Automated data-set generation pipeline for 3D Neuron visualization and cloud processing in Kbrain-map DB station portal

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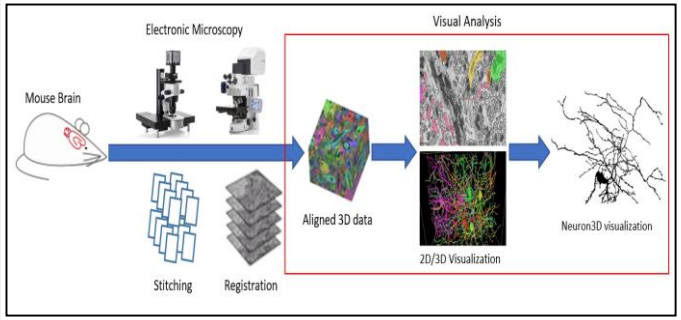
Abstract

In the field of connectome research, there is an ongoing need for analytical techniques to process the massive data obtained using high-resolution microscope imaging technology. In terms of computer science, the development of original technology for technological advancement, simulation of research results, and scalability for additional supplementation and improvement requires the development of third party and open source-based tools. In this study, we propose pre-computed pipeline and methodology generating an automated data set and providing an advantage of block storage in a cloud environment, which are eventually utilized the images produced by electronic microscopy (EM) to be visualized and analyzed in three dimensions through a web browser, KBrain-map platform. We implemented the open sources and computer vision libraries in this pipeline to detect neurons, synaptic connectivity, and neural structure in terabyte-scale EM data. This platform includes an automated pre-processing pipeline for EM images with high-capacity storage space. In addition, we developed the KNeuroViz, an analytical solution for post-processing, for web-based 3D visualization and analysis of neurons. This solution is a modified software of Neuroglancer and optimized to the web-based system. This will be implanted into KBrain-map platform, eventually. In current study, we propose the KBrain-map platform which is a cloud-based platform and includes the pipeline to visualize neurons and synapses in 3D and analyze their connectivity, efficiently. This system will be continuously integrated with various analysis modules providing an interactive platform for brain research.

Introduction

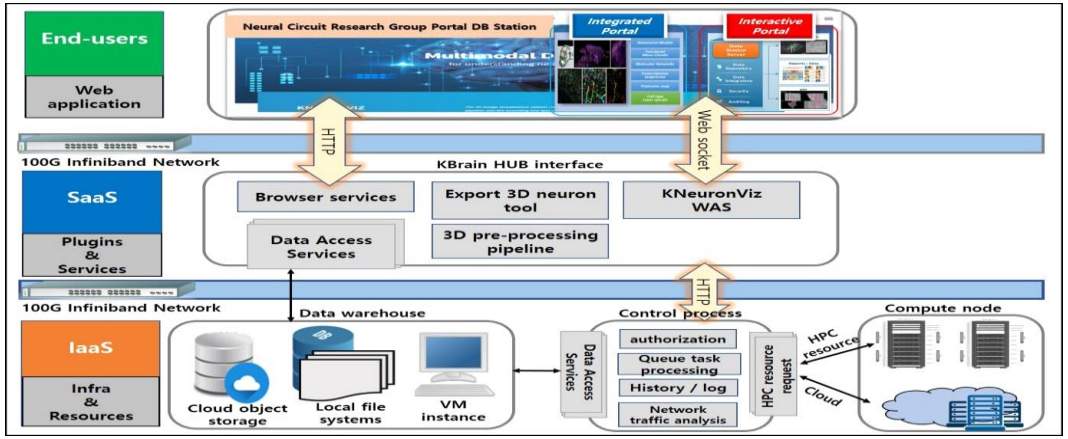
EM(Electron microscope) image analysis process and visual analysis flow chart



The big data are being generated by new optical equipment technologies in neuroscience such as monitoring tools for neural activity and imaging tools for circuit formation. Electron microscope is widely used for neural network and generates high-resolution images. It is still necessary to develop an efficient 3D creation because it is nonexchangeable imaging file format in huge volume affecting data analysis. In this study, we propose the integrated KBrain-map platform as a SaaS that can be used for efficient processing, storage, management, interactive visualization, and analysis.

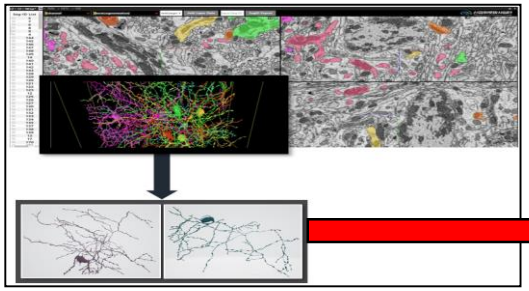
Web based Integrated DB station system

Architecture : Interactive integrated DB station KBrain-map and cloud system



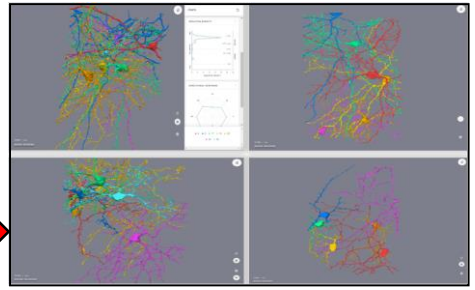
The integrated DB station, which provides cloud-based IaaS and SaaS models, is composed of 3 major layers: (1) The end-users (Web application) level, which provides access to KBrain-map, (2)the SaaS (plugins & services) level, and (3) the IaaS (infrastructure as a service, Infra & Resource) level.

KBrain-map App: KNeuroViz for visualization of 3D neuron meshes



KNeuroViz shows neuron viewer for 3D analysis and visualization of neural circuit networks. In the bottom 3D mesh display of figure, the 3D image of each 2 neurons is the result of visualization in KNeuroViz from an exported neuron image file (.obj or .ctm) to a 3D neuron mesh.

KBrain-map App: Neuron browser for analysis of 3D neuron



The Neuron Browser connects to KNueronViz and provides the ability to find cell classifications, perform statistical analysis, and determine the structure of connections between neurons.

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