Visiome Environment: Enterprise Solution for Neuroinformatics in Vision Science

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Abstract

In order to understand the brain function, it is required integration of diverse information from the level of molecule to the level of neuronal networks. However, the huge amount of information is making it almost impossible for any individual

researcher to construct an integrated view of the brain. To solve this problem, it is required useful neuroinformatics database and tools for preserving, maintaining and sharing of research accomplishments and resources. In the NRV (Neuroinformatics Research in Vision) project in Japan, it has been developed an integrated system and tools for neuroinformatics in vision science named “Visiome Environment”.

1. Introduction

The NRV (Neuroinformatics Research in Vision) project is the first project in Japan started in 1999 under the Strategic Promotion System for Brain Science of the Special Coordination Funds for Promoting Science and Technology at the Science and Technology Agency (now under the Ministry of Education, Culture, Sports, Science and Technology of the Japanese Government), aimed at building the foundation of neuroinformatics research. Because of the wealth of data and researchers on the visual system in Japan, the NRV project aimed to the vision science field to promote experimental, theoretical and technical research in neuroinformatics.

In this project, the Visiome Environment developing group provides a portal site,

Visiome Platform and related components in order to promote further development of the field and support researchers and students. . The Visiome Platform is a web-based data sharing system integrating mathematical models, experimental data, analysis libraries, software tools and related bibliographic information, described basically in published journal papers. The Personal Visiome, which is a database system for individual researchers or laboratories, is also developed for realizing the management of personal research sources collaborating with the platform. Furthermore, an interactive signal processing and system analysis tool, SATELLITE, will contribute for data visualization and modeling. The Visiome Environment will realize a virtual environment for global informational collaborations by providing to researchers with useful tools for simulation and data analysis environment with reusable models and data.

2. System configuration of Visiome Environment

As shown in Fig.1, the Visiome Environment is consisted of two server side systems, Visiome Platform and Simulation Server, and two user support tools, Personal Visiome and SATELLITE. Each component has following characteristics.

2.1 Visiome Platform (neuroinformatics database for vision science)

The Visiome Platform (released in early 2004 at http://platform.visiome.org/) is a database system that provides reusable programs/scripts of mathematical model, experimental data, analysis tools and their related information described basically in published journal papers (Fig. 2). Downloading and executing model programs or scripts registered on the platform allow researchers to see how the models work or compare their own results with other experimental data. It must be useful to improve or integrate related models, and formulate their own hypothesis into a new model. Conversely, they can register their own models, data, and tools to the platform for sharing with colleagues.

The contents of the Visiome platform are provided along the novel tree-structure index system (Visiome Index) in the field of visual neuroscience. This index is based on neuronal and cognitive functions that are important targets in vision science. It will provide useful information to students and beginners to understand an overview of the field.

2.2 Visiome Simulation Server (online simulation server)

Our concept, sharing model programs and experimental data via the Internet, might be an effective way to the rigorous testing by others, but there still exist some difficulties to do it because of incompatibilities between providers and clients on various factors, such as hardware compatibility and difference of software version. In order to solve this barrier, the platform provides on site simulation capability as Visiome Simulation Server (VSS). It comes with a high-performance simulation engine and simulation tools for computing and visualization.

Executable contents on the server are made their links to the Platform and thus VSS provides a trial of model by accessing to them through the web browser like Internet Explore, Netscape navigator. VSS also provides visualization functions for registered experimental data by additional registration of SATELLITE script for data plotting.

2.3 SATELLITE (System Analysis Total Environment for Laboratory - Language and InTeractive Execution)

We considered that it is vital for promoting neuroinformatics to improve research environment for data analysis and model simulation in laboratory. SATELLITE is a powerful tool combined function for experimental data analysis and simulation of mathematical models. SATELLITE shell is launched and displayed command prompt on your UNIX, Linux or Windows operating system. There are wide ranges of functions for data acquisition, filtering, frequency analysis, parameter estimation and visualization are accommodated, and all the functions can be used by entering commands through the shell. Programming capability of SATELLITE provides automatic execution of command sequence in the script file. The script files made and used by researchers in experiment and analysis must be precious resources of techniques and know-how for many scientists and students. In our project, it is provided an environment for exchanging and executing scripts through the Visiome Platform and Simulation Server.

