The background of the slide is a photograph of a natural landscape. In the foreground, there's a rocky bank of a river or stream. The water is calm, reflecting the surrounding environment, which includes green trees and a sky filled with white and grey clouds.

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# **Application of Modern Information Technologies to the Study of Karelian Petroglyphs**

Ksenia A. Rogova, Konstantin N. Spiridonov, Maksim U. Bystrov

Scientific supervisor: Professor Alexander A. Rogov

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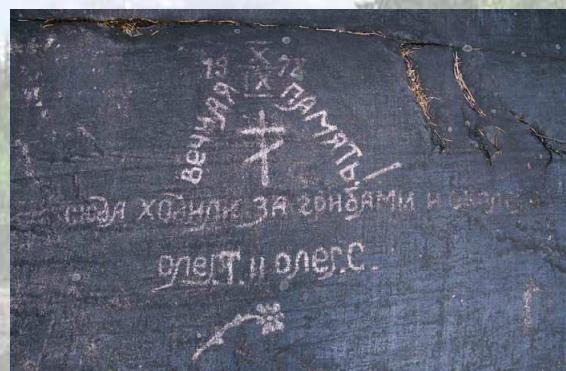
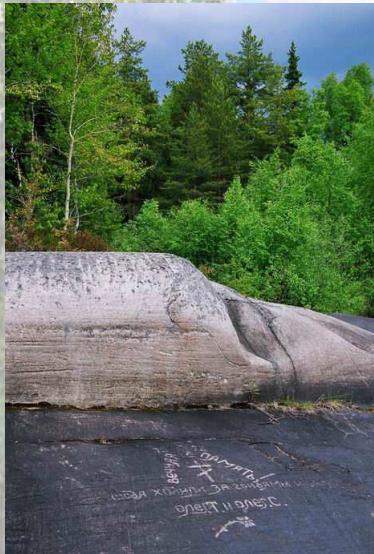
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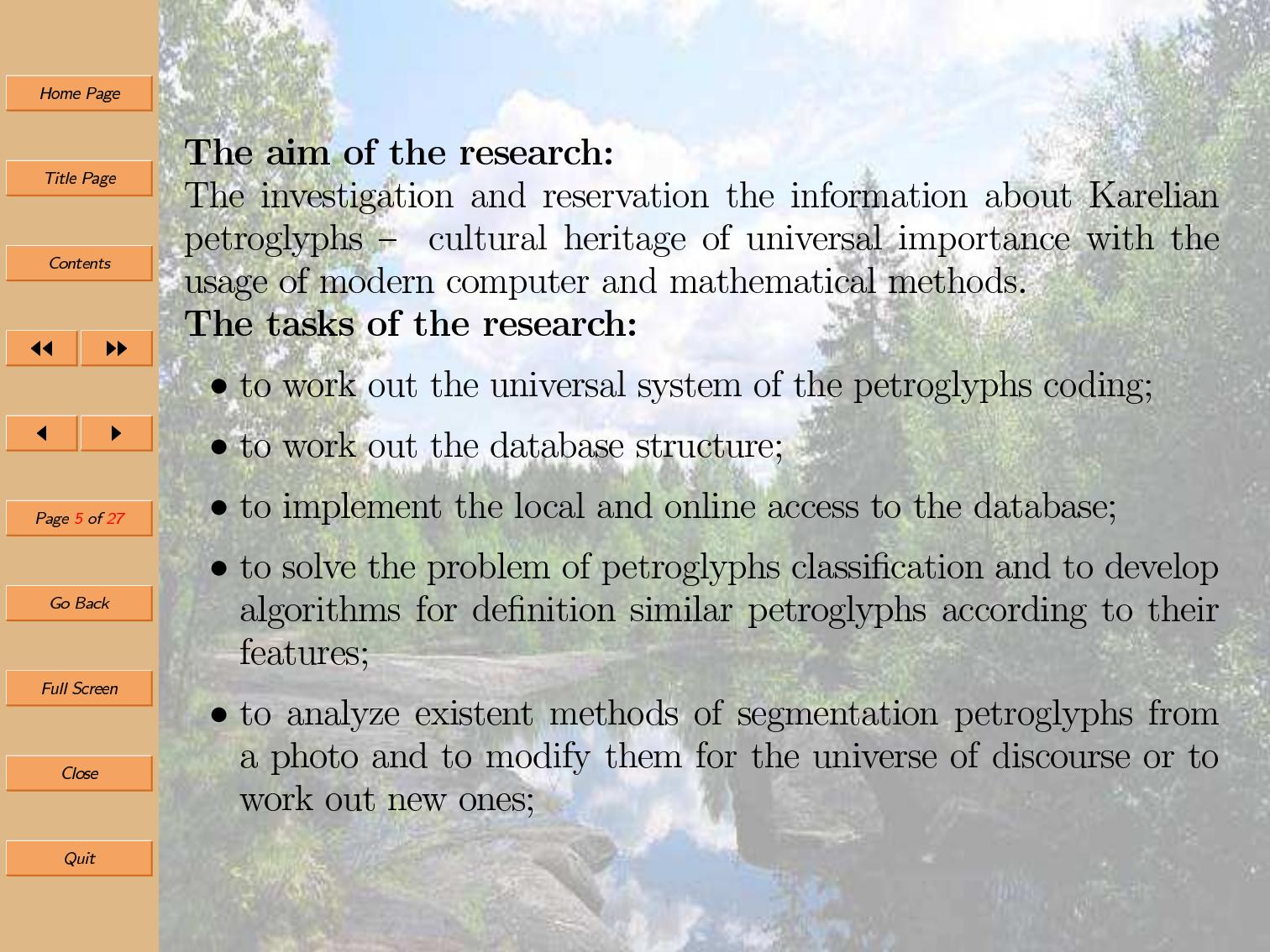
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## Vandalism



A scenic landscape featuring a rocky foreground, a winding path through a forest of tall evergreen trees, and a bright blue sky with scattered white clouds.

