

Optimal Maneuvering of Forest Fire Protection Resources¹

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Abstract

Resources that are used in forest fire fights may vary. They imply different types of machinery, chemical means of fire fighting, explosives, and some others.

We may distinguish two types of maneuvering: maneuvering, induced before the start of fire season, for example, aircraft transfer to their base location; maneuvering, induced in real time during the fire season.

The forest fire resources decision-maker should have optimal plan of transfer of resources from the places of their availability to the places, where they are needed. What is more, this transfer should be fulfilled according to some criterion, for example, transfer expenses. We should remark that the means of transferring resources from the places of their availability to the places, where they are needed vary a lot. This might be airplanes, helicopters, cars, etc. The difficulty of solving the problem of optimal maneuvering also depends on variety of packages, used for resources transfer. For example, chemical substances may be delivered in bags that weigh 25, 50 and 100 kilograms.

One of the ways of solving the problem of optimal maneuvering of forest fire resources is mixed integer linear programming that implies some modification of simplex-method of linear programming.

In order to solve this program a complex of programs was developed. It provides the user with convenient form of getting information about the availability and needs of resources. Current information, organized in different data bases. Information about the means of transfer and transfer expenses is used to determine the optimal plan for solving the transport problem. The complex is made with the help of Delphi 6.0.

Functionality of the program

The program should process data base of efficient information about forest fires that is formed by regional forestry geographical informational systems for air and land fire prevention services.

In this case fire fighting supposes both preventing maneuvering of the available resources before fire season and detection and extinguishing fires during the fire season.

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Resources imply all that is necessary for detection and extinguishing forest fires: technical units, chemical substances, explosives, etc.

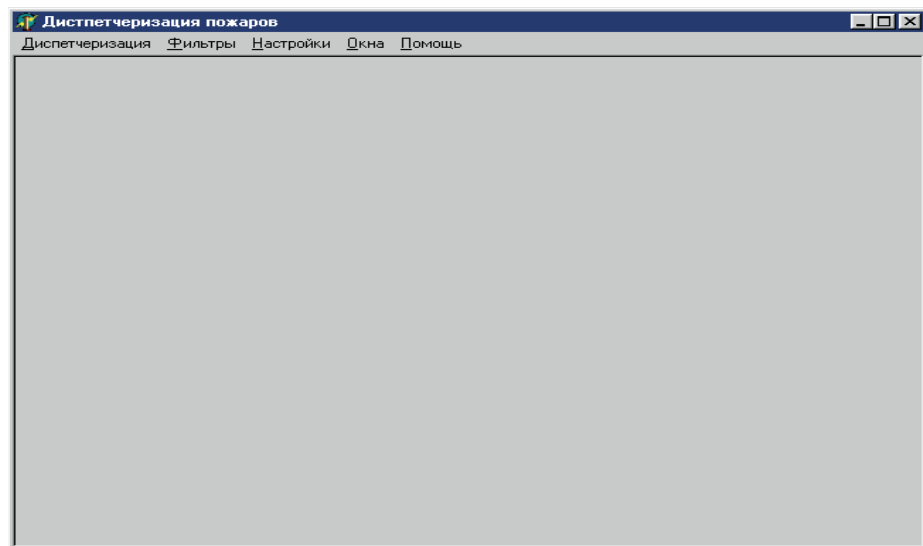
Identifier characteristics of objects, that may require resources and objects that have free resources (like geographical coordinates of forest fires and air bases) are stored in forms, tables and files. What is more, they contain information about availability of free resources that are out of the zone of forest fires. It includes geographical names, coordinates and expenses on transpiration of particular resource. After this work is finished there is full information for solving the problem of optimal maneuvering with the abilities of forest fire services at the dispatcher base.

It is taken in consideration, that now there are no one dispatcher bases that monitor both air fire protection and land fire protection in the regions. There is also no department, other then MPR of Russian Federation, that are engaged forest fire fighting. The program can be used for separate work with air and land fire protection.