Other unique feature in SATELLITE is a real-time simulation function (Real-time simulator). Experimental data can be sampled through A/D converter and calculate model response. The results are then output as an analog signal from D/A converter and

then feedback to the system. This function enables to implement a mathematical model into a real biological or neural system.

2.4 Personal Visiome (neuroinformatics database for laboratories)

As a data management system of individual researchers or laboratories, , the Personal Visiome is also released. This system is a personal edition of the Visiome Platform, thus sharing most of its functions with the platform. The Personal Visiome can accept arbitrary formatted files, like PDF files of literature, image files and binary experimental data in user's computer. Each user or group can make their own indexing system and customize display style of their contents in the system.

Many articles or papers are published day by day, and it is hard to keep tracking research trends and getting variable information for one's research. We thus are developing an agent module in the Personal Visiome, which automatically accesses to neuroinformatics, neuroscience and literature database sites through Internet, and collects information such as newly published paper, updating of homepage, conference information, based on registered keywords. This module effectively works with the

Visiome Platform for collaboration of contents registration, searching and updating.

3. Conclusion

As we described in this article, the Visiome Environment will realize a virtual environment for global electronic collaborations of researchers, especially for young scientists. Personal tools are also useful for data analysis, simulation and arrangement of the results and research sources. We hope that the Visiome Environment to be used by many researchers collaborating internationally and compiled most of important contents in the future.

References

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2) Usui S., Visiome: Neuroinformatics Research in Vision (NRV) Project. Neural Networks, Special Issue on Neuroinformatics: vol.16(9), 2003.