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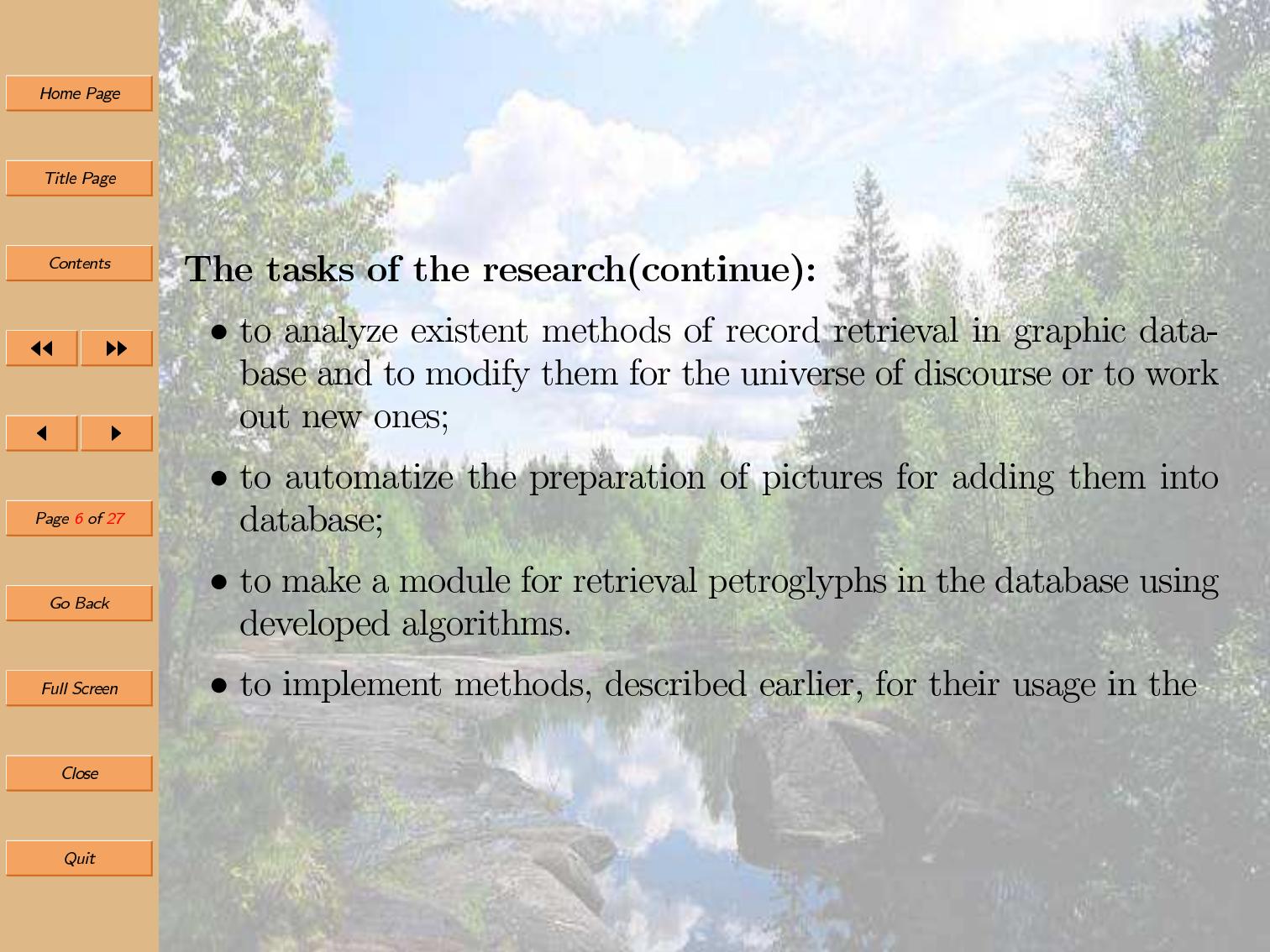
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## The aim of the research:

The investigation and reservation the information about Karelian petroglyphs – cultural heritage of universal importance with the usage of modern computer and mathematical methods.

## The tasks of the research:

- to work out the universal system of the petroglyphs coding;
- to work out the database structure;
- to implement the local and online access to the database;
- to solve the problem of petroglyphs classification and to develop algorithms for definition similar petroglyphs according to their features;
- to analyze existent methods of segmentation petroglyphs from a photo and to modify them for the universe of discourse or to work out new ones;

A scenic landscape featuring a rocky foreground, a body of water, and a sky filled with large, white, fluffy clouds.

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## The tasks of the research(continue):

- to analyze existent methods of record retrieval in graphic database and to modify them for the universe of discourse or to work out new ones;
- to automatize the preparation of pictures for adding them into database;
- to make a module for retrieval petroglyphs in the database using developed algorithms.
- to implement methods, described earlier, for their usage in the

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The module for online access to the database (section “Catalogue” of the website “Karelian Petroglyphs”)

The search by the feature “the petroglyph’s location”

[smalt.karelia.ru/~petroglyphs](http://smalt.karelia.ru/~petroglyphs)

The module for pictures preparation for database

The reduction petroglyph’s depictions to common standart

Marking photos for protection copyright

The database of Karelian petroglyphs

The detachment single depictions from the group

The depiction’s segmentation

The module for local access for the database

The description of the petroglyph

The search by features

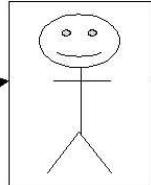
The search by the feature “the petroglyph’s location”

The search by the usage of skeletons

The search by the usage of neural networks

The search by the usage of fractal characteristics

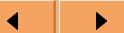
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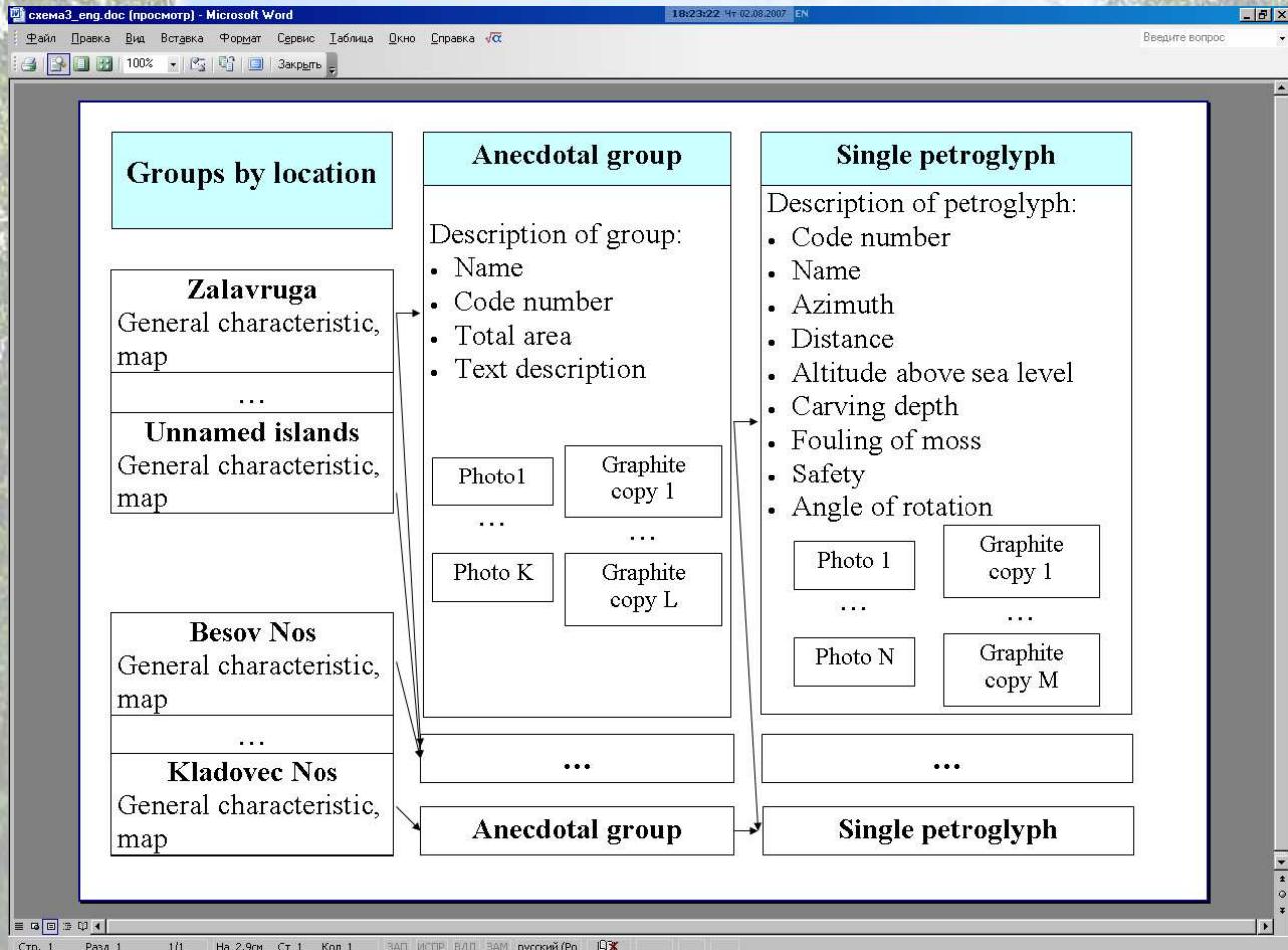
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МИНИСТЕРСТВО ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ И СВЯЗИ  
РОССИЙСКОЙ ФЕДЕРАЦИИ  
ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ИНФОРМАЦИОННЫМ ТЕХНОЛОГИЯМ  
ФГУП Научно-технический центр "Информрегистр"  
ГОСУДАРСТВЕННЫЙ РЕГИСТР БАЗ ДАННЫХ

РЕГИСТРАЦИОННОЕ СВИДЕТЕЛЬСТВО

№ 10542

от "07" сентября 2006 г.