Description of the work of the program

At first the main window appears. It contains main menu with following items:

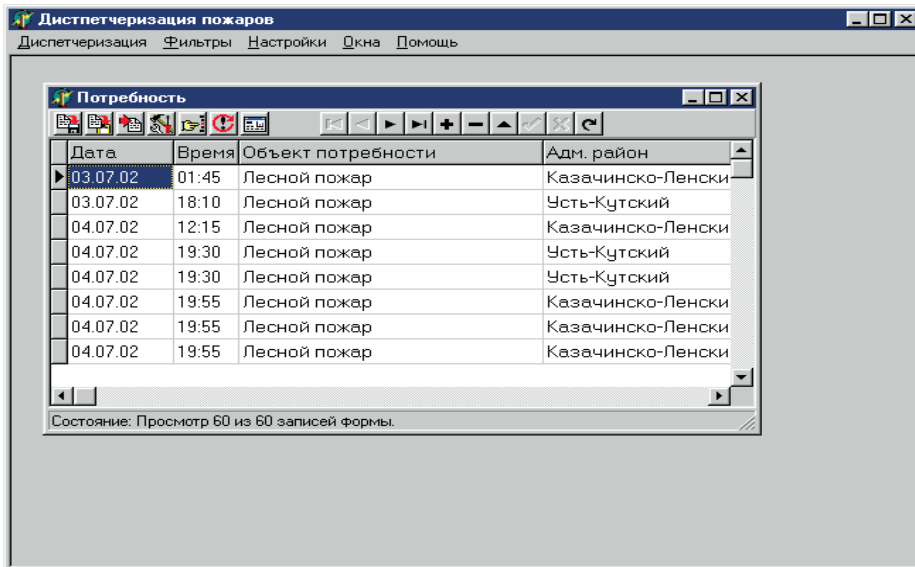
- dispatching
- filters
- settings
- windows
- help



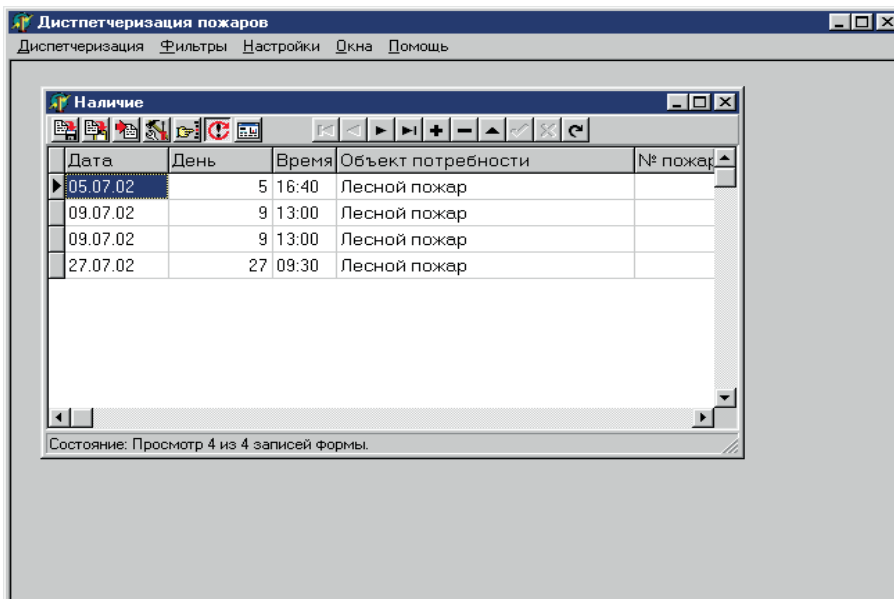
After choosing dispatching one can see a menu, that contains following items:

- need
- availability
- expenses

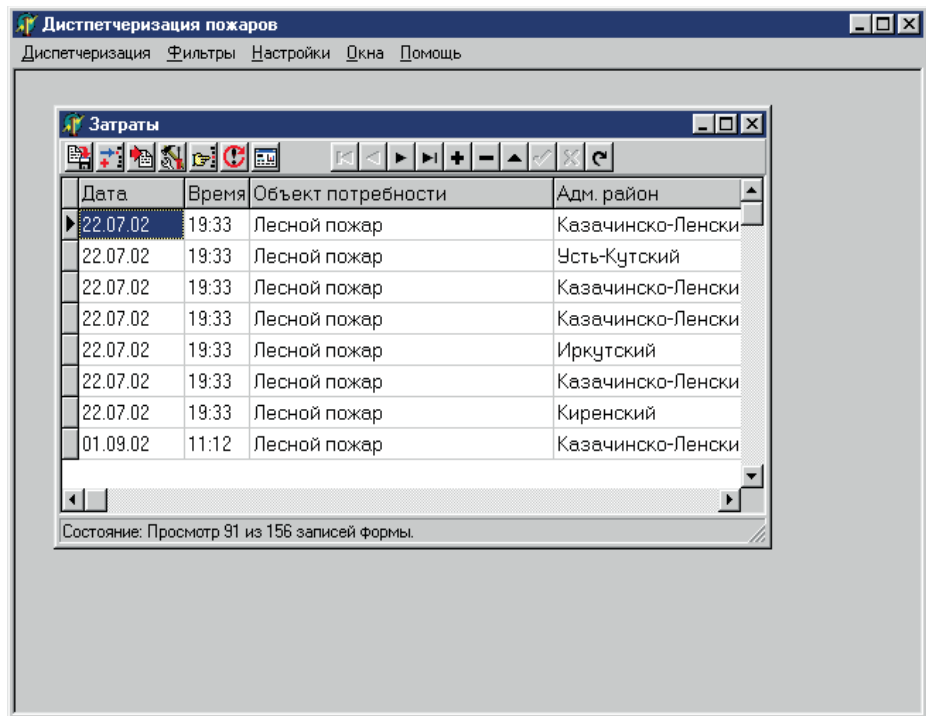
After choosing 'need' one can see window like that:



Tables and forms are either shown automatically or are entered manually. These forms contain information about needs of resources at current moment. After choosing 'availability' one can see window like that:



These windows contain information about the availability of resources. They could also be entered manually. After choosing 'expenses' one can see window like that:



There one may manually enter data about expenses on the delivery of different resources from the places of availability to the places of need.

After choosing 'filters' in the main menu one will see following items:

- filter management
- need
- availability
- expenses

After choosing 'need' a user get the opportunity to create an inquiry on need of particular type of resource. In order to create an inquiry a user should do following actions.

Choosing an inquiry from existing.

In this case a user should mark necessary inquiry. In the field 'inquiry' he can view an inquiry. After making sure that the content of an inquiry fulfills the requirements, a user check a checkbox to the left of the name of the inquiry and clicks 'apply' button/ The result of the inquiry may be seen after choosing 'Dispatching->Need' menu item.

Changing the content of an inquiry.

In this case a user, after choosing one of the existing inquiries may activate 'Change' button. Then a window will appear.

In it the content of the fields may be changed. The change is accepted if a checkbox to the left of the field is checked. After then one should push 'Accept' button. The changed inquiry a user may see in a previous window. The next actions look much like the previous point.

Adding a new inquiry.

A user should open 'Filter management' window. After activation 'Add' button a user gets to the window 'New Filter' of 'Need' form. In this window all the fields are empty and the user may for inquiry to add. Next actions are like in the previous point.

Adding to all above, a user may delete one or several inquiries by clicking 'Delete' button.

