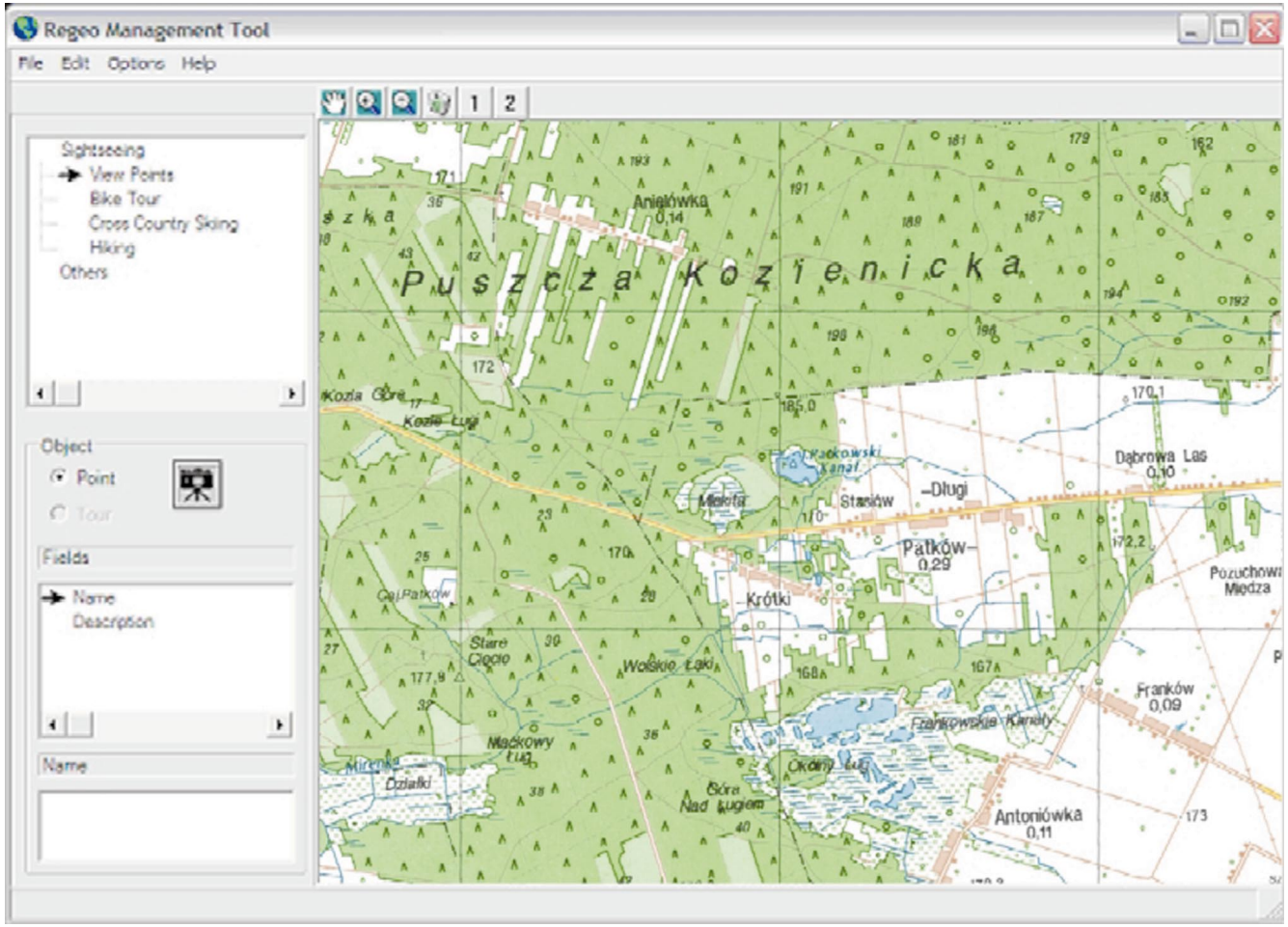

Fig. 4. Data Management Tool

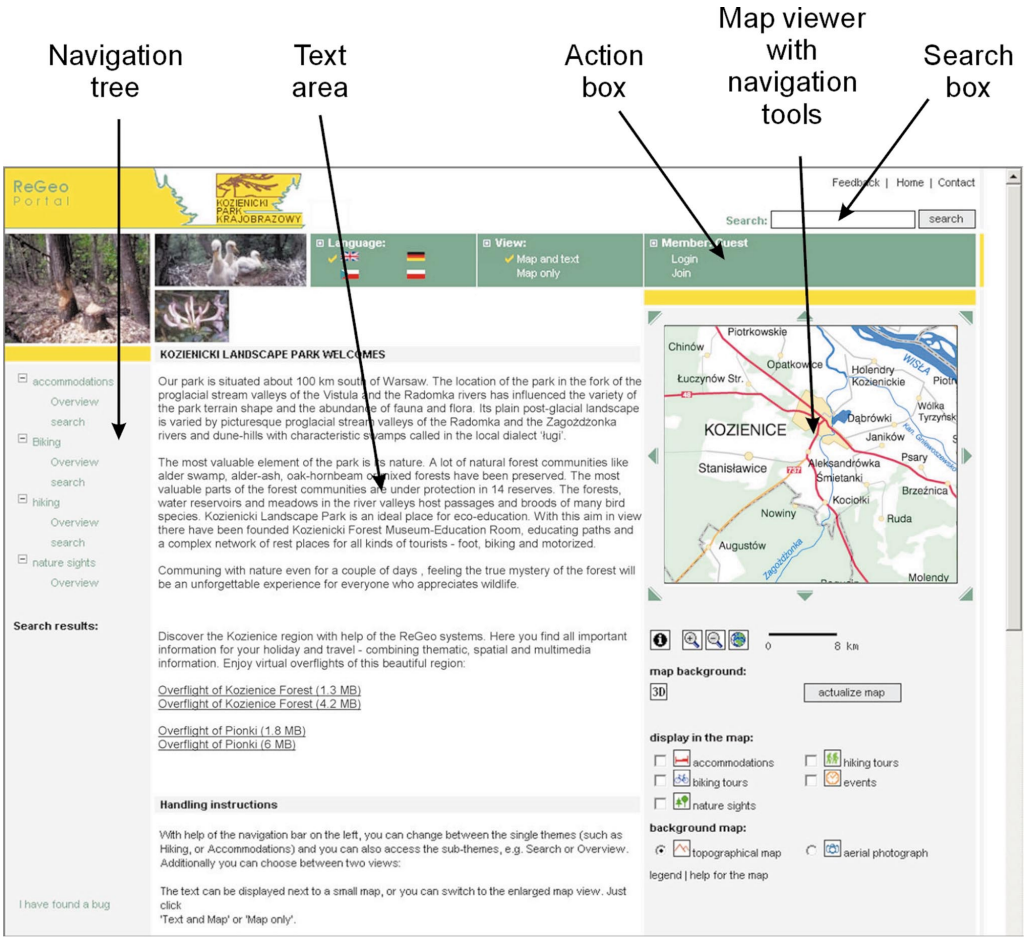

Fig. 5. General User Interface elements

a – the welcome screen with main menu

b – picture viewer

c – presentation of a map

Fig. 6. Examples of ReGeo system interface on pocket PC

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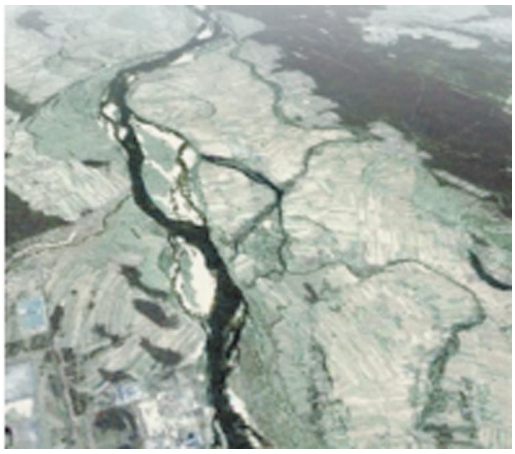
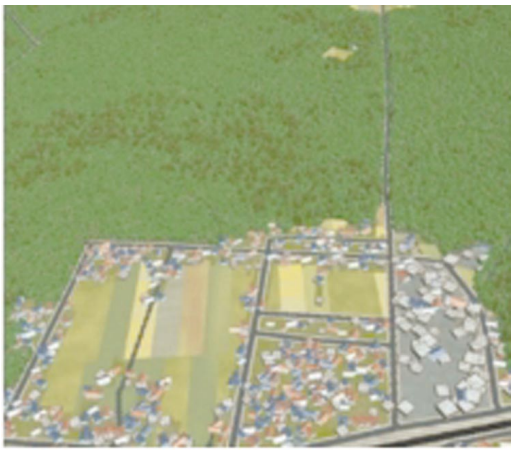
a – natural texture obtained by fusion of panchromatic channel with multispectral data from Landsat ETM satellite image



b – orthophoto as natural texture



c – artificial texture based on landuse data.

Fig. 7. Examples of 3D models with various textures prepared for Kozienice Landscape Park