Настоящее свидетельство выдано организации: Институт языка, литературы  
и истории Карельского научного центра РАН

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Петроглифы Карелии

зарегистрирована за № 0220611248



Директор ФГУП НТЦ "Информрегистр"

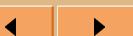
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"07" сентября 2006 г.

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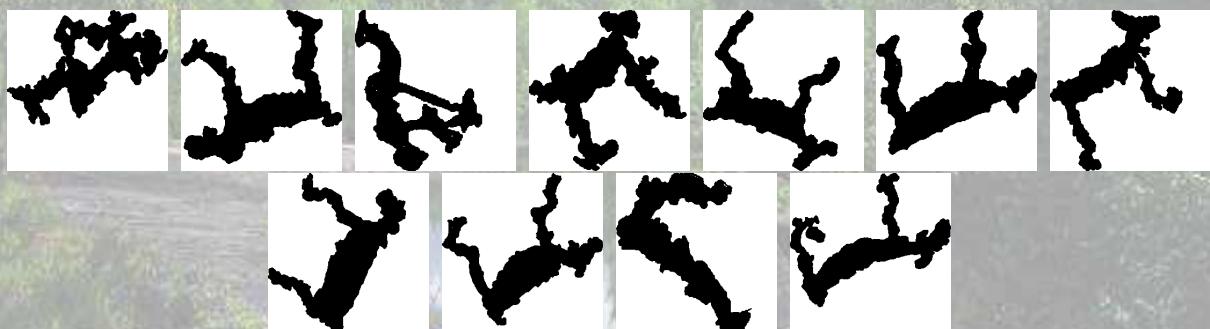
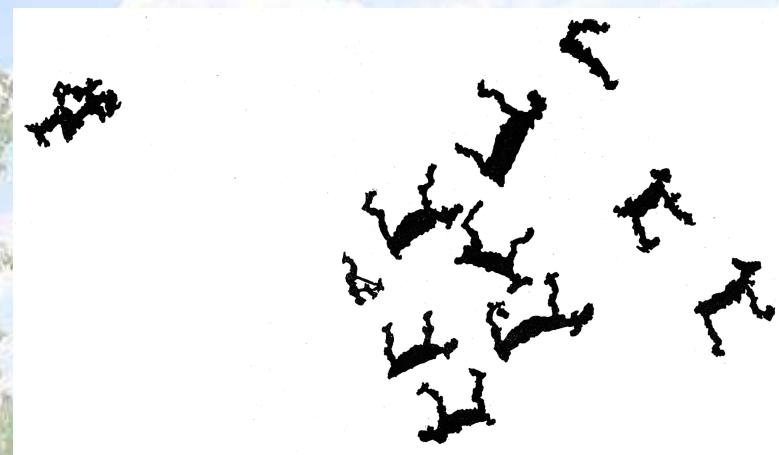
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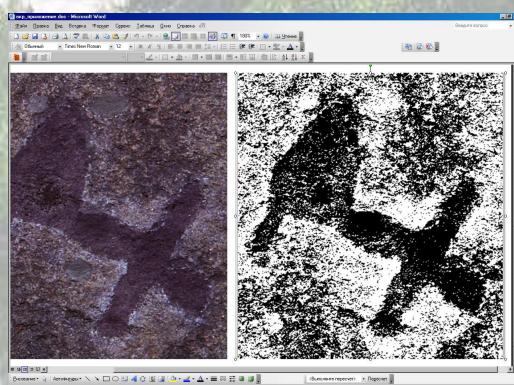
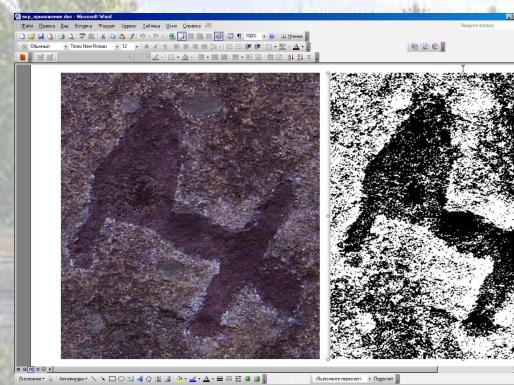
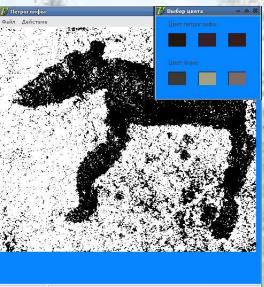
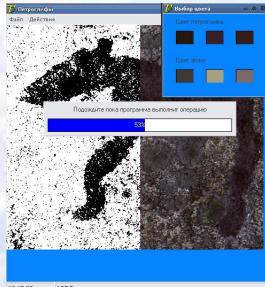
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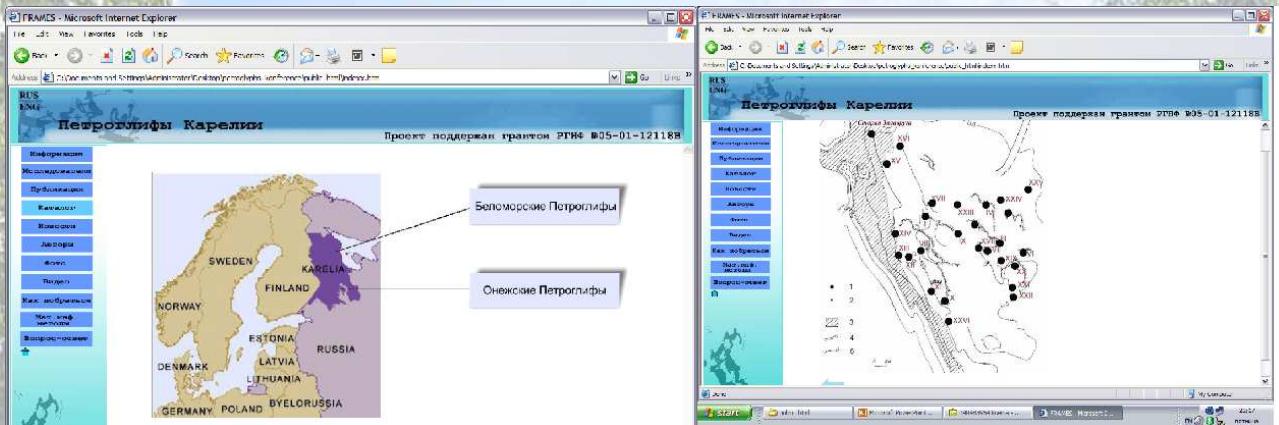
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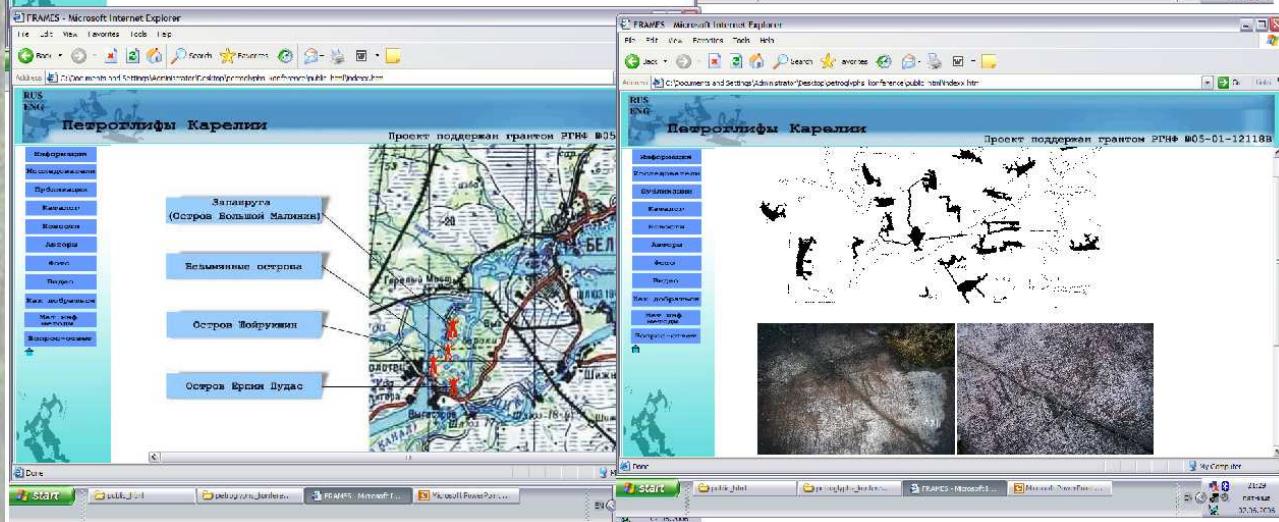
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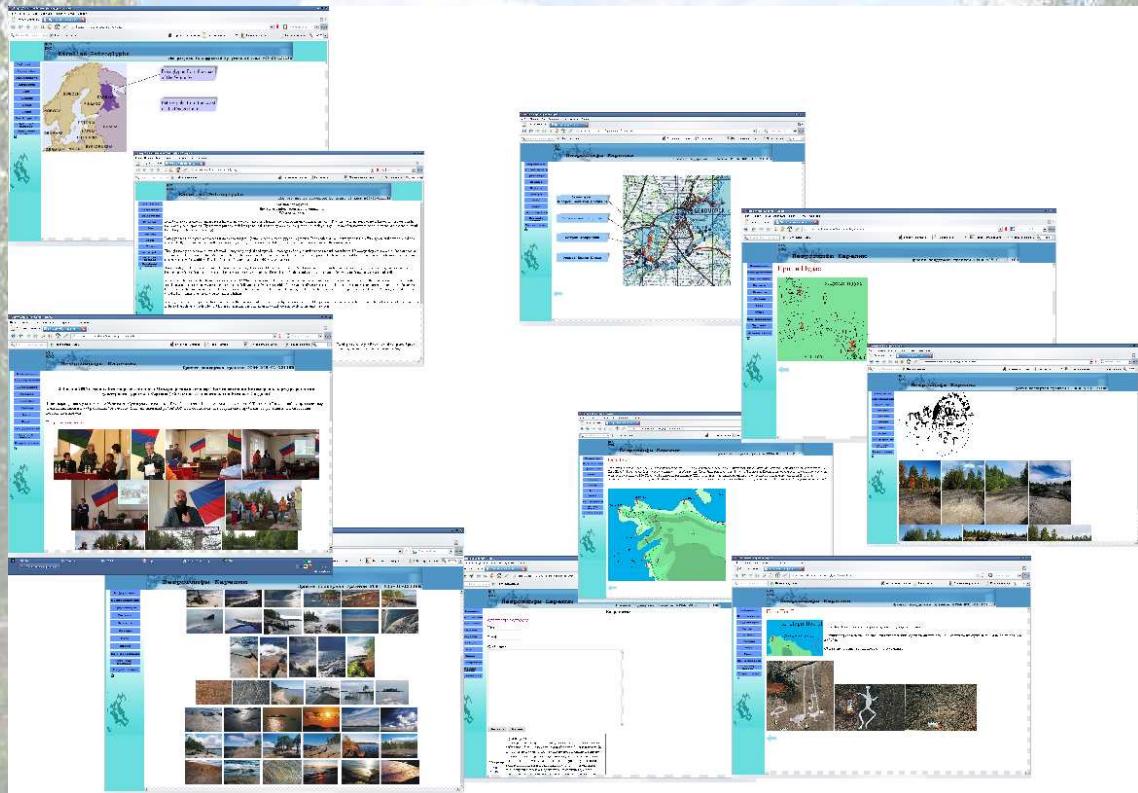
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# Website “Karelian Petroglyphs”



