3^D IMAGING SOFTWARE TOOLS FOR MULTIBEAM SONAR DATA

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Nowadays, the techniques for 3^D computer graphics are developing dynamically. They are finding application not only for creating computer games, but often for three-dimensional data visualization systems. Applying these techniques make graphical operations more effective and consequently these systems are more efficient. The paper presents the system for 3^D seafloor visualization using multibeam sonar data. In the presented system three programming techniques for 3^D graphic were used C++ OpenGL, Java3D, Java OpenGL. The problems related to the system development and the ways of its solution are presented.

FORMULATION OF THE PROBLEM

Spatial Information Systems play quite important role in contemporary world. Their role is not limiting only for the storage of geospatial data, but also for their visualization. Geographical Information Systems (GIS) more often became helpful for different institutions and companies for threats monitoring and the exploration places, which research with the naked eye is impossible. More dynamically developed branch of Spatial Information Systems are Seafloor Information Systems (SIS) dedicated to the acquisition and visualization of data, which contains information about sea areas.

One of the basics requirements for SIS system is real time data acquisition and its visualization. Two essential limitations are important, when creating software which meet this requirements:

- the memory complexity i.e. the amount of the memory needed for storing information gathered in system for spatial data visualization,
- the computational complexity i.e. the amount of operations that processor must do in order to visualize data contained in the program memory.

It is worthwhile remembering that the system must keep spatial data in the operating memory of the computer or in the memory of graphics card. Access time to this information is critical for providing entire action and it is improves the fluency of graphical operations.

Having in mind above requirements it seems necessary practicing technologies, which improve graphical operations and memory management where data are stored. In order to attain it is possible to use the concept of the graphical acceleration. The block diagram of utilization of graphics card properties was presented in Fig.1.

