Brain Analysis Simulator for Analysing Brain Tumor

A quick start user manual,

Current Brain Analysis Version: v1.0,

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For help, please contact:

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About Brain Analysis

Brain Analysis Simulator, an open-source tool designed for efficient MR image analysis. This innovative simulator allows users to interact with the model at runtime, enabling real-time adjustments and visualizations during the analysis process. It serves as an efficient alternative to traditional code-based experiments, providing a more accessible and user-friendly experience.

It is developed on a graphical programming language platform called LabVIEW (Laboratory Virtual Instrument Engineering Workbench) [1]. One of its key features is its open-source nature, which makes the simulator freely available for use by researchers, students, and medical professionals. This allows for easy integration into existing workflows and encourages collaboration within the community. Furthermore, the algorithm used in the simulator is based on a combination of machine learning techniques and appropriate filters, which ensures high precision in the classification and segmentation of tumors in MR images. The resulting robust and accurate detection of brain tumors makes it a valuable tool in the field of medical image analysis and early detection.

This short document will teach you how to use Brain Analysis Simulator to perform run-time experiments.

Basic Requirements

A graphical programming approach LabVIEW Runtime 2021 or above.
A minimum computer requirement:

- Processor: i3 CPU @ 2.3 GHz
- RAM: 4.0 GB
- System Type: 32/64-bit OS
- Operating System: Mac OS, Window

To Install Runtime LabVIEW:

https://www.ni.com/kokr/support/downloads/softwareproducts/download.labview.html#305931

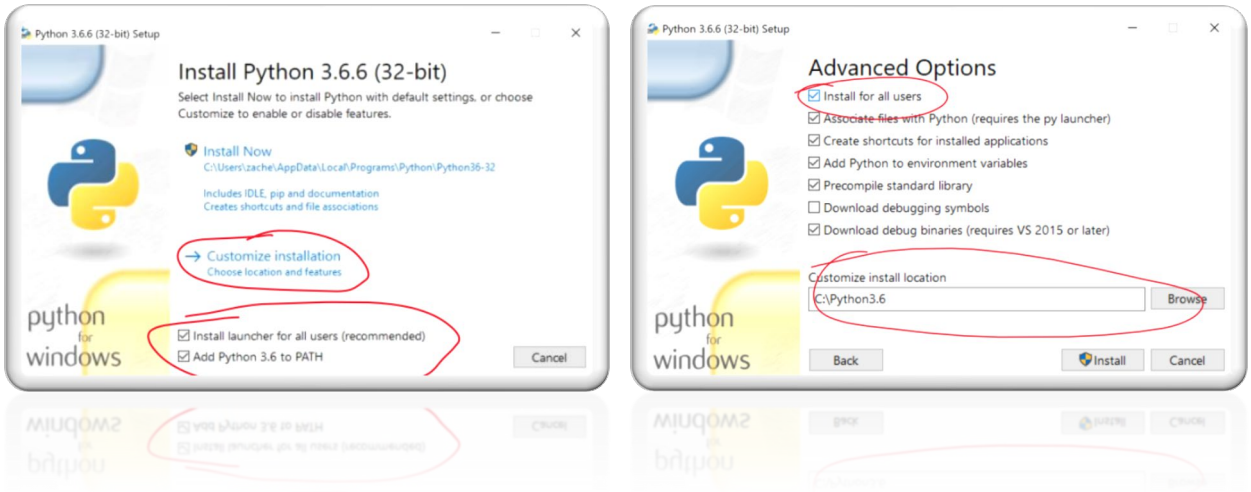
To Install Python:

Users May also need to install the Python version for image classification VI. As LabVIEW requires a very specific Python Installation and is not compatible with many installers. It requires you to download Python 2.7 or 3.6 from "**Python.org**". Since most individuals polled still use LabVIEW 32-bit that version is referenced.

