NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

Department of Computer Science and Engineering

Major project report on

Image processing on arbitrary regions of biological significance

By

Sumukha R M	**Abhishek Reddy**	**Job J**
12CO67	12CO03	12CO34
VII Sem B.Tech	VII Sem B.Tech	VII Sem B.Tech

Under the guidance of

Dr. Basavaraj Talawar

Assistant Professor

Department of Computer Science and Engineering

National Institute of Technology Karnataka, Surathkal

INTRODUCTION

The complex geometrcal patterns formed by the various components of the brain play a huge role in its information processing capabilities. Even at a neuron level the shape of the dendric tree determines many details of the electrical activity, and those of the synapses determine how signals are integrated. Thus the signal processing carried out by a neuron is determined both by its own morphology and the 3d structure of the network in which it is embedded. Understanding how these low level features of the neurons give rise to higher level features of the brain requires the help of advanced network models. Research has supported a relationship between the morphological and functional properties of neurons. For instance, the accordance between the morphology and the functional classes of cat retinal ganglion cells has been studied to show the relationship between neuron shape and function. Orientation sensitivity and dendritic branching patterns are a few other common characteristics of neurons that researchers have noted as having an effect on neuron function. nueroConstruct allows us to model many of these morphologies and network models and analyse the electrical characteristics and the associated functionalities.It is implemented in Java and generates script files for a number of widely used neuronal simulation platforms.

APPLICATIONS

The applicataions of neuroConstruct basically fall into 5 categories.

(1) Importation and Validation of Morphologies

Reconstructed neuronal morphologies, commonly used in conductance-based neuronal models, can be imported into neuroConstruct in various formats (e.g., Neurolucida) and automatically checked for errors. More abstract morphologies with a smaller number of compartments can also be created manually

(2) Creation of Simulator-Independent Conductance-Based Cell Models

Modeling of detailed cellular mechanisms, such as the conductance changes produced by voltage-and ligand-gated ion channels, is essential for reproducing the complex behavior of real neurons. Cell mechanisms can be defined in neuroConstruct in a simulator-independent format and cell models created by specifying the complement and density of these on the cell membrane.

(3) Network Generation

Once cell models have been created in neuroConstruct, they can be placed within a region of 3D space at a specified density . Layered structures, such as the cortex, can be created from stacks of contiguous regions. Once the cells are arranged, synaptic connections can be generated according to specified sets of rules.

(4) Simulation Management

Network simulations are carried out by automatically generating script files for the simulator packages NEURON or GENESIS and the results stored in text files.

(5) Network Analysis

Simulations can be loaded back into neuroConstruct for visualization and analysis. For more specialized analyses, script files are created that allow data to be imported into two common numerical analysis packages.

PROBLEM STATEMENT

Currently neuroconstruct allows creation of regions which are geometric only, for e.g sphere, cube etc. It cannot process regions of irregulare shapes. The only method to specify an arbitrary region is to define its entire boundary of co-ordinates.

TOOLS USED

Image processing routines are coded in Java. OpenCV and MATLAB to determine the correctness of algorithms used, Neuro construct

WORK COMPLETED TILL NOW

Text removal from images :

The text letters specifying the regions are coloured in black and they are removed from the image. This forms the first step in image processing, This text forms a large part of noise and it is composed of layers of black pixels. Each of these text represents different cross sections of the spinal cord.