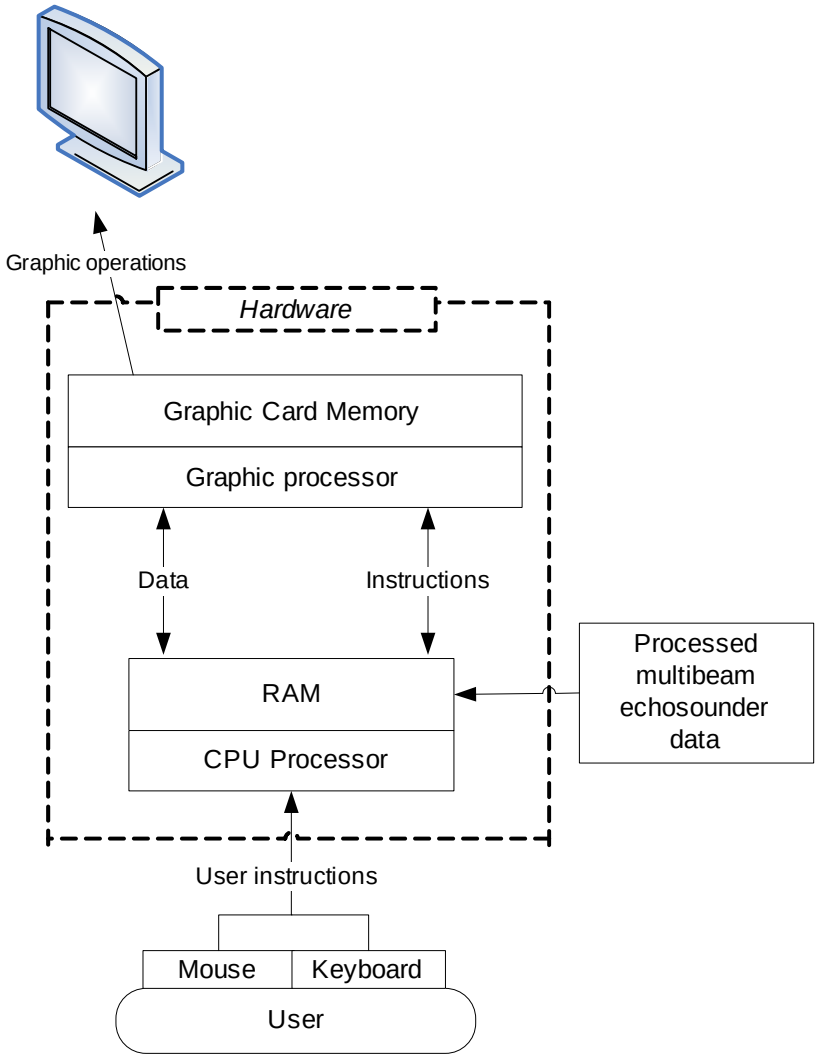

Fig.1 The concept of graphics card utilization in multibeam data processing

1. PROJECT OF THE SYSTEM

The usage of technologies for creating computer games and software working in the 3^D graphics mode might be alternative to classical Seafloor Information Systems [1]. In the aim of the verification of the possibility in application of these technologies in systems like SIS, the authors designed the system called Cousteau which was made in three different technologies. Data for visualization for Cousteau were acquired by the multibeam system EM3002 [2]. It is advanced technologically device, which due to multidirectional wide-angle observation of the bottom and simultaneous high angular resolution, allows for the excellent bathymetry sampling and depicting the sea bottom from received signals of the echo. Cousteau system uses three different programming technologies, that is: Java OpenGL [3], C++ OpenGL [4], Java3D [5]. This solution permits to compare the productivity of used

programming languages and to define their usefulness when creating systems of the SIS type. They represents application programming interface (API) which speed up graphical operations being aimed in a three-dimensional visualization and hence effectively speed up the performance of the entire system. The architecture of the system was shown in Fig. 2.

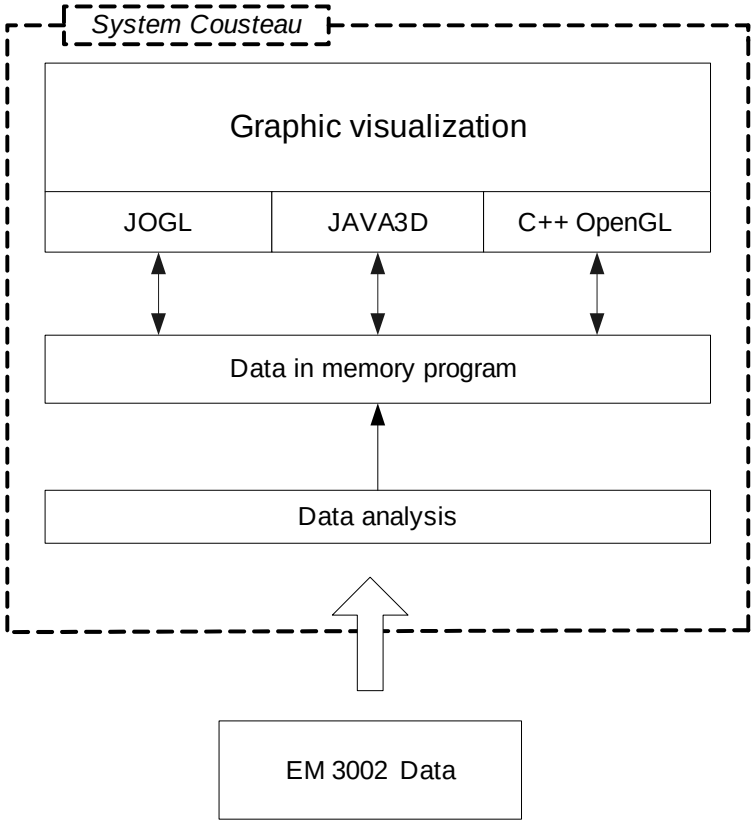

Fig.2 Block diagram of the system

2. IMPLEMENTATION

Two separate programming modules were created in the course of works on the presented system. These modules analyze data acquired by the multibeam system and prepares for three-dimensional visualization. Functionality of the system consists of graphical operations such as rotation, moving and scaling. The software may be thought as an alternative for the classical SIS created by some of the companies, manufacturing multibeam systems. In Figures 3 to 6 the screen shots from the running system are presented. Fig. 3 shows the three-dimensional visualization of the sea bottom made in Java OpenGL technology. Fig. 4 contains the same data observed from different point when using C++ OpenGL technology. File analysis algorithms and its visualization were worked out for all technologies together. Results of using different technologies are similar although differences in the performance are distinct.

The system of the visualization was equipped with meshing and triangulation taking measuring points as a base data. The result of drawing measured data in the form of the mesh as obtained using Java3D are presented in Fig. 5 and similarly using Java OpenGL in Fig. 6, whereas the triangulation results in Fig. 7. Measured data comes from acoustic survey made in the Oslofjord and contain the shipwreck of the German cruiser Blucher. The system was tested using several multibeam data sets contains few hundred megabytes each.

