GEO-INFORMATION SYSTEM FOR ENSURING THE FUNCTIONING OF THE VHF RANGE RADIO DIRECTION FINDING NETWORK

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Abstract
The development of computer information technologies is inextricably linked with the development of geographic information systems, which in turn are used for automated solving of various problems. The construction of modern geoinformation systems is directly related to the use of databases, which have become not only a tool for storing information, but also a source of information. The functioning of modern means of radio direction finding and radio interception is impossible without a developed geo-information system, which allows automating the collection, processing, storage and reproduction of information. A wide range of available radio direction finding and radio monitoring tools allow solving various tasks, but most of the tools and complexes work in their own network. Today, one of the problematic issues is the creation of a single information space for various means of a certain purpose. The growing trend of the diversity of radio monitoring and radio direction finding means requires the development of a unified geoinformation system that will significantly increase the accuracy of direction finding and reduce information processing time.
Keywords[1]
geoinformation system; direction finding; plotting objects on a digital map

1. Introduction and Literature Review

Usually, all data are delimited and form a kind of level. In general, all levels of data representation form a hierarchy that can be classified and distinguished as separate parts of a GIS, as shown in Figure 1.

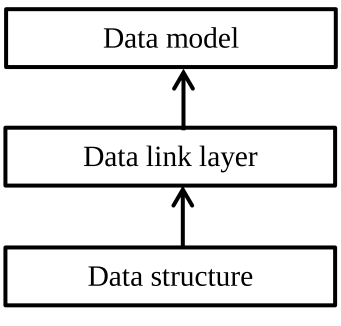

Figure 1. Method of data organization in GIS

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A data model is a general concept of data organization in a geoinformation system, which is data created and ready for display and transformation into a result. Such data can include: thematic layers, individual visualization objects, polygons, statistical data, as well as any object from GIS thematic layers[1].

The data link layer is an intermediate layer and is designed for communication. These are usually transformation matrices, vector data, links, lists, and other GIS-specific ways of structuring data.

Data structures are the lowest level that provides the maximum detail of the data model and enables data normalization. This level includes file structures, databases and data types.

Each data model element must contain identifiers, attributes, binding to spatiotemporal data models, data transformation and processing functions.

Characterizing the purpose of the identifier, it should be noted that this is one of the main parameters involved in data structuring. Its purpose is to define certain features, information about the object, which can change dynamically, despite the static nature of this object. Each object must contain its own attributes, which define basic properties (for example: area, volume, mass, speed, etc.). Since each object can be both a separate element of one of the thematic layers and a specific layer, a clear reference to space and time is required. For complex GIS modeling, it is not enough to have information only about the structure and position of the object [2]. Sometimes there may be an acute problem of determining the reaction of groups of objects to certain artificially created situations. For this, you should use the built-in methods of object behavior, which are specific for each of the many. The use of built-in behavior methods will give the most clear results when simulating complex processes. Thanks to the built-in methods, it is also possible to simplify the simulation of processes inside the GIS, considering it as one of the functions of the GIS.

One of the main tasks of GIS modeling should be considered the possibility of combining various data models [3], structures into others, thereby creating a different type or model of data. The created data model can be of two types: final and intermediate. The intermediate data type is intended for temporary storage of this data and subsequent formation of another data model. The corresponding final data model is a model obtained as a result of calculations and can be used to visualize individual thematic layers of objects, etc. According to each of the data types, the information should be stored separately, maintaining a clear isolation of levels to prevent false results.

2. Materials and Methods

A geographic information system must store basic data and data specific to a particular GIS. All data is stored in databases, which can be conditionally divided into the following types:

a) a geodatabase is a spatial database (DB) containing data sets that represent geographic information in the context of a general GIS data model. These data should include vector objects, vector images, rasters, topology, networks, three-dimensional objects, as well as all objects that are part of the thematic layers and are one of the components of the data model;

b) geovisualization base is a set of intelligent maps and other types that show spatial objects and functional interaction between objects on the earth's surface. Different types of maps can be built in this database and can be used as "windows to the database" [4] to support queries, analysis and editing of information;

c) type of geoprocessing GIS is a set of tools for obtaining new sets of geographic data from existing data sets. Spatial data functions obtain information from data sets, apply analytical functions to them, and write the resulting results to new derived data sets. An example can be a specific thematic layer, for the creation of which data from other thematic layers was selected.

