International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-11 Issue-8, July 2022

Brain Segmentation using MATLAB

V.V Nitin, T. Rohan, E. Sathwik, T Satya Jayanth

***Abstract:** A surprising mass of tissue wherein some cells duplicates and develops wildly is calledcerebrum growth. It should be identified at a beginning phase utilizing X-ray or CT checked pictures when it is just about as little as conceivable in light of the fact that the growth might perhaps result to malignant growth. This paper, for the most part centers around identifying and limiting the growth locale existing in the cerebrum by proposed philosophy utilizing patient's X-ray pictures. The proposed procedure comprises of different stages which assume an alternate parts to deliver the examination with at most precision. division is applied to obviously show the growth impacted locale in the X-ray pictures.*

There are two main objectives of our project:

1) To analyze brain tumor

2) If there is, specify the location of the tumor [1]

***Keywords:** Brain Tumor, Matlab analysis, MRI analysis*

I. INTRODUCTION

Brain Segmentation is a system wherein different X-ray filters are handled and ends are gotten from this. IN cerebrum X-ray, examination picture division is usually utilized for estimating and imagining the cerebrum's physical designs, for dissecting cerebrum changes, for depicting obsessive districts, and for careful arranging and picture directed mediations. Over the most recent couple of many years, different division strategies of various exactness and level of intricacy have been created and announced in the writing. Cerebrum X-ray division is a fundamental assignment in numerous clinical applications since it impacts the result of the whole investigation. This is on the grounds that different handling steps depend on precise division of physical areas. For instance, X-ray division is generally utilized for estimating and imagining different mind structures, for portraying sores, for breaking down mental health, and for imageguided intercessions and careful preparation. This variety of picture handling applications has prompted advancement of different division methods of various precision and level of intricacy [5].

Manuscript received on 26 June 2022 | Revised Manuscript received on 02 July 2022 | Manuscript Accepted on 15 July 2022 | Manuscript published on 30 July 2022.

* Correspondence Author

Venkata Nitin Voona, Department of Electronics and Communication Engineering, Vellore Institute of Technology, Vellore (Tamil Nadu), India.

Ennapureddy Sathwik, Department of Electronics and Communication Engineering, Vellore Institute of Technology, Vellore (Tamil Nadu), India.

Tamire Satya Jayanth, Department of Electronics and Communication Engineering, Vellore Institute of Technology, Vellore (Tamil Nadu), India.

Thatikonda Rohan*, Department of Electronics and Communication Engineering, Vellore Institute of Technology, Vellore (Tamil Nadu), India.

II. IDEOLOGY FOR IMAGE PROCESSING

Anisotropic dissemination, likewise called Perona-Malik dispersion, is a procedure targeting lessening picture commotion without eliminating huge pieces of the picture content, ordinarily edges, lines or different subtleties that are significant for the understanding of the picture [3] [6] [8].

• Anisotropic dissemination looks like the interaction that makes a scale space, where a picture produces a defined group of progressively more what's more, more obscured pictures in light of a dissemination cycle. Each of the coming about pictures in this family are given as a convolution between the picture and a 2D isotropic Gaussian, where the width of the channel increments with the boundary [7].

• Anisotropic dissemination is a speculation of this dispersion cycle: it produces a group of defined pictures, yet each subsequent picture is a blend between the first picture and a channel that relies upon the neighborhood content of the unique picture [9]. As an outcome, anisotropic dispersion is a non-straight and space-variation change of the first picture

III.ALGORITHM AND IMPLEMENTATION

The diffusion equation is a general case of the heat equation that describes the density changes in a material undergoing diffusion over time. Isotropic diffusion, in image processing parlance, is an instance of the heat equation as a partial differential equation (PDE), given as:

$$\frac{\partial I}{\partial t} = \nabla^2 I = \frac{\partial^2 I}{\partial x^2} + \frac{\partial^2 I}{\partial y^2}$$

where, I is the image and t is the time of evolution.

Perona & Malik introduce the flux function as a means to constrain the diffusion process to contiguous homogeneous regions, but not cross region boundaries. The heat equation (after appropriate expansion of terms) is thus modified to:

$$\frac{\partial I}{\partial t} = c(x, y, t)\Delta I + \nabla c \cdot \nabla I$$

where c is the proposed flux function which controls the rate of diffusion at any point in the image.

A choice of c such that it follows the gradient magnitude at the point enables us to restrain the diffusion process as we approach region boundaries. As we approach edges in the image, the flux function may trigger inverse diffusion and actually enhance the edges !