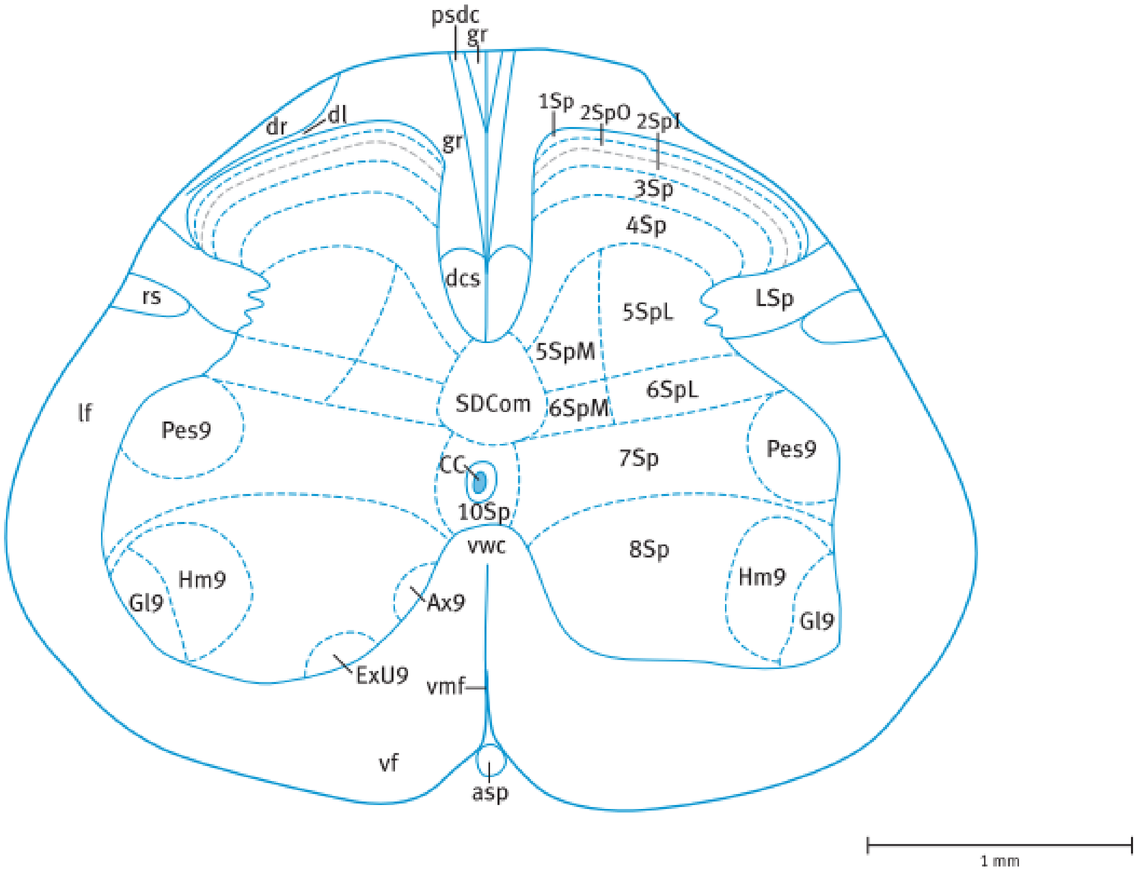

Fig 2 : Initial image

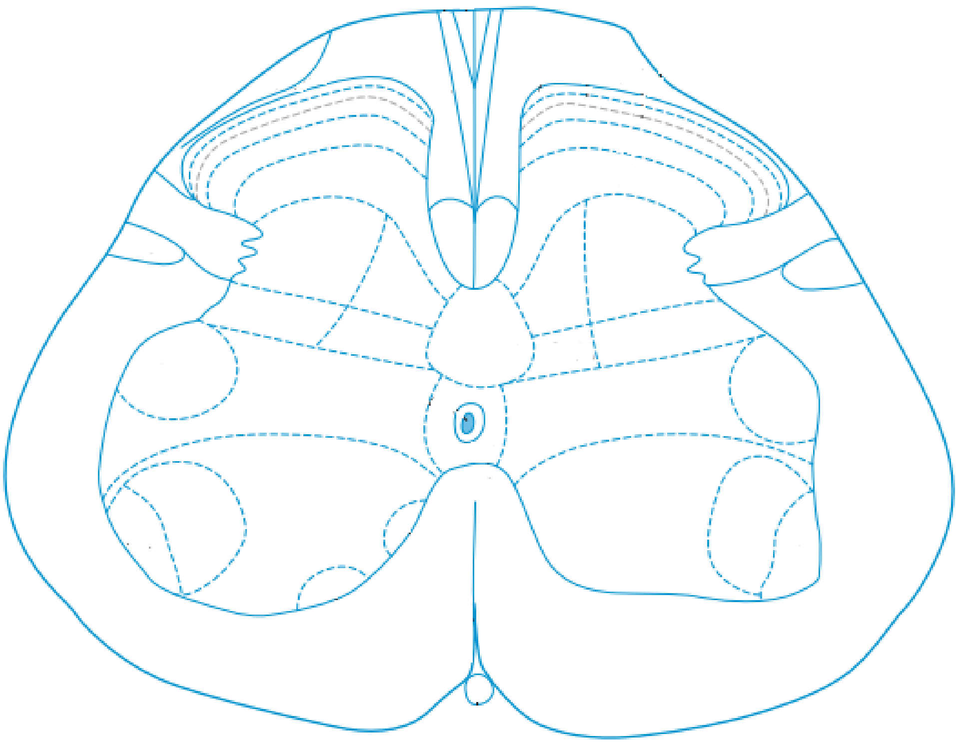

Fig 3 : Image after removing text

The black pixels appearing in the first figure have a property that each of the pairwise differences between (R,G,B) triplet exceed no more than 80. This is what differentiates these pixels from the bluish ones which have marked deviation in (R,G,B) values. As this pairwise difference increases, the image becomes more bright. In some other datasets(images) we have got some grey lines as a part of the border, they have been retained but the text has been scrapped off.

Closing up the gaps :

Next step is to close the small openings as shown in the figure 3. Pixels are examined for their colour and blue pixels are subjected to dilation. This fills up the gaps and results in the image as shown.

Erosion is performed on this image to smoothen the borders and to avoid merging of different regions, Depending on the binary file representation, Mask size of erosion has to be decided, In this case it comes out to be 1.