Technologies applied in the system are enabling to prepare the 3^D graphics "moving in virtual three-dimensional world" system as a fluently rendered application. However, for a few hundred megabytes datafiles the responsiveness of the system for the user actions is getting smaller. This is the results of characteristic features applied in the system of programming languages (C++, Java).

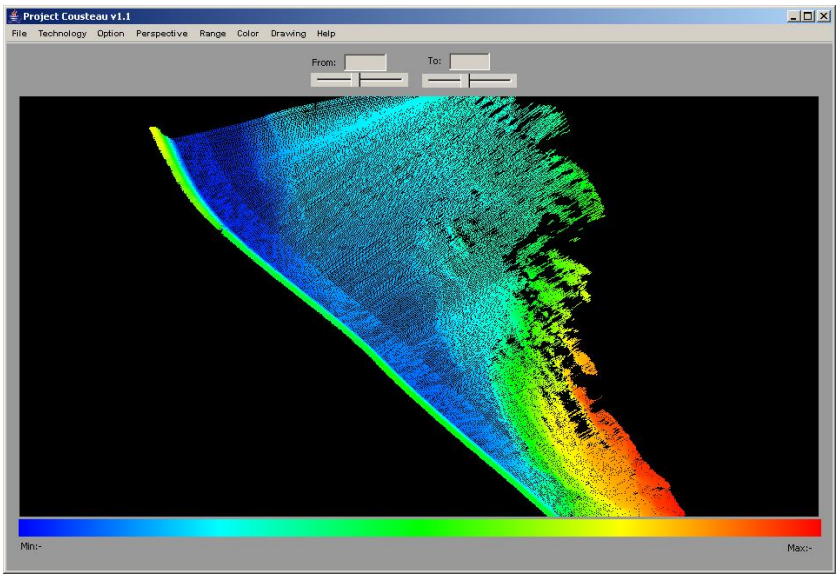

Fig.3 Three-dimensional visualization of the sea using Java OpenGL technology

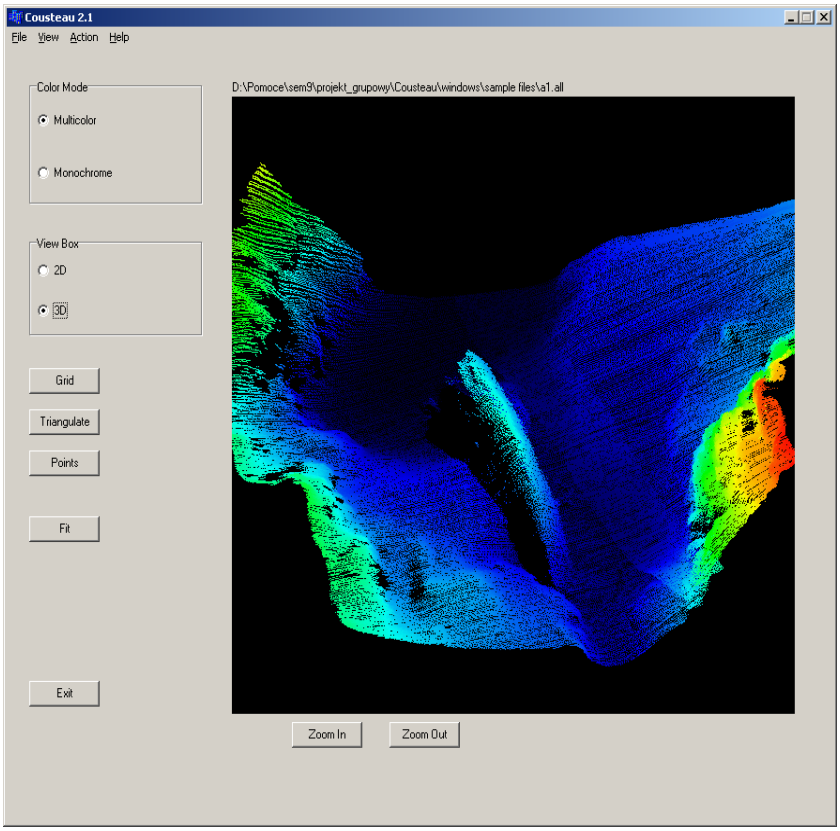

Fig.4 Three-dimensional visualization of the sea bottom obtained by C++OpenGL technology