Version	Operating System	Description	MD5 Sum	File Size	GPG
Gzipped source tarball	Source release		9a080a86e1a8d85e45eee4b1cd0a18a2	22930752	SIG
XZ compressed source tarball	Source release		c3f30a0aff425dda77d19e02f420d6ba	17156744	SIG
macOS 64-bit/32-bit installer	Mac OS X	for Mac OS X 10.6 and later	c58267cab96f6d291d332a2b163edd33	28060853	SIG
macOS 64-bit installer	Mac OS X	for OS X 10.9 and later	3ad13cc51c488182ed21a50050a38ba7	26954940	SIG
Windows help file	Windows		e01b52e24494611121b4a866932b4123	8139973	SIG
Windows x86-64 embeddable zip file	Windows	for AMD64/EM64T/x64	7148ec14edfdc13f42e06a14d617c921	7186734	SIG
Windows x86-64 executable installer	Windows	for AMD64/EM64T/x64	767db14ed07b245e24e10785f9d28e29	31930528	SIG
Windows x86-64 web-based installer	Windows	for AMD64/EM64T/x64	f30be4659721a0ef68e29cae099fed6f	1319992	SIG
Windows x86 embeddable zip file	Windows		b4c424de065bad238c71359f3cd71ef2	6401894	SIG
Windows x86 executable installer	Windows		467161f1e894254096f9a69e2db3302c	30878752	SIG
Windows x86 web-based installer	Windows		a940f770b4bc617ab4a308ff1e27abd6	1293456	SIG

Installing Python for LabVIEW:

After downloading the above-specified version, use the following method for installation,



After the successful installation, the windows user might need to set the system path. To set the path, please use the following link,

- https://learn.microsoft.com/en-us/previous-versions/office/developer/sharepoint-2010/ee537574(v=office.14)#to-add-a-path-to-the-path-environment-variable.

1. Analysing the MR-Images using Brain Analysis Simulator

In this section, you will learn how to analyze and visualize the MR-Images using Brain Analysis tool.

1.1. Launching Simulator

The front interface/welcome page of Brain Analysis Simulator, shown in Figure 1, will appear when you double-click on **BrainAnalysis.*app*** (for MAC OS) or **BrainAnalysis.*exe*** (for Windows OS).

Figure 1. Front interface/welcome page of BrainAnalysis.

The image on the right side of the corner illustrates the basic overflow of the simulator. In the upcoming version of BrainAnalysis, version 1.1, the team plans to implement a convolutional neural network for both supervised and unsupervised models. Once the user selects the "Generate Analysis VI" button, a runtime VI will appear. The following section provides a detailed explanation of runtime VI.

1.2. Simulator Menu Bar

A menu bar is **a graphical control element that contains drop-down menus**.

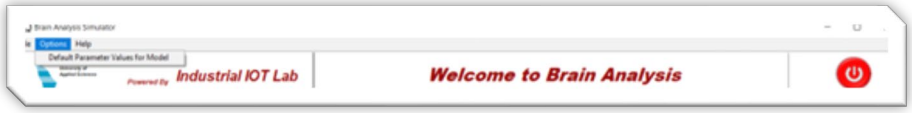


Figure 2. Menu tab showing the drop-down listed features of a BrainAnalysis tool.

The menu bar's purpose is to supply a common housing for window- or application-specific menus which provide access to such functions as closing the BrainAnalysis tool, looking at the default parametric values of the model, and displaying help or contact information.