<http://smalt.karelia.ru/petroglyphs>

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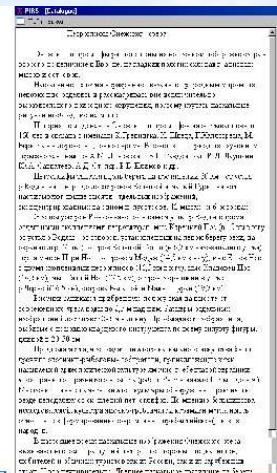
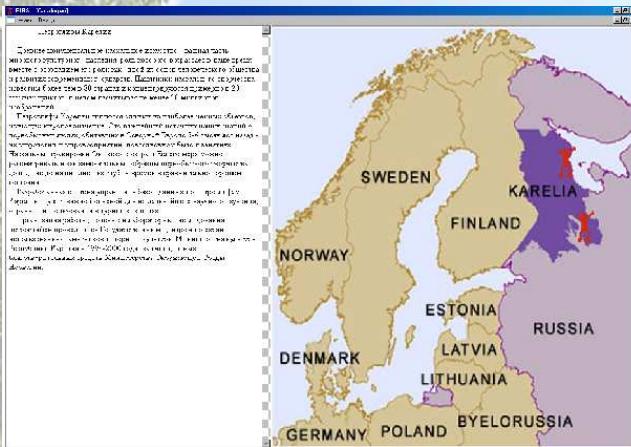
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RIBI Technical Report

Project Name: [REDACTED]

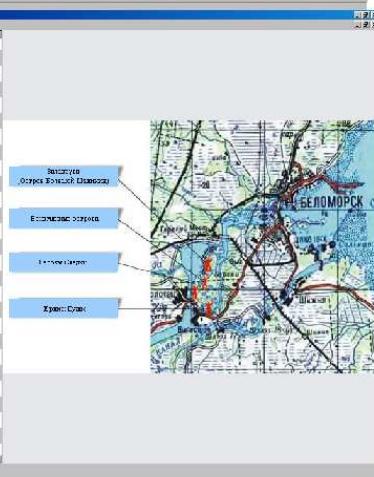
Report ID: [REDACTED]

Geographical context: The project area is located in the Kola Peninsula, Russia, specifically in the Murmansk Oblast. The area is characterized by its rugged terrain, with numerous lakes and rivers. The project is situated near the town of Belomorsk, which is connected to the outside world via a network of roads and railways. The terrain is predominantly hilly and mountainous, with some flat areas along the coast and river valleys.

The project area is part of the Kola Peninsula, which is known for its unique geological features, including the presence of large amounts of iron and nickel deposits. The area is also home to several indigenous communities, including the Nenets and the Komi peoples, who have lived in the region for centuries.

The project itself is a major infrastructure development, aimed at improving transportation links between the Kola Peninsula and the rest of Russia. It involves the construction of new roads, bridges, and rail lines, as well as the upgrading of existing facilities. The project is expected to bring significant economic benefits to the local community and the region as a whole.

Overall, the project represents a major investment in the future of the Kola Peninsula, and its success will depend on careful planning and implementation.

