Campus GIS functionality and interface

Boriana Deliiska, Maya Dencheva, Radoslav Milchev
Department of Computer Science and Informatics, University of Forestry, Sofia, Bulgaria

***Abstract**: A geographical information systems (GIS) are powerful tool for better planning and management of the university campus due to easier and more illustrative information access, affluent functionality, and improved data processing. The survey shows that existing online campus GIS have various scope and resources. On the base of the survey in the article a suggestion of its functionality and interface is proposed depending on the different user groups. A simple prototype geodatabase schema is developed. The key thematic data layers comprise campus regions, buildings and building floor plans. The resources of online campus GIS interface are described.*

***Keywords**: campus GIS, campus map, geodatabase, GIS server*

1. INTRODUCTION

A geographical information systems (GIS), as a branch of Information Technology (IT), and related geospatial technologies are a tool that will result in better planning and management of the university campus due to easier information access, more clearness and improved data management. Benefits that are likely to result include: cost savings, because of better planning and management of physical resources; better decisions in result from more accessible information, higher quality of data, and established procedures for repetitive analyses; improved communications etc [1].

A lot of well-known universities have campus GIS [5] with different functionality and interface. The better of them are GIS of: Idaho State University (http://www.isu.edu/isutour/isumap.html), Michigan State University [http://www.gis.msu.edu/], University of Texas (http://www.utexas.edu/maps/), Carleton University, Canada [http://www2.carleton.ca/campus/], National University of Singapore [http://www.nus.edu.sg/campusmap/], University of Leeds, UK [http://webprod2.leeds.ac.uk/campusmap/index.asp] etc.

The search under keyword "campus map" in Google finds about 970 campus map sites, and under "campus GIS" – about 100. The predominant number of them are of US universities. Excepting some digital raster campus maps, campus GIS of any Bulgarian university has not been found.

The goal of the current work is to investigate the user needs and to formulate campus GIS set of functions and relevant interface. Then software technology and environment for its implementation is determined.

This paper is organized as follows. Campus GIS functionality in Section 2 is investigated. In Section 3 the interface of campus GIS is grounded. Section 4 discusses the conclusions and the future work.

2. CAMPUS GIS FUNCTIONALITY

Campus GIS design and development includes preliminary analysis of:

- existing paper and digital maps and plans of university territories and buildings;
- scope and place of university territories;
- university activities and possibility of its maintenance by GIS;

- user groups;
- necessary hardware and software resources.

Because of specificity of university activities and potential user groups, campus GIS has to include following main functions:

- visualization of maps and plans of university regions, buildings, floors and rooms;
- localization of:
  - → educational and administrative places – teaching and administrative staff offices, rooms (halls, laboratories);
  - → parks, sport centers, experimental fields etc;
  - → infrastructure objects – sewerage, water supply, electric mains, heating installation, road network etc;
  - → educational staff position;
  - → student group or course position;
- producing of thematic maps and charts of:
  - → educational staff work load;
  - → student day occupation;
  - → rooms, centers and fields occupancy;
  - → room destination;
  - → room work place number

etc.

The above functions determine GIS layer structure and hierarchy. The key thematic data layers of such GIS comprise campus regions, buildings, building floor plans and master plan data [4]. This layers include spatial and attribute data necessary for function execution.

2.1. Layer design

As a whole by the reason of different destination and map scale, the layers of an university GIS are distributed in the following kind of containers (feature datasets) (Fig.1):

- all university areas in point layer of small- or medium-scale map;
- large-scale maps of campus regions, training centers, experimental fields, rehabilitation, sporting and holiday centers;
- building and floor plans.

The availability of concrete containers depends on the university structure. Each container can include layers (feature classes) of administrative or cadastral boundaries, infrastructure resources, buildings, contours, vegetation etc.

Only campus region container is mandatory.

The geospatial data in the contemporary GIS are organized in one of more geodatabases (called also GIS or spatial databases). Commonly, geodatabase is a object-relational database designed to store, query, and manipulate geometry and coordinate data type as the other standard (attribute) database data types [Wikipedia]. The geometry and coordinate data type represents the shape and the location of an object in the physical world.

All geospatial data are in relational tables.