If we consider modern, already created GIS, then, for example, in the ESRI® ArcGIS® software, these three types of GIS are represented by a catalog (GIS as a collection of geodata sets), a map (GIS as an intelligent cartographic view) and a set of tools (GIS as a set of tools for spatial data processing). All of them are integral components of a full-fledged GIS and are used to a greater or lesser extent in all GIS applications.

If GIS is considered comprehensively as a whole, then it is a special type of database about the surrounding world - a geographic database (geodatabase), the basis of which is a structured database that describes the world in geographical, economic and other aspects.

When creating a GIS geodatabase design, determine how various spatial objects will be displayed. For example, plots of land are usually represented as polygons, streets as center lines, wells as points, etc. These objects are grouped into classes of objects in which each set has a single geographic mapping.

Each GIS data set provides a spatial representation of some aspect of the world around us, including:

- ordered sets of vector objects (sets of points, lines and polygons);
- raster data sets, such as digital terrain models or images;
- spatial networks;
- terrain topography and other surfaces;
- geodetic survey data sets;
- other types of data such as addresses, place names, map information and any other information required for a particular thematic layer.

In addition to geographic representations, GIS datasets contain traditional tabular attributes describing geographic objects. Many tables can be linked to geographic objects by common fields. Such tabular sets of information and relationships play a key role in GIS data models, similar to the one they perform in traditional database situations.

Spatial relationships such as topologies and networks are very important parts of a GIS database.

Topology is used to control common boundaries between spatial objects, to define and enforce data integrity rules, and to support topological queries and navigation (for example, to determine the adjacency and connectivity of objects). Topology is also used for advanced editing and construction of spatial objects based on unstructured geometric data (for example, to construct polygons from lines).

Networks form a graph of interconnected GIS objects that can be navigated. This is important for modeling routes and navigation in such areas of activity as transport, pipeline, engineering communications, hydrology and in many other applied tasks related to networks. GIS organizes spatial data within thematic layers because datasets in GIS are geographically linked, have real-world locations assigned to them, and overlap with each other.

1st stage. Development of the structural diagram of the geoinformation system. The structural diagram contains three main blocks: server, client and database. Directly, the server itself contains four modules, each of which is responsible for the implementation of a certain function. The user interaction module is responsible for creating a network connection between the server and the client and receiving information from it. The database interaction module implements the user's ability to search the database, as well as store all information received from the client [2]. The information processing module analyzes the information received from the client and performs certain calculations. The module of interaction with the map allows users to graphically display the contents of the database, namely the results of bearing. In addition, it allows you to apply bearings and determine the location, take measurements on the map.

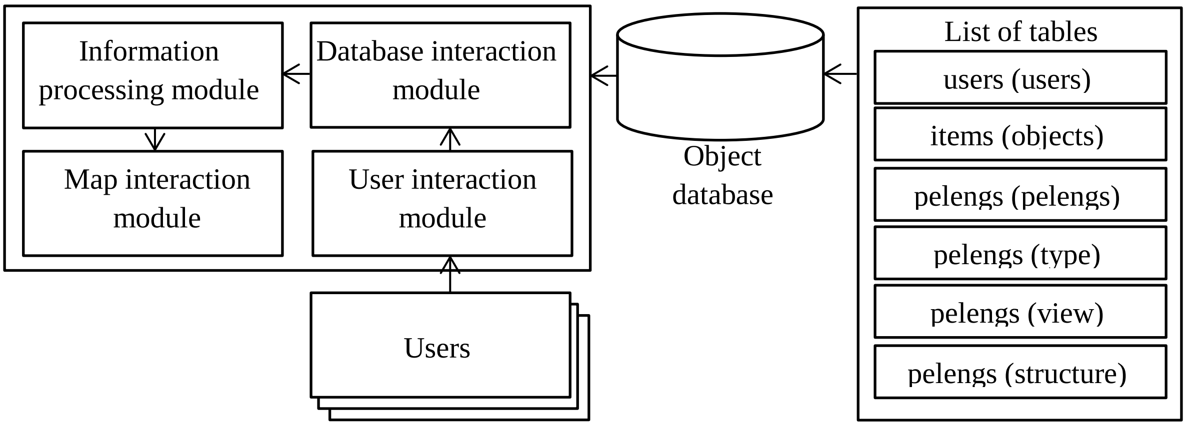

Figure 2. Structural diagram of the geoinformation system

The users block is designed to transfer the results of the direction finding from the direction finding tools to the main server.

The database is intended for storage and accumulation of information and contains 6 tables.