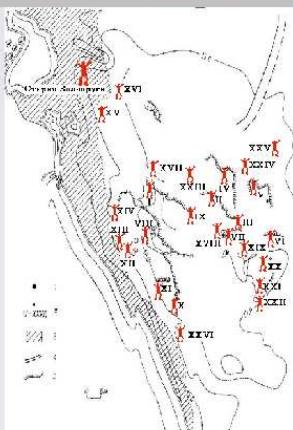


RIBI Technical Report

Project Name: [REDACTED]

Report ID: [REDACTED]

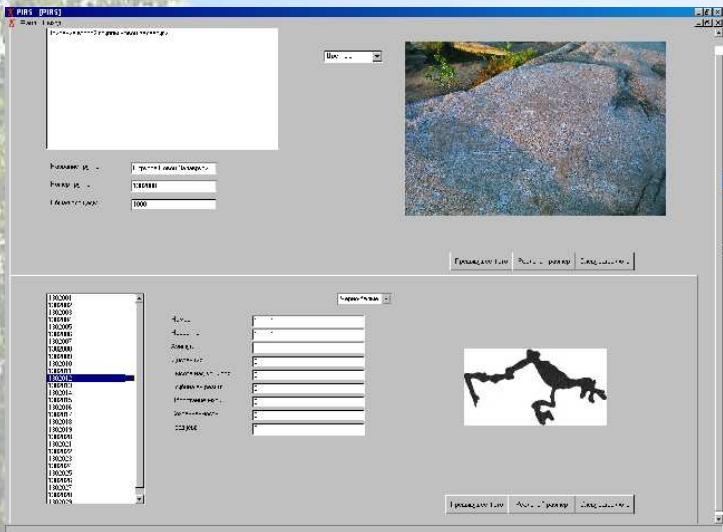
Map showing the location of the project area in Northern Europe. The map includes labels for Sweden, Norway, Finland, Karelia, Estonia, Latvia, Lithuania, Germany, Poland, and Belarus. A red dashed rectangle highlights a specific region in Karelia.



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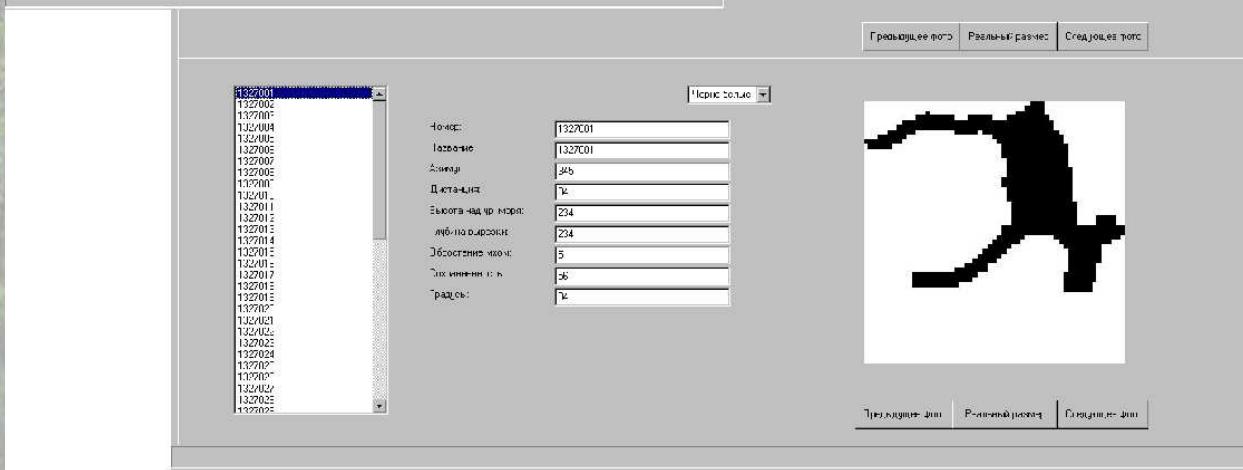
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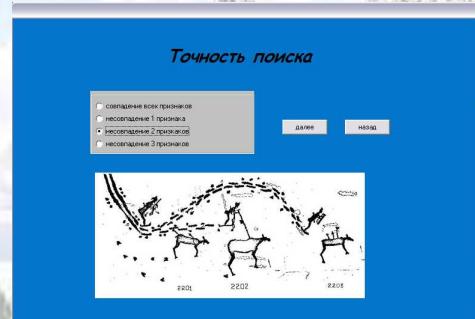
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# Search according to features

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**Петроглифы, найденные по выделенным признакам**

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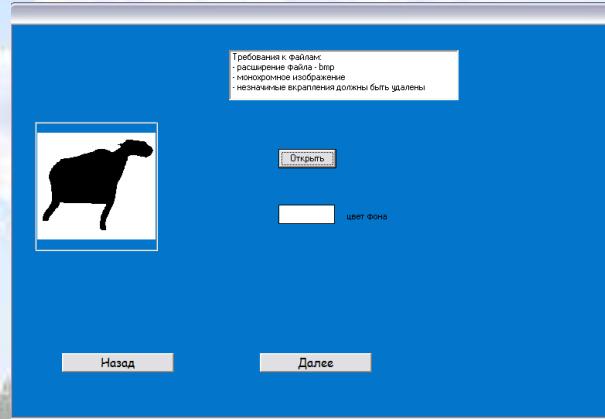
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# Search according to pictures similarity



**Результаты**

Бесовы следки Старая Залавруга

	1404		
Новая Залавуга Ерпин Пудас		исходное изображение	найденное изображение
		Коловый номер - 1404. Петроглиф находится на Старой Залавруге. Отличающие признаки: голова укороченная, уши и холка присутствуют, рогов нет, шея по линии и ширине нормальная, "сердце" на ней нет. Корпус грузный. Изгиб спины и живота вне. Изгиб передней пары ног - вне, а задней пары ног - внутрь. Хвост удлиненный. Животное обращено вправо.	
<a href="#">Назад</a>		<a href="#">вернуться в главное меню</a>	

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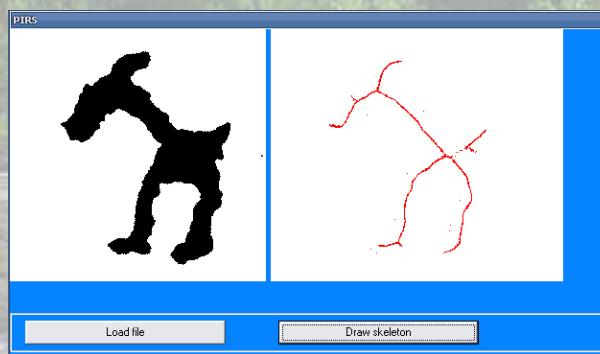
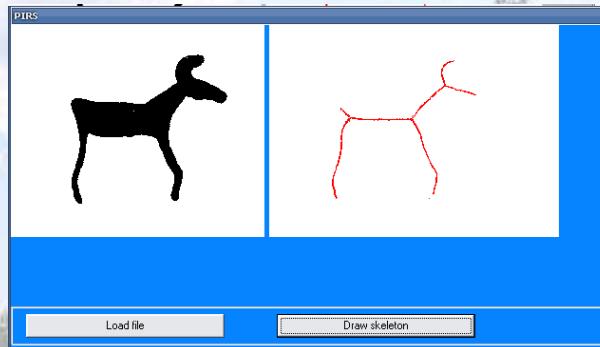
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## Search according to pictures similarity



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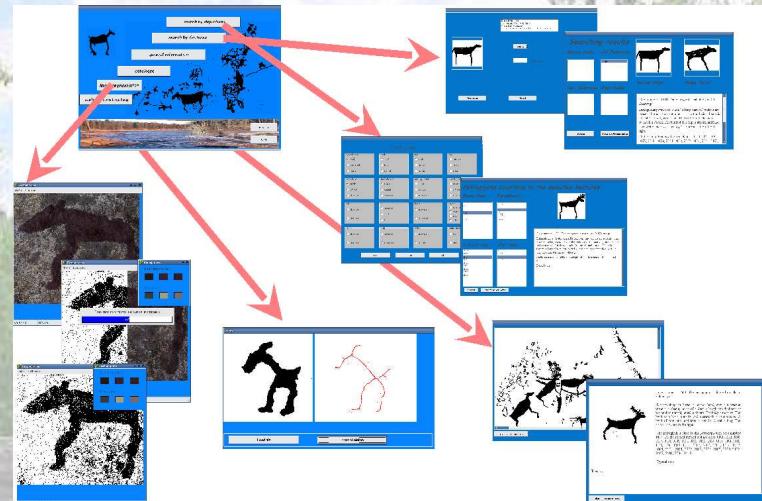
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## The module for database search