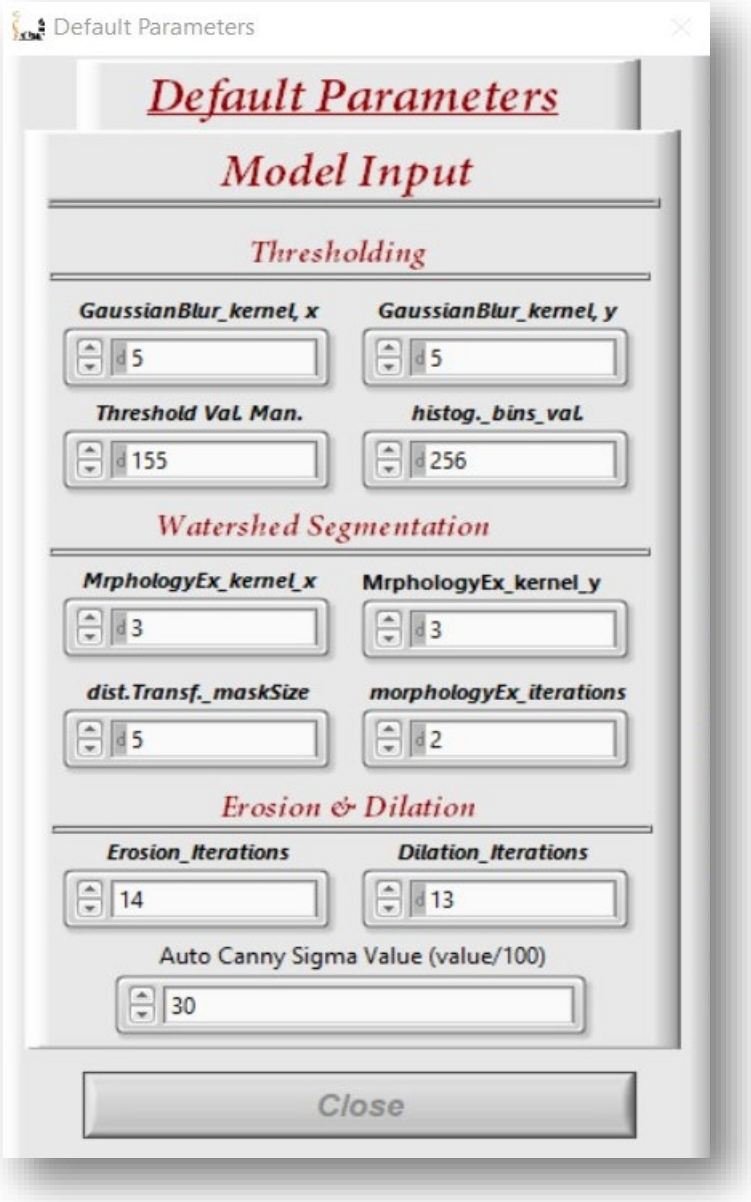


Figure 3. By using the drop-down menu,
users can see the default parametric values of the models.

Figure 4. By using the drop-down menu from a **Help list**, users can see the relevant information.

2. Generating a Run-time Interaction VI:

The runtime simulator allows researchers to fully understand each and every factor while executing the model, and to use a set of balanced values to accurately predict early brain tumors. As soon as the "Generate Analysis VI" button (This will bring up a virtual instrument shown in Figure 5) is clicked the user will enter the run-time simulation environment. The users can enter parametric values before analyzing the model or they can go with the default values and can also change the values accordingly during the time of the simulation.

Our proposed architecture is a novel tool that offers fully automated, user-independent analysis and simulation results, including state-of-the-art accuracy and accurate tumor region segmentation of imbalanced MR images.