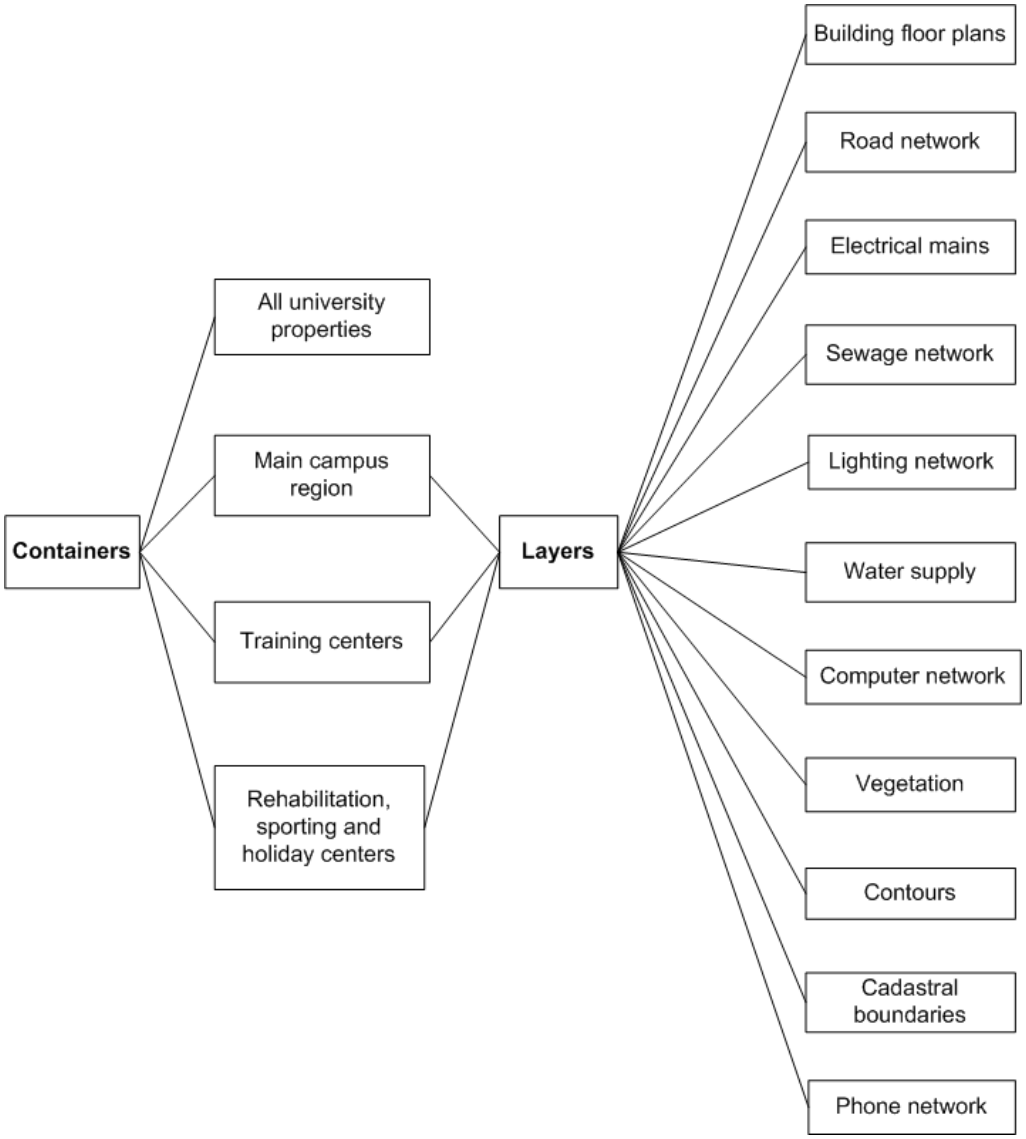

Fig.1. Hierarchical layer structure

2.2. Campus GIS geodatabase schema

The above specified functions can be realized by appropriate logical geodatabase structure. A simple prototype campus geodatabase was designed as a subset of a facility management data model.

On Fig.2 an example of common geodatabase schema about main campus region container including spatial and attribute data in tables, feature classes etc and its relationships is given.

The primary tables *Rooms*, *Schedule* and *Staff* save geospatial data about floor plans, educational schedule and university staff. The secondary tables are code classifiers of properties, buildings, room types, administrative units, educational calendar (days and hours), educational disciplines and specialties, educational levels, staff appointments etc.