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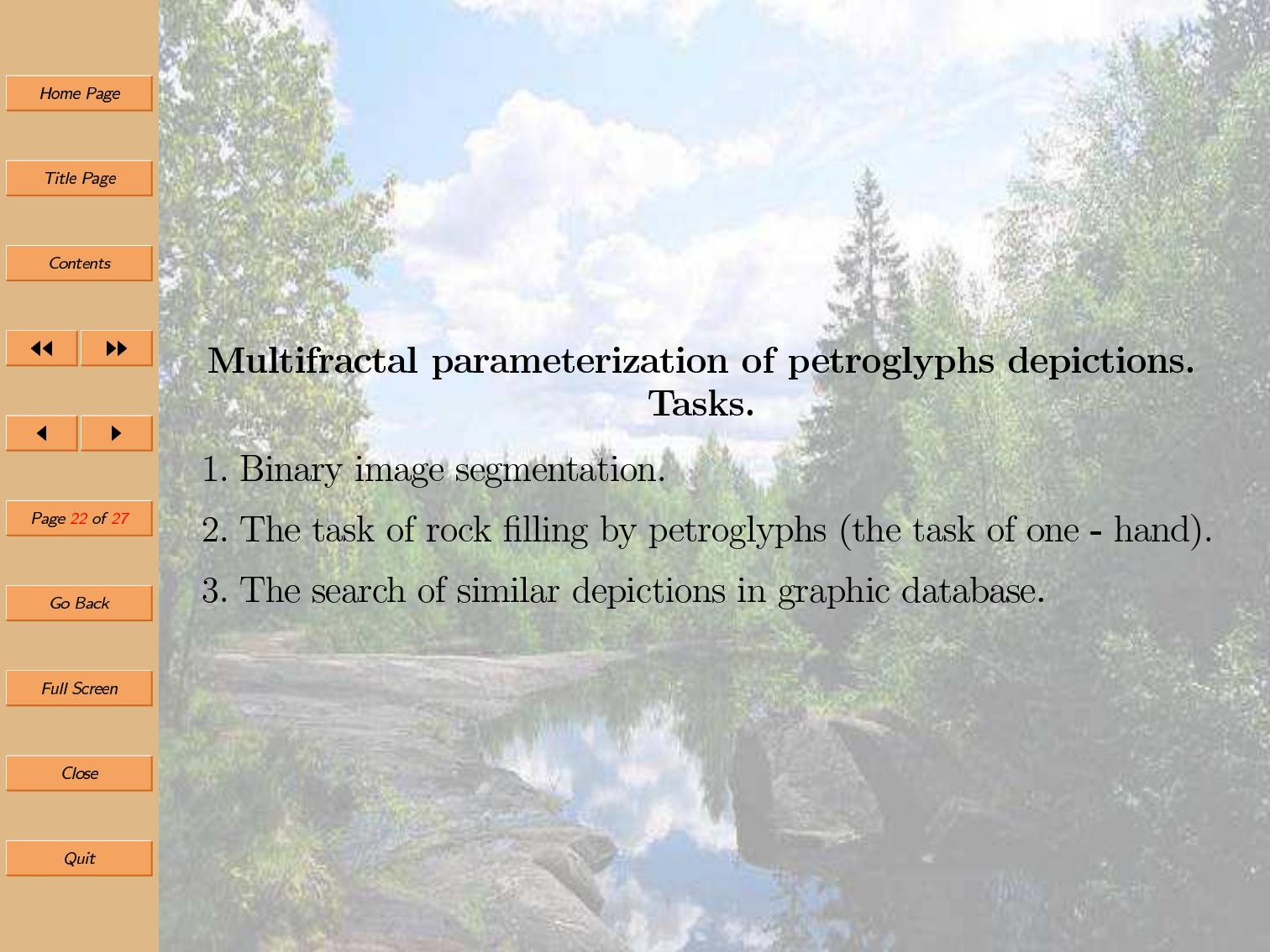
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## Multifractal parameterization of petroglyphs depictions.Spectrum features 1-4.

1. Closeness of values  $D_q$  for image fragments in each area - on petroglyph and on the rock on one photo.
2. Closeness of values  $D_q$  for image fragments in each area - on petroglyph on two different photos.
3. Distinction of values  $D_q$  for image fragments in each area - on petroglyph and on the rock on one photo.
4. Distinction of values  $D_q$  for image fragments in each area - on different petroglyphs on two different photos.

A scenic landscape featuring a rocky foreground with a small stream flowing through it, surrounded by lush green trees and bushes under a bright blue sky with scattered white clouds.

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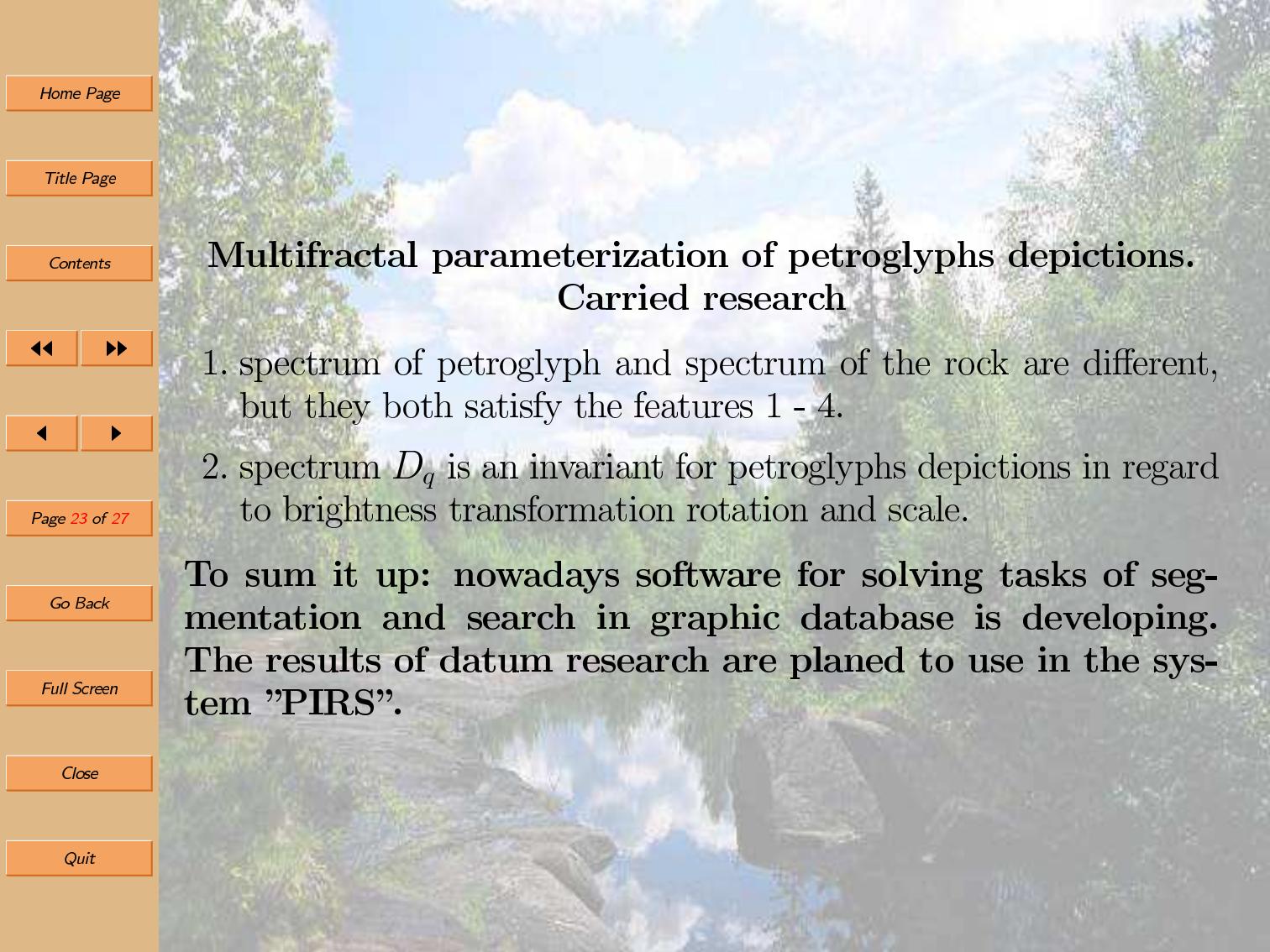
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## Multifractal parameterization of petroglyphs depictions. Tasks.