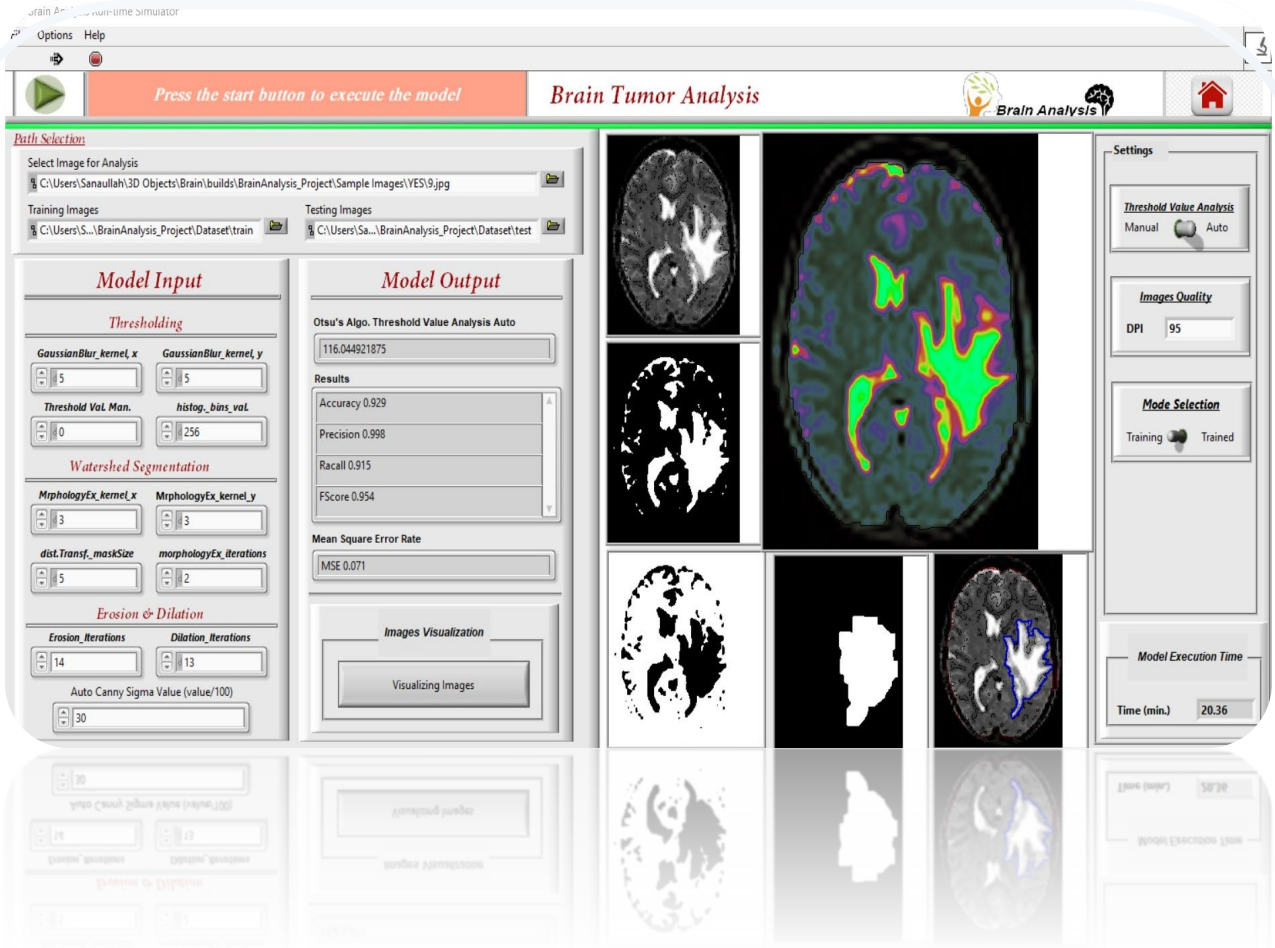


Figure 5. Runtime Virtual Instrument

2.1. Runtime Experimentation VI

Run-time experimentation of the Brain Analysis provides a lot of flexibility for the user to interact with the model at any point in time. Figure 5 shows the simulator's screen overview after hitting the “Generate Analysis VI” button on the welcome page of the simulator.

Images in Figure 5, visualize the model-generated images. On the left side, the VI offers the user to increase/decrease or update the model parametric values at any time during the simulation. The Model Output block provides the dataset training results. On the right side, the VI offers the user to change the simulation different mode.

In Figure 6, the VI simulation illustrates the simulator results with Trained and Manual Threshold Modes.

Figure 6. Runtime Virtual Instrument

3. Generating an Image Visualization VI:

As soon as the "Visualizing Images" button (This will bring up a virtual instrument shown in Figure 7) is clicked the user will enter the image-visualizing environment, where the user can view the model-generated images with the name of the images generated method.