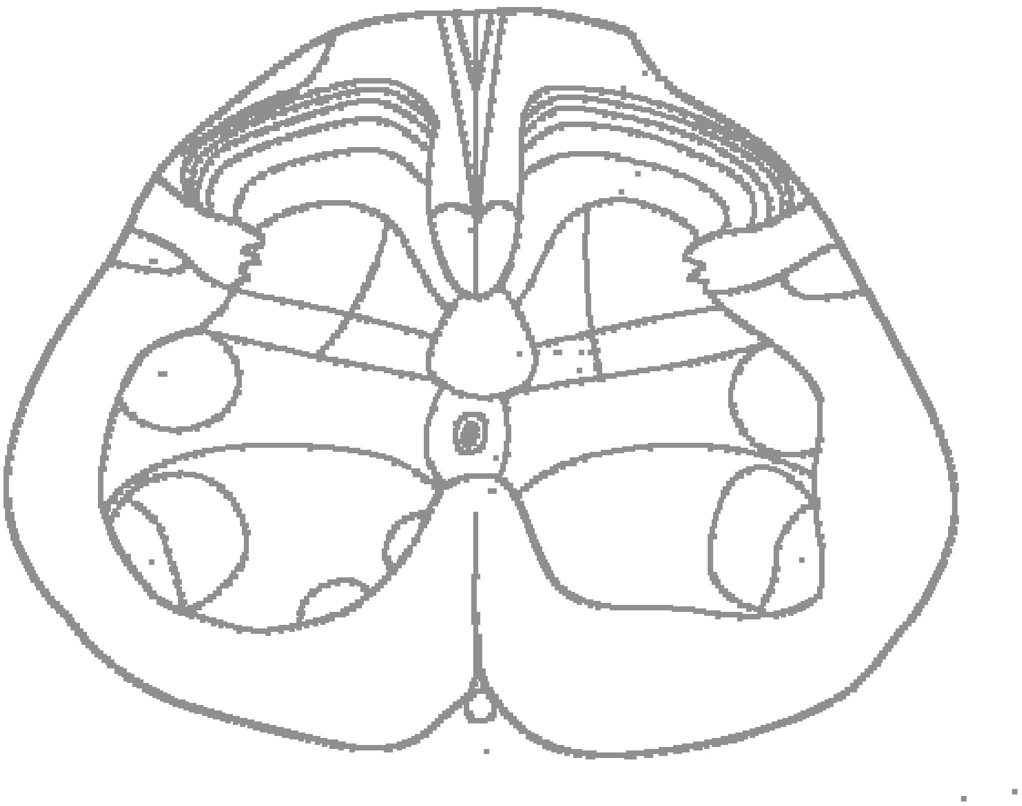

Fig 4 : After dilating

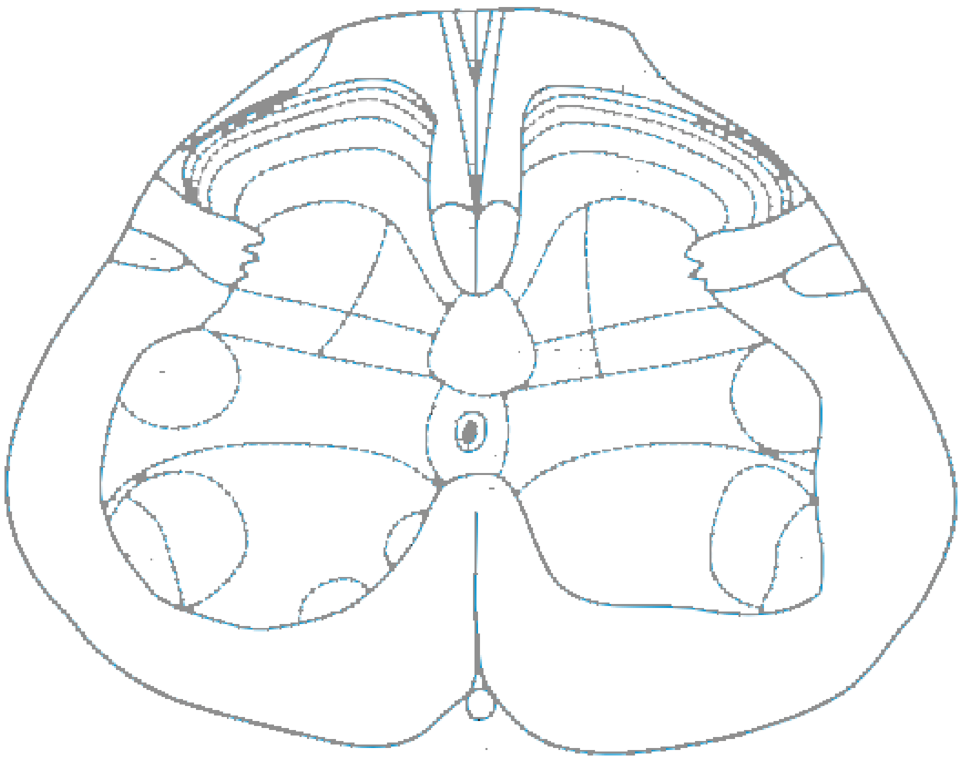

Fig 5 : After erosion

First we perform square dilation, in which each of the black pixels are extended in 8 surrounding directions. This also results in thickening by 2 layers of the already closed border. To smoothen this, we scrap off the top and the bottom black pixel layers of the borders. Extending the lines in the direction of their slopes does not work here because it results in formation of ridges which alter the quality of the image.

Applying floodfill to extract boundary coordinates

Next step is to colour each of these closed regions with different shades of blue,green and red. The binary file to buffered image conversion is achieved by unique number given to each pixel of a particular closed region and assigning a corresponding negative number to its bundary pixel.In this way, each boundary pixel coordinate of a particular region in written to a text file.