2nd stage. Development of the work algorithm and software of the geographic information system to ensure the operation of the radio direction finding network of the ultra-short-wave range. The software of the geoinformation system to ensure the operation of the radio direction finding network of the ultra-short-wave range includes a server and a client part.

The server part is intended for reproduction and accumulation of information from direction finders. The algorithm of the server part includes 15 blocks (Figure 3).

The server part of the geoinformation system is designed to receive information about bearings, accumulate it, process, reproduce, save, as well as create a single information space for radio direction finding and radio monitoring tools.

3. Experiment, Results and Discussions

To verify in practice the functionality of the geoinformation system to ensure the operation of the radio direction finding network of the ultra-short-wave range, the direction finder "PLASTUN-RP" and the direction finding system WD-3300 were used.

For the interaction of the geoinformation system with the "PLASTUN-RP" database, it is necessary to connect the server's PC with the direction finder's PC to the local network, grant access in the firewall to listen to port 5432 (by default in PostgreSQL), and create a new user with a password in the "plastun" database. The next stage is the configuration of the geoinformation system client to connect to the database. The connection parameters are shown in Figure 4.

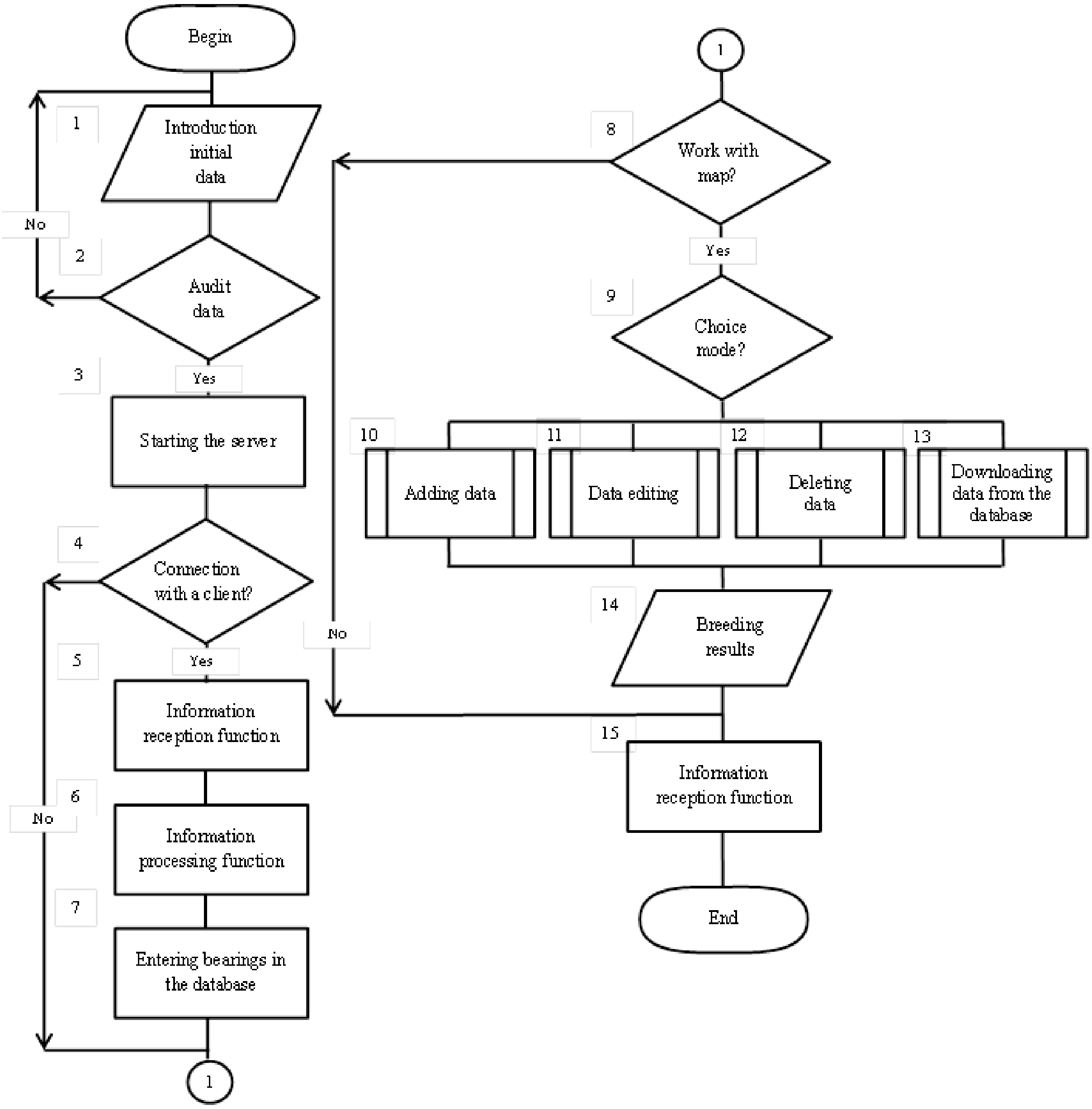

Figure 3. Block diagram of the algorithm of the server part of GIS

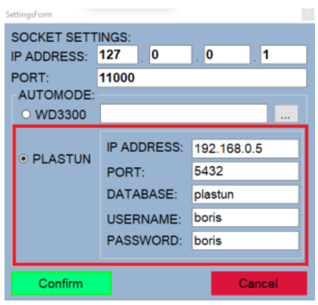

Figure 4. Options for connecting to the "plastun" database via remote access

After correctly entering the connection parameters, the client will try to connect to the database. In the case of a successful connection to the database, a dialog box will appear informing about the opening of the database. After choosing the automatic mode of working with the database, the parameters will be read and transferred to the main form of the client application, the result of connecting to the "plastun" database and obtaining the results of the last bearing.