1. Binary image segmentation.
2. The task of rock filling by petroglyphs (the task of one - hand).
3. The search of similar depictions in graphic database.

A scenic landscape featuring a large, light-colored rock formation in the foreground. The sky above is filled with white and grey clouds. The overall atmosphere is natural and historical.

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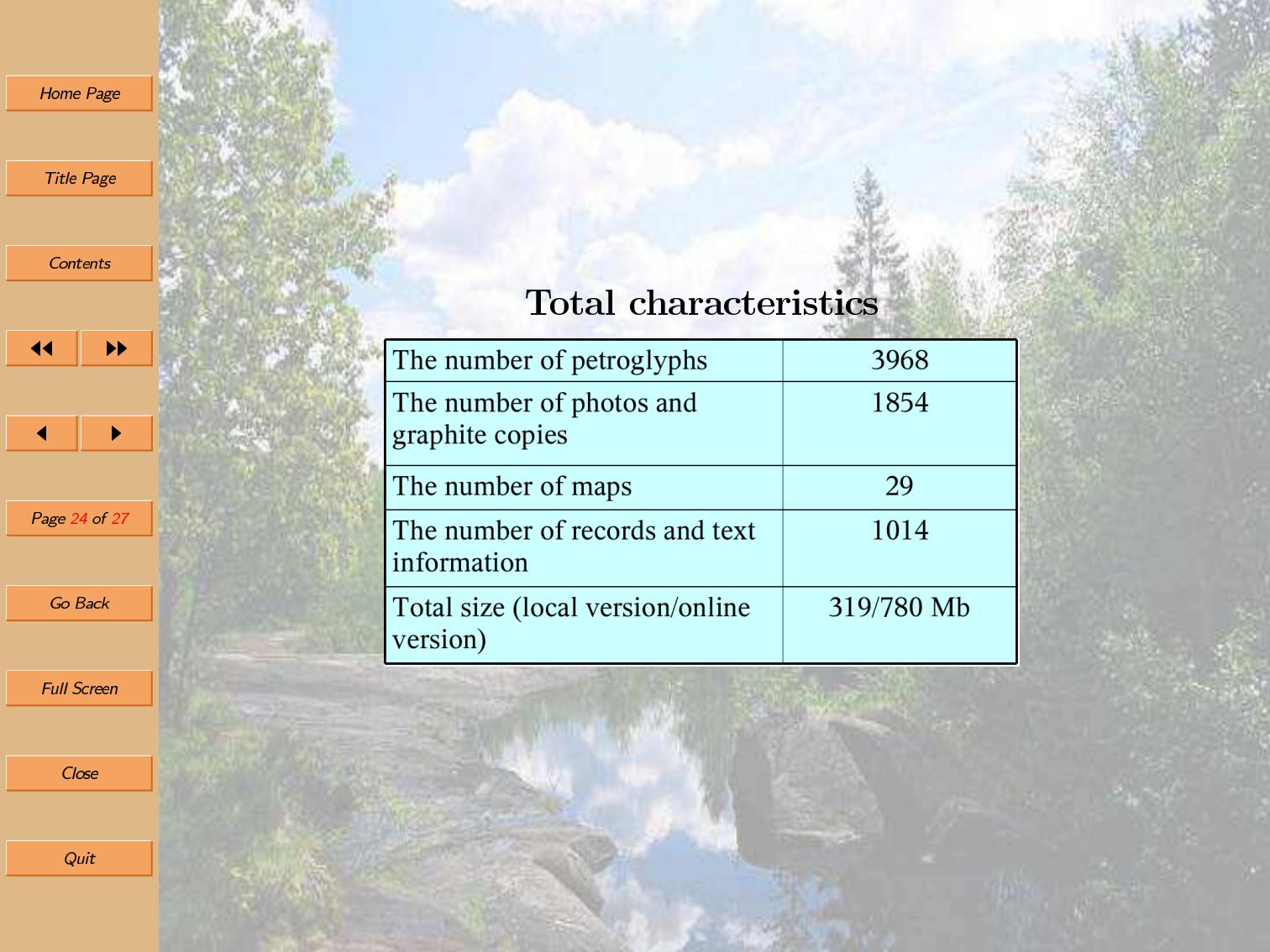
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## Multifractal parameterization of petroglyphs depictions. Carried research

1. spectrum of petroglyph and spectrum of the rock are different, but they both satisfy the features 1 - 4.
2. spectrum  $D_q$  is an invariant for petroglyphs depictions in regard to brightness transformation rotation and scale.

To sum it up: nowadays software for solving tasks of segmentation and search in graphic database is developing. The results of datum research are planed to use in the system "PIRS".

The background of the slide is a photograph of a natural landscape. In the foreground, there's a rocky bank of a river or stream. The water reflects the surrounding environment. Beyond the water, there are dense green trees and some taller evergreen trees. In the far distance, there are mountains under a bright blue sky with scattered white and grey clouds.

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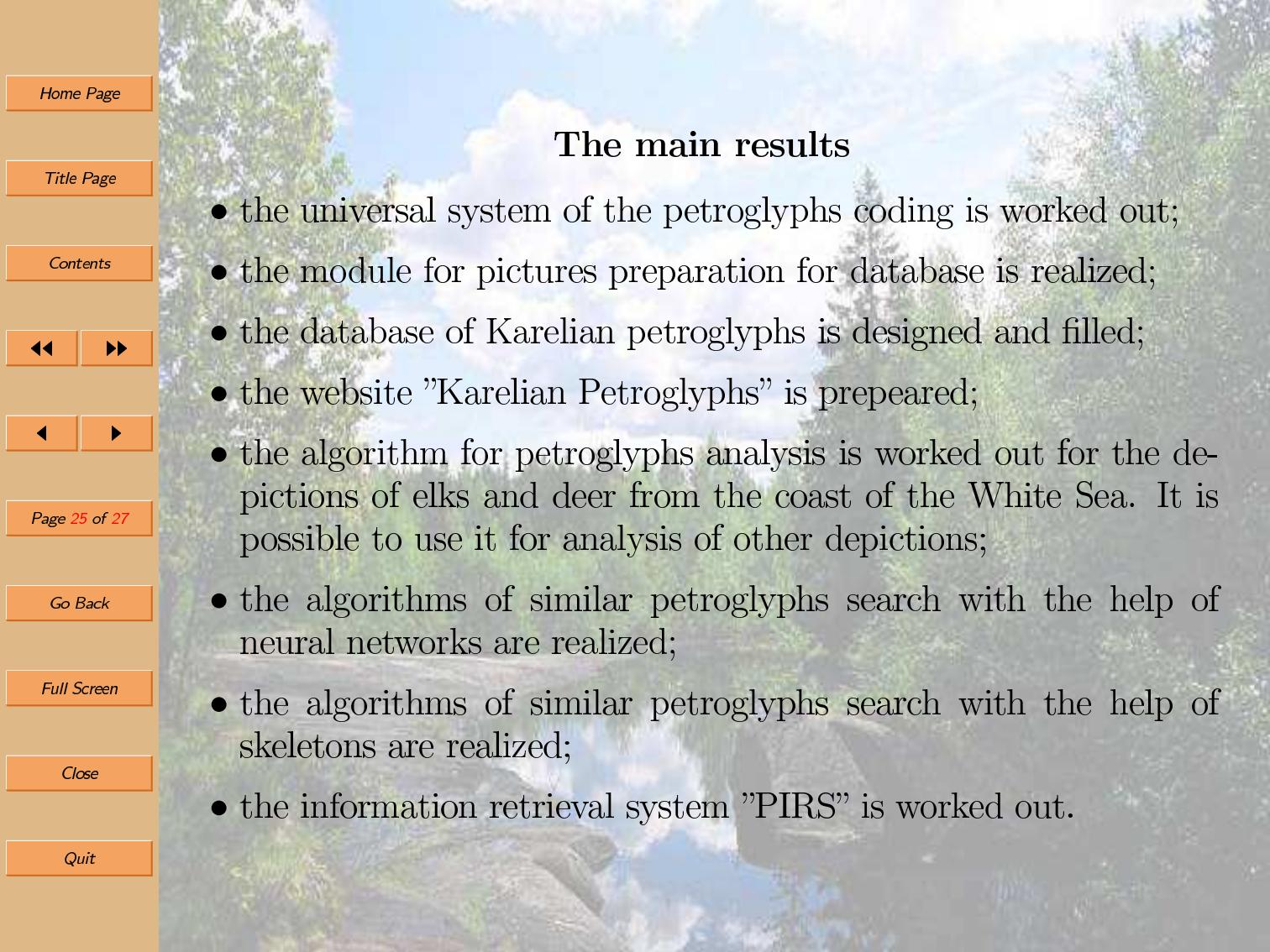
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## Total characteristics