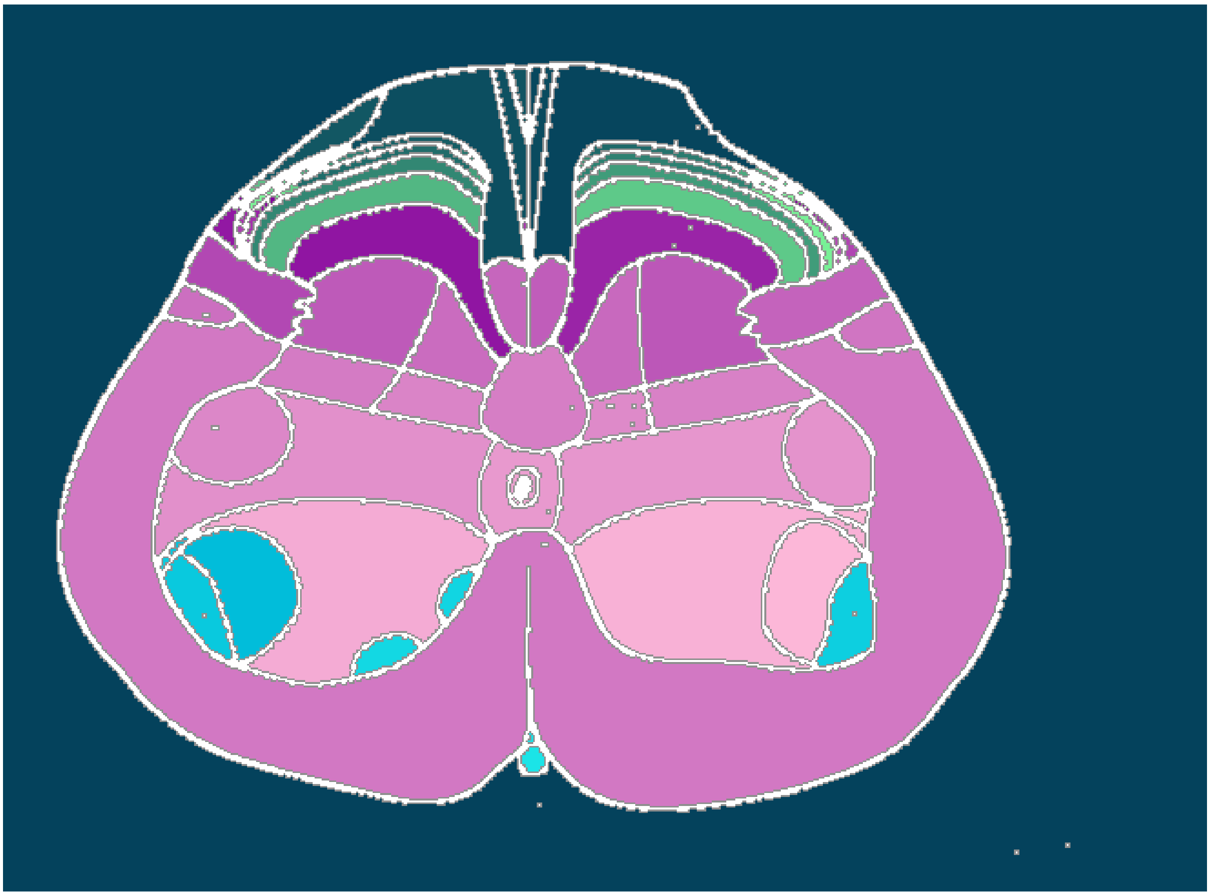

Fig 6 : After applying flood fill.

Flood fill algorith uses standars BFS to group the pixels of same numerical values together. While grouping such pixels, border pixels encountered are given a corresponding value so that contours are layered appropriately. So now the entire images including these subregions can be retraces using those border pixel values assigned during floodfill algorithm.

FUTURE WORK

- Improving text removal algorithm
- Implementing for other dilation algorithms that close gaps without resulting in region dispersion
- Integrating this portion of code with neuro construct

WORK DISTRIBUTION

- Morphological operations, contour extraction : Sumukha R M (12CO67)
- Text removal : Abhishek Reddy Y N (12CO03)
- Floodfill : Job J (12CO34)