After receiving the data, it must be transferred to the server, for this the server user must set the necessary parameters for it (address, port) and turn it on. After that, the client must send the result of the direction finding to the server [6]. In case of successful data transfer to the server, the user receives a message from the client and directly from the server itself (Figure 5).

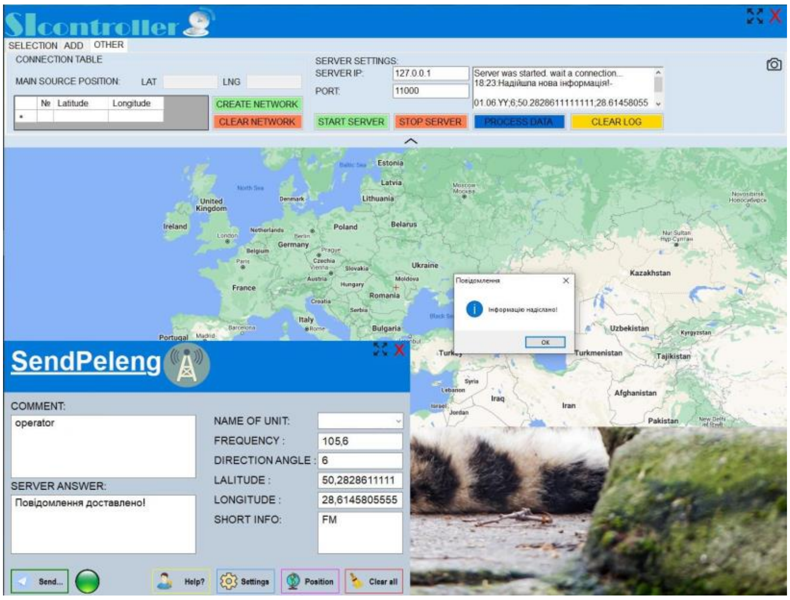

Figure 5. The result of data transfer from the client to the server

After the information is transferred to the server, it is processed and displayed on the map.

To interact with the WD 3300 direction finding system, it is necessary to download the client application to the PC of the system. After starting the application, it is necessary to make initial settings (server address, port and path to the file mod.csv).

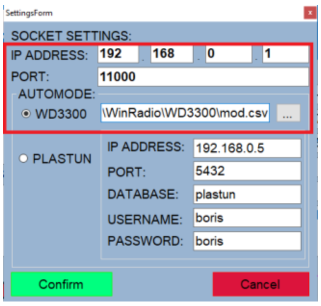

Figure 6. Example of settings for WD3300

After receiving the data, the algorithm for setting up the server and transferring information is repeated. In case of successful data transfer to the server, the user receives a message from the client and directly from the server itself. The information received by the server is processed and displayed on the map.

4. Conclusions

Thus, the user of the geoinformation system is able to combine into a single radio direction-finding network means that the standard software does not provide for this. In the process of accumulating direction finding results, it is possible to create a database of objects, a combination of detected objects.

Functionality of both client and server software of the geo-information system for providing the radio direction finding network of the ultra-short-wave range was practically checked, the ability of the software to work in both manual and automatic mode was checked.

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