Same may be done by the user for filtering the table form 'Availability' and 'Expenses'. Window 'Create' of the filter form 'Expenses' looks like:

Создание фильтра формы Затраты

Название запроса

Дата : Время :

Ресурс :

Стоимость : Средство дост. :

Объект потребности :

Сведения об объекте потребности

№ пожара : № кр. пожара : Адм. район :

Наим. авиазвена : Наим. авиаотделения :

Наим. лесхоза : Наим. лесничества :

Прин. лесов : Зона :

Договор с ТАБ : Иной признак :

Координаты : Широта : Долгота :

Объект наличия :

Сведения об объекте потребности

№ пожара : № кр. пожара : Адм. район :

Наим. авиазвена : Наим. авиаотделения :

Наим. лесхоза : Наим. лесничества :

Прин. лесов : Зона :

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Координаты : Широта : Долгота :

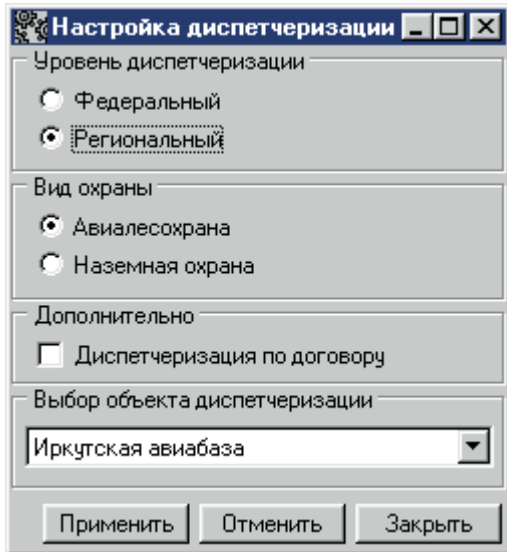
Submenus 'Need', 'Availability' and 'Expenses' of 'Filter' menu are needed to form only one inquiry to 'Need', 'Availability' and 'Expenses' tables. Forming an inquiry is done through menu item 'Set'. If 'Clear' menu item is selected, all filters, connected to this forms and tables, are cleared.

The language of inquires can be also implemented when forms and windows of 'Dispatching' menu item are open.

When selecting 'Settings' menu one has following options:

- 'Dispatching'
- 'Paths'
- 'Forms'

After activating 'Dispatching' menu item a user may see following window:

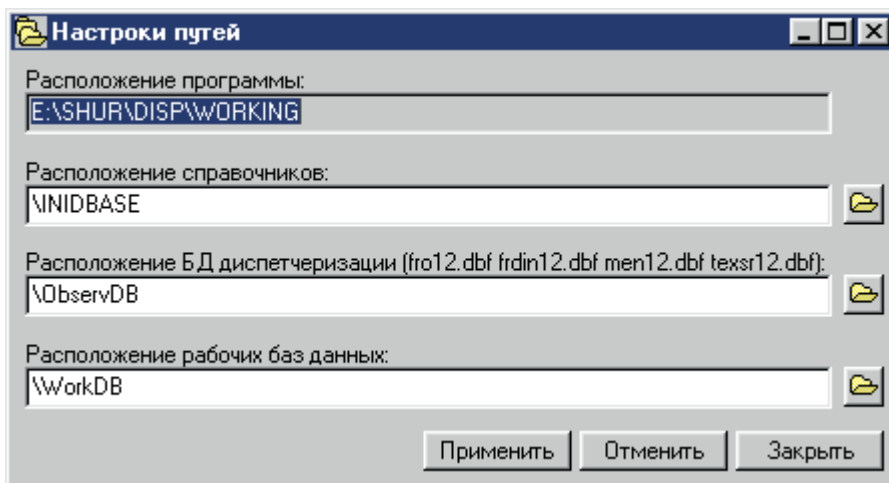


Here one may choose:

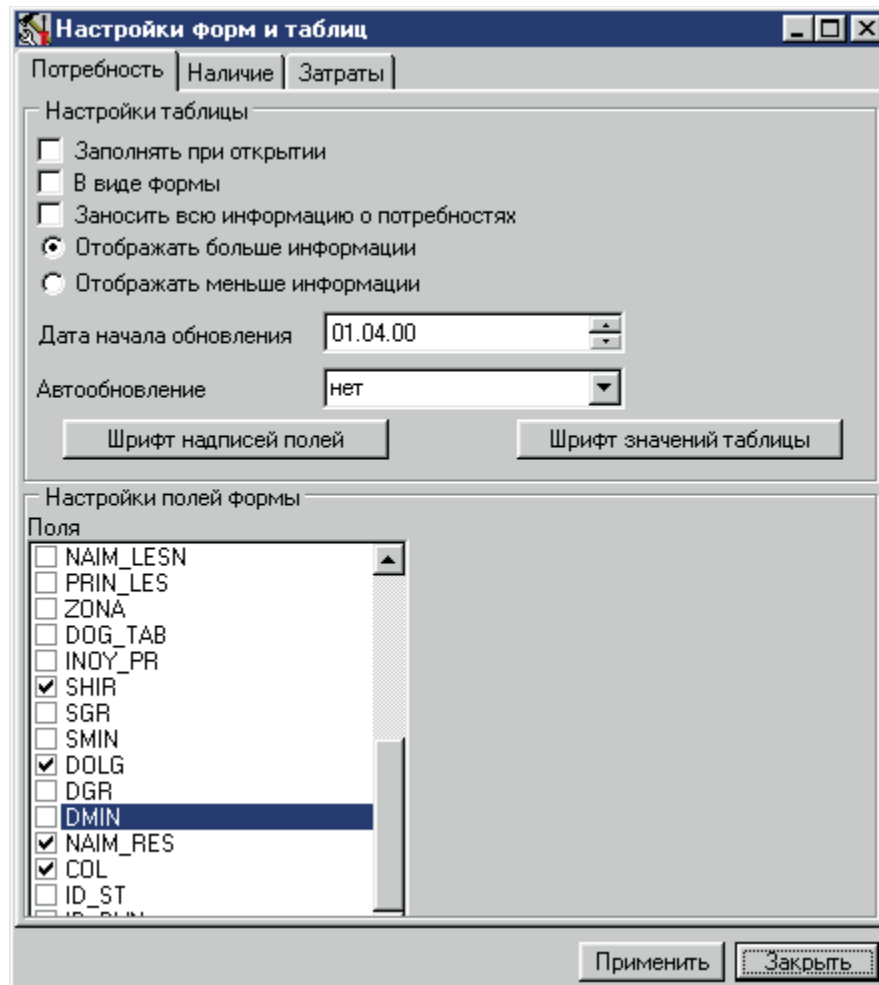
- the level of dispatching (regional or federal)
- type of fire protection (land or air)
- type of relationships between management nodes (contract or not)
- object of dispatching

This option is considered accepted after clicking 'Accept' button.

After choosing 'Paths' a user may define paths to the location of the program, and different data bases, used by the program. It is done in the following window:



After choosing menu item 'Form' one may see a window:



Here a user may define settings for 'Availability', 'Need', 'Expenses' forms and tables.

There are two groups of settings:

- table settings
- form settings

In the first group a user can

- fill in when entered or not
- enter information as a table or not
- enter all information about the need or not
- show all the information or not (the latter supposes that a user needs only some fields)
- enter the date of update out of the databases (this means that a user may set some date, after which the information of particular databases will be output)
- setting in automatic mode the time interval, starting with which the information from databases will be output
- set fonts for names and content.

In the second group a user can:

- choose form fields that will be shown and could be changed. To do this a user should check a checkbox to the left of the field name
After choosing 'Windows' menu a user can set the window locations.
Menu item 'Help' shows help content for the program.

Programming tools

The complex of the programs is written on Delphi 6.01 and can work under Windows 98, Windows NT and Windows 2000.

