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RECONSTRUCTION AND SEPARATION OF 3D NEURON USING RANDOM FOREST ALGORITHM

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ABSTRACT:

Digital reconstruction (or) tracing 3-dimensional neuron structure with optical microscopy images is a primary approach for characterizing the 3-dimensional neuron, which is very important for understanding the brain functions. It is more difficult when the images are contaminated by the noise and it is very challenging tasks when the neuron images having the discontinued segments of neuron pattern. While the existing algorithm works only for the single clean neuron image and does not classify the neuron and the surrounding nerve fibres. Here, the proposed method of 3-dimensional neuron segmentation using the spatial filter, Patch extraction and classification using the random forest algorithm. This segmentation process helps to reduce and remove the noise in neuron image, so the 3-dimensional neuron tracing performance will be improved. Then the neuron and nerve fibre are separated by using the random forest algorithm. The experimental results showed that the proposed method has accurate results when compared with the other reconstruction algorithm.

INDEX TERMS *– Image segmentation, Spatial filter, Patch extraction, Neuron Reconstruction, Image Classification, Random forest algorithm.*

I. INTRODUCTION:

The neuron is also known as a nerve cell that carries the electrical impulse. The neuron plays a vital role in the function of the brain which comprises roughly 10% of the brain cell. Therefore it is necessary to characterize an individual neuron and also separate from the nerve fibre. Each neuron is made up of a cell, dendrites, and axons. The dendrite and axon are nerve fibre. There are billions of neuron in the brain which is used to communicate and transmit information to other nerve cells, muscles.

Neurons are connected to one another and tissues. They do not touch and instead form a tiny gap called synapses. These gaps can be chemical synapsis (or) electrical synapses and pass the signal a lot of efforts can be implemented to develop an automatic (or) semiautomatic neuron reconstruction algorithm based on optical microscopy 3Dimensional neuron images. 3-Dimensional Neuron images from optical microscopy have low SNR Signal to Noise Ratio and the neuron images having discontinued segment of patterns, this reconstruction

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method is very difficult to implement. In the existing system 3-Dimensional [12] U Net-based network, namely, 3-Dimensional U Net Plus, to segment the neuron from the surrounding nerve fibres.

U Net is a convolutional neural network it is used to segment the neuron from the microscopy images. U Net [8]is a class of deep feedforward and artificial neural networks. The U Net completely lose their internal data about the orientation of an image and does not encode the position and orientation of an image. There is no separation (or) classification of neurons from the surrounding fibres to get a clear image of the neuron and the nerve fibres. The classification of the neuron and nerve fibres gives a medical application to identify the defected area with better accuracy.

One of the major difficulties to face by using the U Net is that the volumetric images used on CNN[6] are having a very large size. Thus it will increase the computational expensive and orientation of the image problem also occurs in the U Net. To give a solution for a problem by using U Net is to use a Spatial filter to remove the noise and obtain the neuron image and classifiers the neuron and nerve fibre using the random forest algorithm. The random forest algorithm is mainly used for object detection and classification of the image. This is a very efficient technique for the classification. It will improve the tracing performance as well as reconstruction and classification of the neuron.

II. METHOD:

The Neuron image is through the pre processing where the RGB color image is converted to a grayscale image. In the training stage, segmentation and extracted features will be used to train the framework by growing the random forest algorithm and classify the neuron and the nerve fibres.

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FLOW CHART:

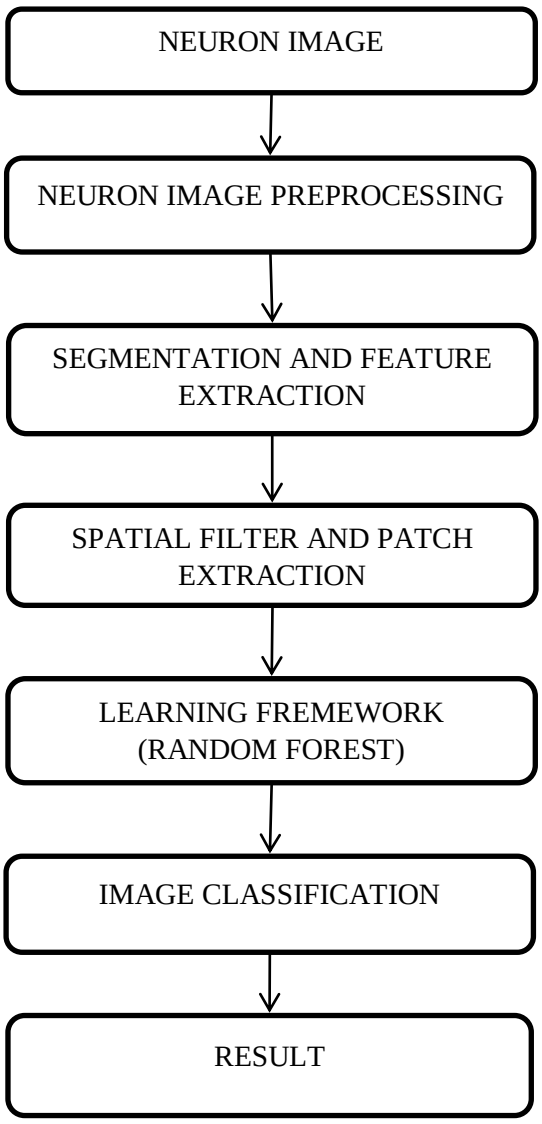

Fig 1: Proposed algorithm flowchart

PREPROCESSING:

The aim of pre-processing to reduce the unwanted noise on the image and create a digitally encoder representation of the image. The pre-processing stage is a process of optimizing image quality. Filter operations applied to the image to reduce image for faster computational speed .