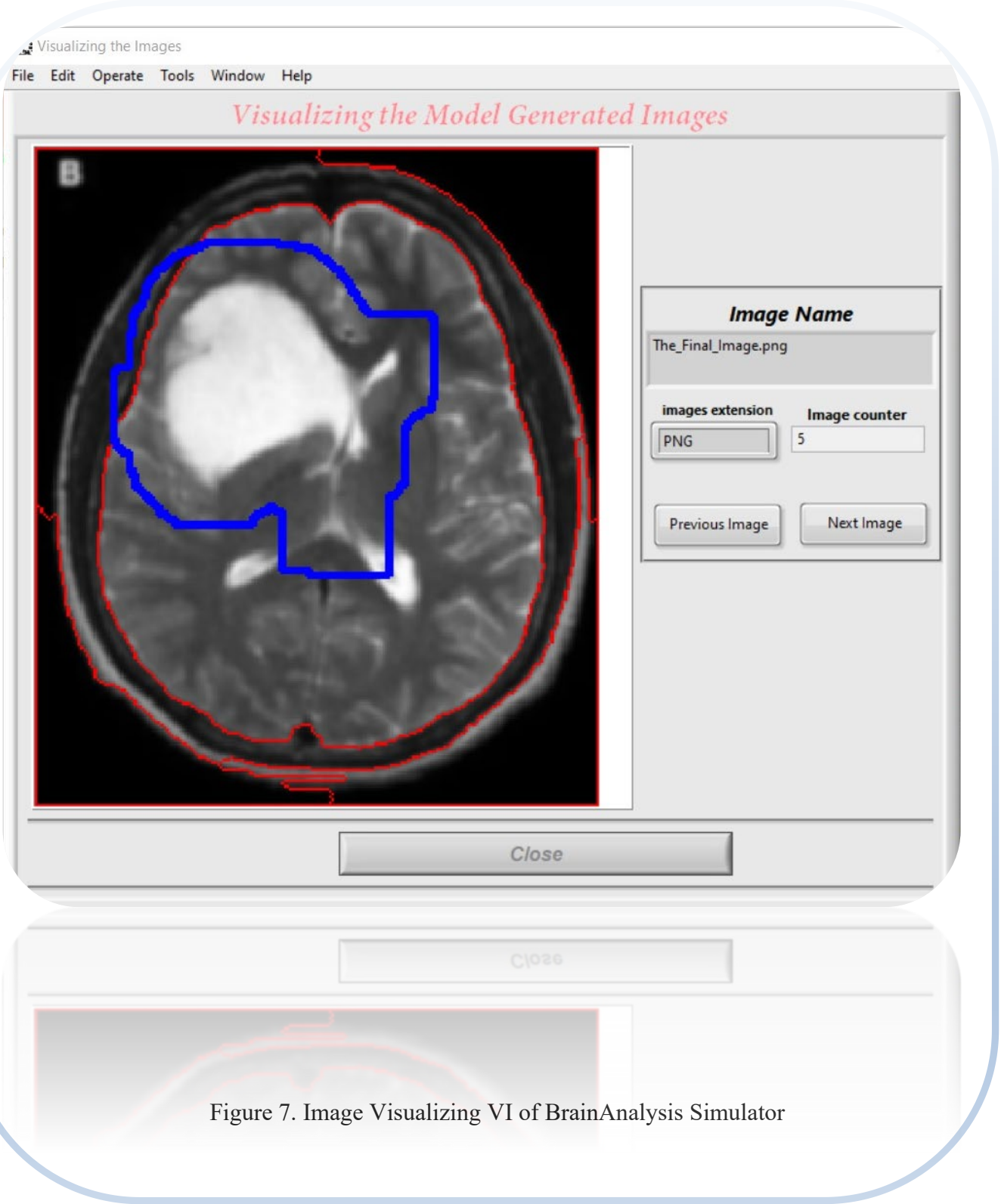
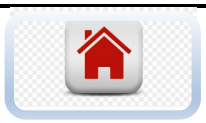


Figure 7. Image Visualizing VI of BrainAnalysis Simulator

4. Additional features in BrainAnalysis Simulator



If a **STOP** button (icon located at the top right corner in Figure 7.) is pressed, "BrainAnalysis VI" navigates the user back to the home screen.

Alert – When the **STOP** button is pressed, the user navigates to the home page and the stop button on the home page can be used to terminate the BrainAnalysis tool immediately.

Tip – The functionality of graphical plots, including simulation colors, can be changed by using a left-click on the plot legend and selecting the desired drip-down option.

Runtime – The runtime simulation option, available in BrainAnalysis v1.0, is shown at the botton right corner of a VI in Figures 5 & 6. The option is described below,

- **Simulation Time**: This option allows the user to record the time of simulation in ms.

Alert – Make sure the triggered values is always in valid format and for training always select dataset path before simulation.

References

[1]. NI LabVIEW, https://www.ni.com/de-de/shop/labview.html.