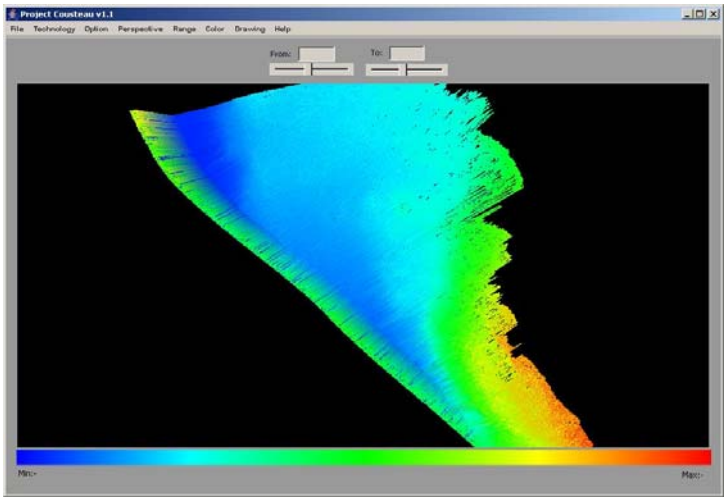

Fig.5 Data visualization using Java3D technology

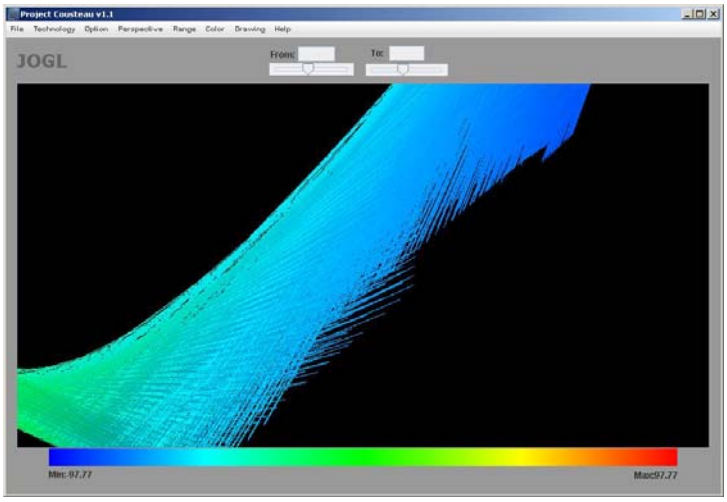

Fig.6 Data visualization using C++ OpenGL technology

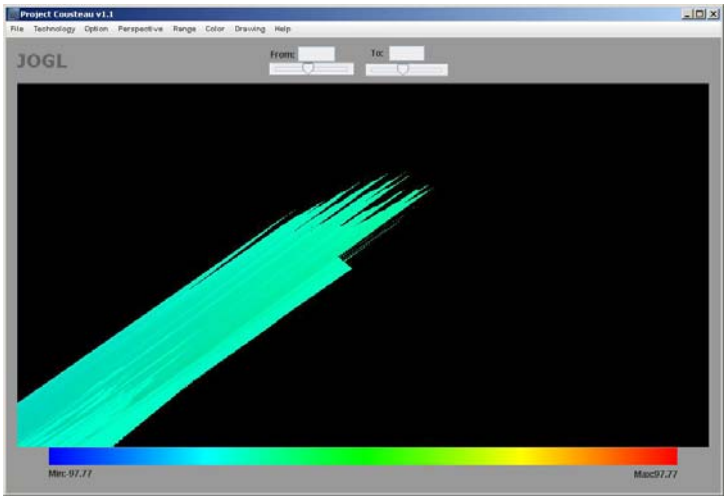

Fig.7 Triangulation performed on excerpt of data acquired by multibeam system

3. CONCLUSIONS

SIS systems are dynamically developing branch of Spatial Information Systems dedicated to marine applications. Towards increasing technological abilities in the scope of the cooperation of modern hydroacoustic devices with computer systems and of increasing the computational strength of every computer hardware, expectation in comparison to the software are growing. Very often systems made for this purposes do not possess unique requirements for the visualization. The users still wait for the systems which will be fast and smooth for the three-dimensional visualisation of bathymetric data coming from the sonar.

Practicing the 3^D design in SIS systems where the requirement of the work is a base of designing in the real time, seems to be justified and perspective. 3^D technologies are in the permanent development and their implementation is relatively easy. The SIS systems based on the 3^D graphics give far more possibilities at relatively little programming and financial effort.

ACKNOWLEDGEMENTS

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