GRAY SCALE:

The neuron image is RGB form which is converted into the Grayscale image. An RGB image has three channels which are red, green and blue, where each channel has 8 bits, making a total of 24 bits; whereas a grayscale image contains only 1 channel, which displays the intensity level in 8-bits. Grayscale conversion helps to reduce the dimensional size of the image for faster computation.

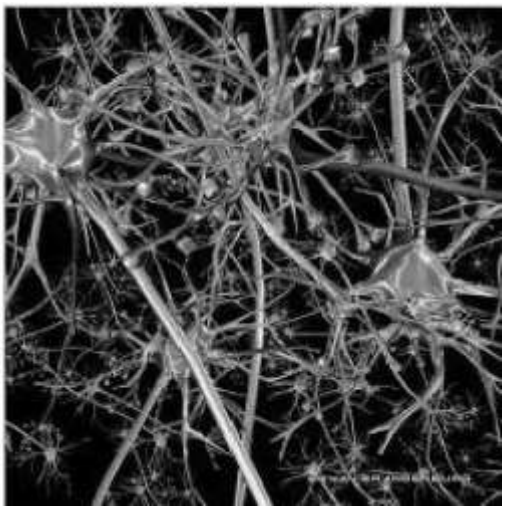

FIG 2: GRAY CONVERTED IMAGE

SEGMENTATION AND FEATURE EXTRACTION:

Spatial filtering is used to remove the noise from the given input neuronal image. The segmentation is used for the converting the image in to the understandable one which is divide the given input into the pixels. In the spatial technique is also known as the denoising technique. After the conversion of gray image the image is undergoes the filtering technique. Then the patch extraction is used for the image extraction

This technique extracts the blood vessels and fibres and neuro vascular cells. It will find a weightage for every given data set. This patch extraction is mostly used for the enhance the image features like quality,intensity,control. The below figure shows the extracted neuron.

FIG3: EXTRACTED NEURON

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FIG 4: PATCH EXTRACTION

RANDOM FOREST ALGORITHM:

Random forest or Random decision tree is the supervised algorithm which is used for the classification of neuron , blood vessels and the nerve fibre from the given input image. This build the multiple decision tree and merge the results to get accurate image. Random decision tree is also used for the missing data (or) values and also used for the large number of data.

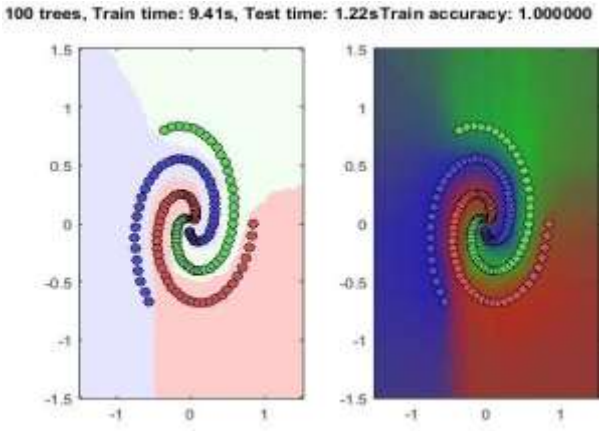

Fig 5: TRAINING ACCURACY DIAGRAM

III. DISCUSSION AND RESULTS:

The reconstruction and separation of the result is obtained by the applying random forest algorithm to the 3-Dimensional neuronal image. The trained neuron image is also compared with the given neuronal image to reduce the time consumption and give accurate results.

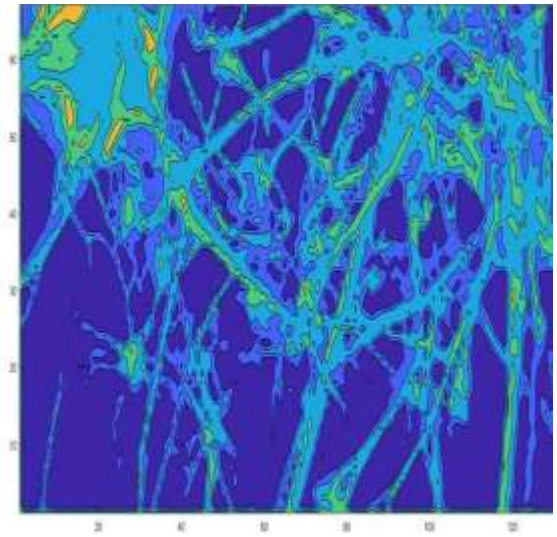

Fig 5: TANGLED NEURON

The above diagram shows the presence of the tangled neuron, blood vessels, nerve fibres. The yellow colour indicates the tangled neuron image.

The blue colour indicates the extracted blood vessels and fibres from the given neuron image.

IV. CONCLUSION:

The main aim of the paper is to improving 3D neuronal reconstruction based on tanged neuron image and to reduce the unwanted noise in the neuron image. This was achieved by employing the Spatial filter for the accurate segmentation and the feature extraction to obtain the target neuron. Each neuron is surrounded with a number of fibres. This classification of the neuron is achieved by the random forest algorithm with the better results. This results shows that the very promising segmentation and the classification of neuron and the nerve fibres.

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