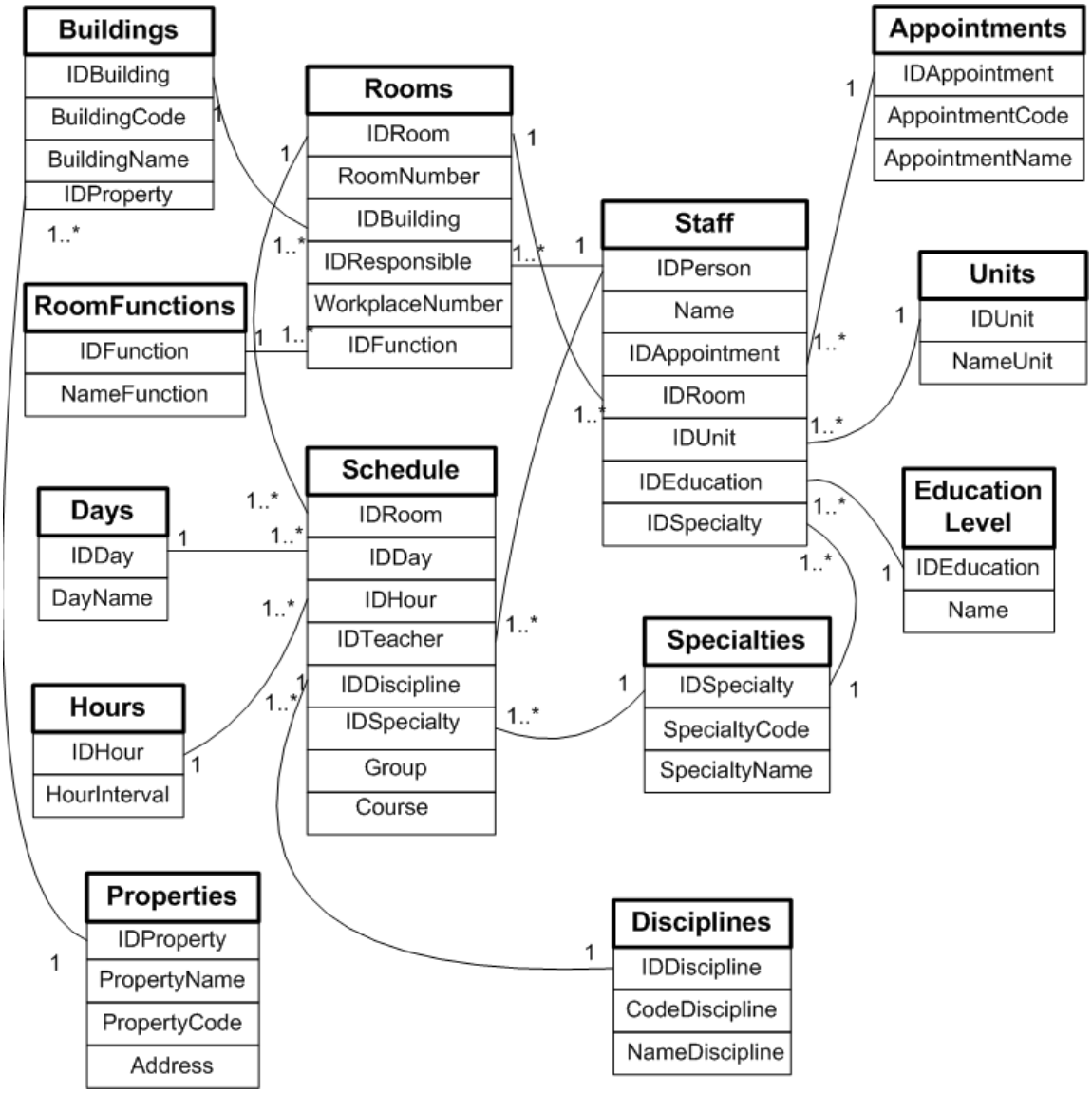

Fig.2. Campus region geodatabase schema

3. CAMPUS GIS INTERFACE

The design and development of campus GIS interface is based on the information needs of the users and on the selected software and communication technology. The main user groups are average users (students, teachers, administrative staff), system administrator and data support staff [5].

Undoubtedly, campus GIS is an online GIS having multiuser geodatabase. Depending on software capabilities, users can only display or query and analyze spatial data. A key issue is the format (vector or raster) used to transfer data to the client. The communication with users is by server-client technology including [2]:

- client-based applets in web pages or plug-ins to browser (depends on selected method);
- web (or special map) browser;
- web server;
- middleware on server to interpret requests from clients;

- GIS (map) server;
- geodatabase.

The most popular map browsers are Map Viewer [http://www.oracle.com/ technology/products/mapviewer/index.html], ER Viewer [http://www.ermapper.com/], Global Mapper [www.globalmapper.com/] etc. There are various GIS servers: ArcIMS [www.arcims.com] and ArcSDE gateway [www.arcsde.com] of ESRI; MapGuide Server of Autodesk; Technologica Internet Map Server (TIMS) [http://www.technologica.com]; Intergraph GeoMedia WebMap; MapXtreme of MapInfo, Caliper's Maptitude [www.mapinfo.com] etc [3].

At the present time the most popular web GIS technologies are those of Autodesk and ESRI.

4. CONCLUSION

The survey did not find any published campus GIS with spatial references (thematic maps) about schedule, room occupancy and other educational activities specified in Section 2. The availability of such references determines links and data exchange with a traditional university information system.

The next step of campus GIS development is selection of optimal integration of the common data and appropriate web technology.

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