The number of petroglyphs	3968
The number of photos and graphite copies	1854
The number of maps	29
The number of records and text information	1014
Total size (local version/online version)	319/780 Mb

A scenic background image showing a rocky shoreline with green trees and a body of water under a blue sky with white clouds.

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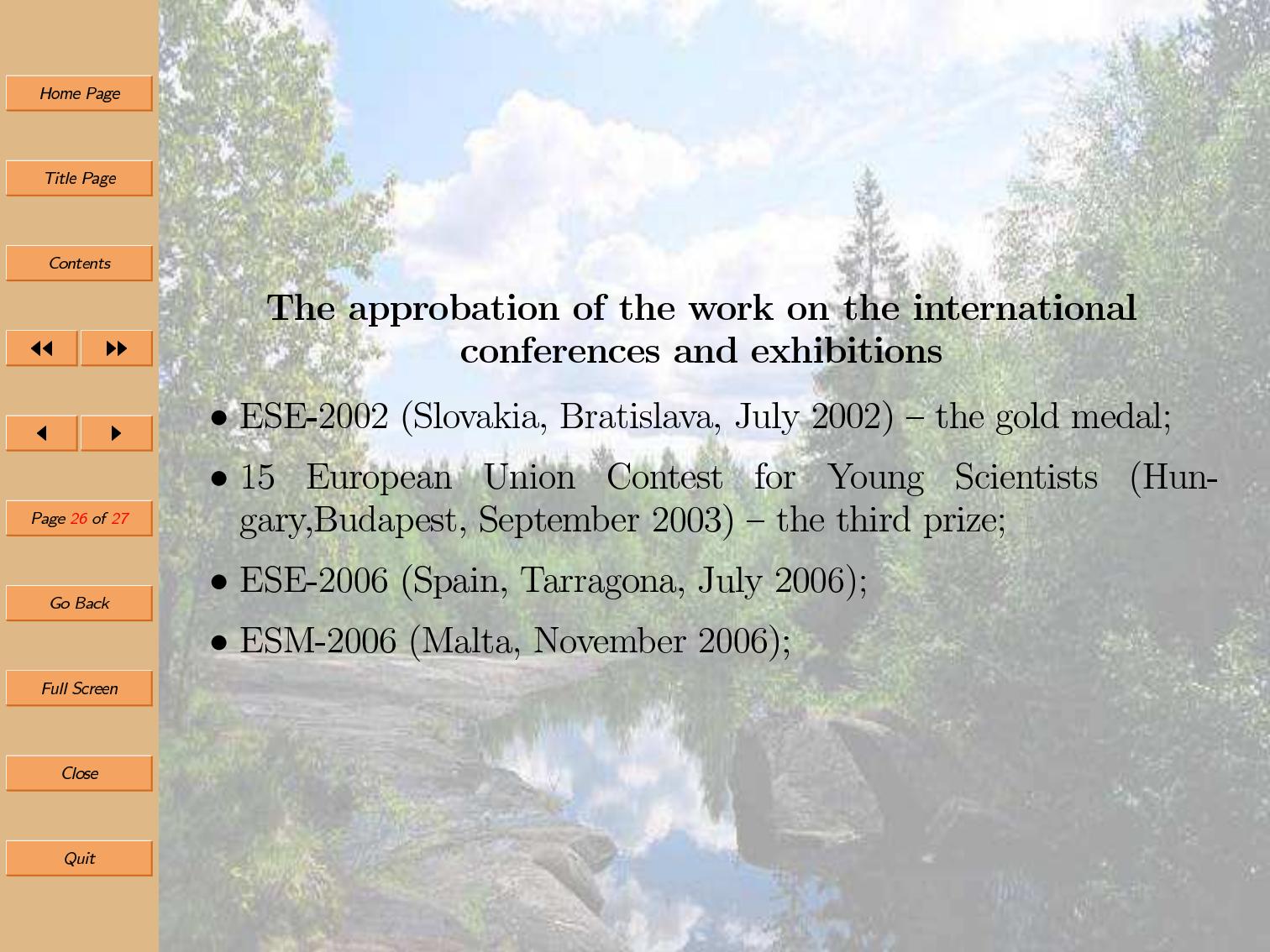
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## The main results

- the universal system of the petroglyphs coding is worked out;
- the module for pictures preparation for database is realized;
- the database of Karelian petroglyphs is designed and filled;
- the website "Karelian Petroglyphs" is prepared;
- the algorithm for petroglyphs analysis is worked out for the depictions of elks and deer from the coast of the White Sea. It is possible to use it for analysis of other depictions;
- the algorithms of similar petroglyphs search with the help of neural networks are realized;
- the algorithms of similar petroglyphs search with the help of skeletons are realized;
- the information retrieval system "PIRS" is worked out.

The background of the slide is a photograph of a natural landscape. It features a river flowing through the foreground, surrounded by lush green trees and bushes. In the distance, there are tall, dark evergreen trees and rolling hills or mountains under a bright blue sky filled with white and grey clouds.

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## **The approbation of the work on the international conferences and exhibitions**

- ESE-2002 (Slovakia, Bratislava, July 2002) – the gold medal;
- 15 European Union Contest for Young Scientists (Hungary, Budapest, September 2003) – the third prize;
- ESE-2006 (Spain, Tarragona, July 2006);
- ESM-2006 (Malta, November 2006);

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## The approbation of the work on the international conferences and exhibitions(continue)

- IX contest of business ideas and research works "Young. Darling. Perspective." (Saint-Petersburg, December 2006) – the third diploma;
- IX international conference "Intellectual Systems and Computer Science" (Moscow, mechanics and mathematics faculty MSU, October 2006);
- VII all-Russian exhibition of scientific and technical works of youth NTTM (Moscow, June, 2007) - the medal "For Progress in Scientific and Technical Works";

All in all more than 12 scientific conferences and contests of different level (2002 – 2007). 7 articles are published on the theme of the research, 3 are printing.