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Figures

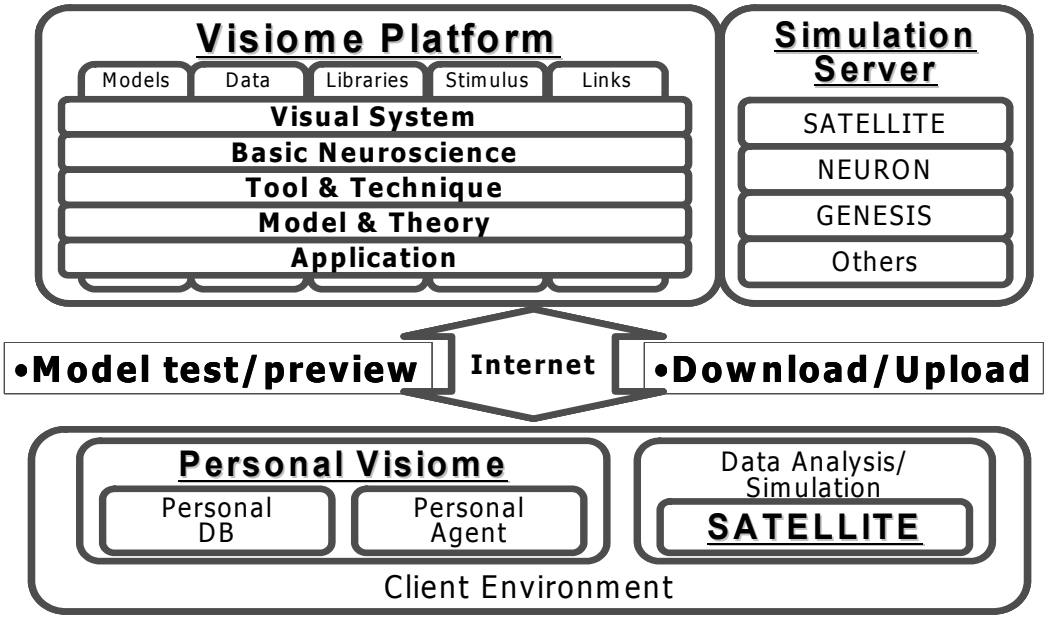

Fig. 1 Components of the visiome environment

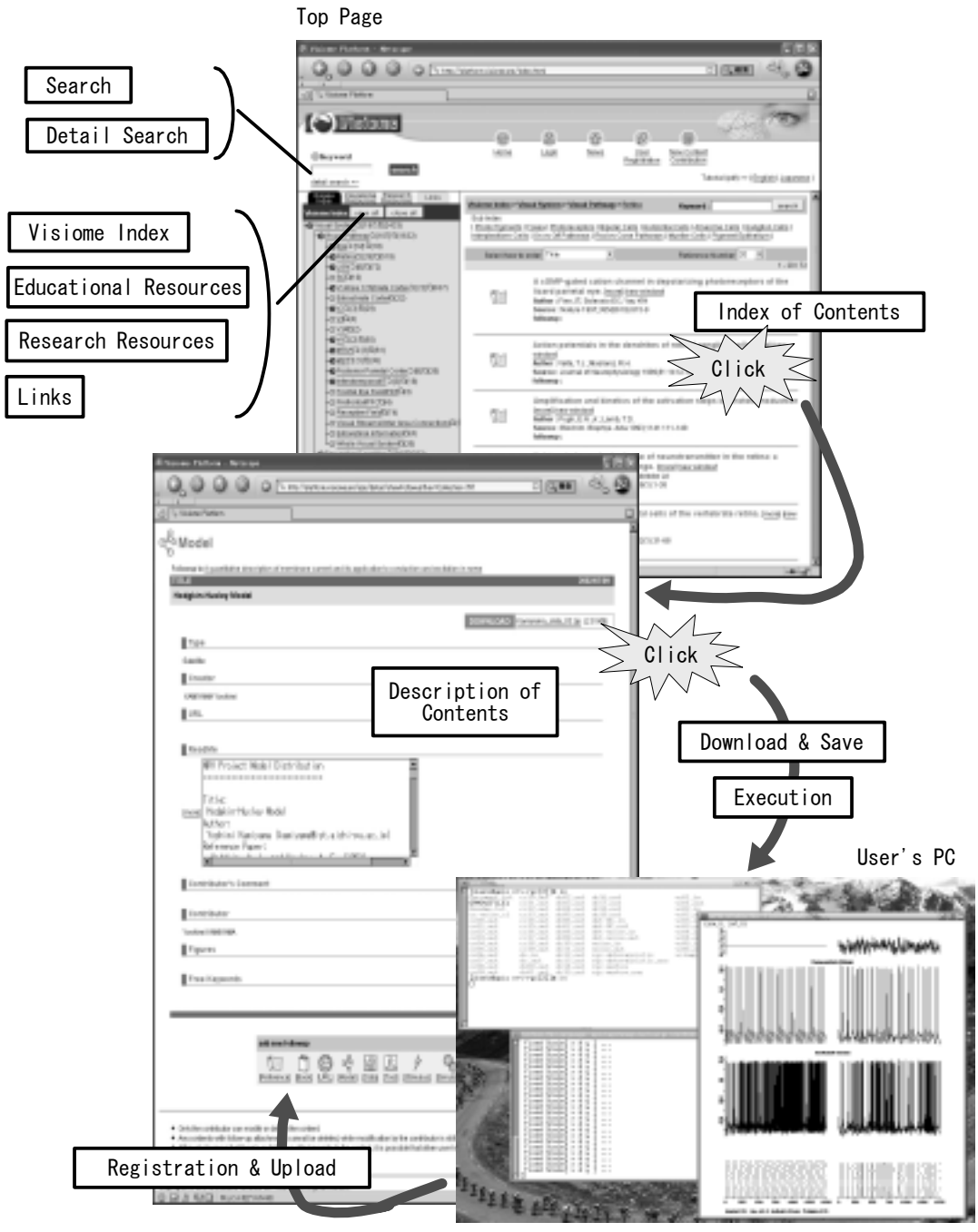

Fig.2 Exploitation of Visiome Platform