Perona & Malik suggest the following two flux functions:

$$c(||\nabla I||) = e^{-(||\nabla I||/K)^2}$$

$$c(||\nabla I||) = \frac{1}{1 + \left(\frac{||\nabla I||}{K}\right)^2}$$

- The flux functions offer a trade-off between edge-preservation and blurring (smoothing) homogeneous regions. Both the functions are governed by the free parameter κ which determines the edge-strength to consider as a valid region boundary. Intuitively, a large value of κ will lead back into an isotropic-like solution.

The transition capacities offer a compromise between edge-safeguarding and obscuring (smoothing) homogeneous locales. Both the capacities are represented by the free boundary κ which decides the edge-solidarity to consider as a substantial locale limit. Naturally, a huge worth of κ will lead once again into an isotropic-like arrangement.

We will experiment with both the flux functions in this report

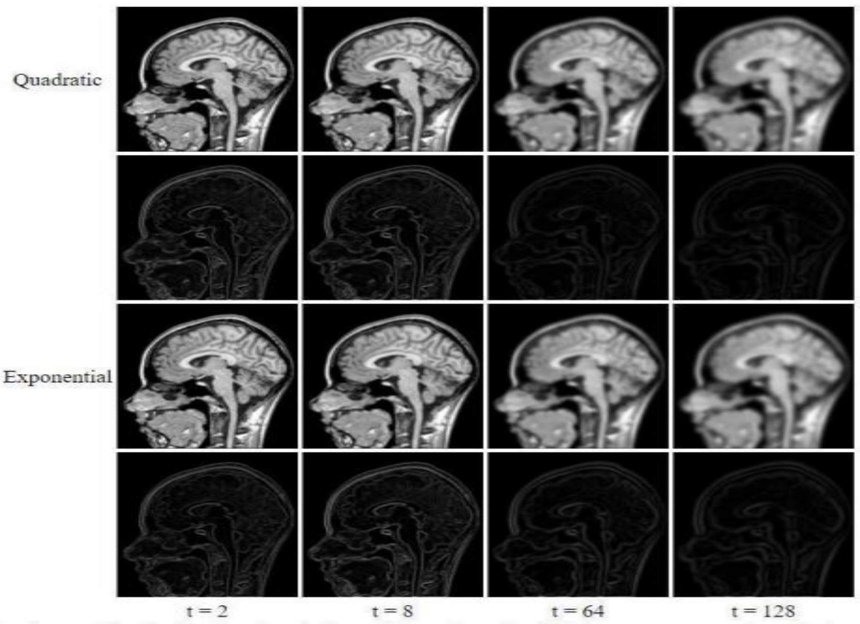
A discrete numerical solution can be derived for the anisotropic case using the FTCS method as follows:

$$I_{i,j}^{t+1} = I_{i,j}^{t} + \lambda\left[c_N \cdot \nabla_N I + c_S \cdot \nabla_S I + c_E \cdot \nabla_E I + c_W \cdot \nabla_W I\right]_{i,j}^{t}$$

where {N,S,W,E} correspond to the pixel above, below, left and right of the pixel under consideration (i,j).

- Another nice property is that c is based on the gradient magnitude, thus it does not matter if we take forward or backward gradients ! The following table displays the results of th anisotropic diffusion process for the same example image as above. κ=0.35 was used for both flux functions.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)



As seen in the above table, the flux functions behave differently as the diffusion progresses and can lead to interesting choices based on the application at hand.

IV.CODE

```
function diff_im = anisodiff(im, num_iter, delta_t, kappa, option)
fprintf('Removing noise\n');


fprintf('Filtering Completed.');

% Convert input image to double.
im = double(im);

% PDE (partial differential equation) initial condition.
diff_im = im;

% Center pixel distances.
dx = 1;
dy = 1;
dd = sqrt(2);


% 2D convolution masks - finite differences.
hN = [0 1 0; 0 -1 0; 0 0 0];
hS = [0 0 0; 0 -1 0; 0 1 0];
hE = [0 0 0; 0 -1 1; 0 0 0];
hW = [0 0 0; 1 -1 0; 0 0 0];
hNE = [0 0 1; 0 -1 0; 0 0 0];
hSE = [0 0 0; 0 -1 0; 0 0 1];
hSW = [0 0 0; 0 -1 0; 1 0 0];
hNW = [1 0 0; 0 -1 0; 0 0 0];


% Anisotropic diffusion.
for t = 1:num_iter


        % Finite differences. [imfilter(.,.,'conv') can be replaced by
conv2(.,.,'same')]

        nablaN = imfilter(diff_im,hN,'conv');
        nablaS = imfilter(diff_im,hS,'conv');
        nablaW = imfilter(diff_im,hW,'conv');
        nablaE = imfilter(diff_im,hE,'conv');
        nablaNE = imfilter(diff_im,hNE,'conv');
        nablaSE = imfilter(diff_im,hSE,'conv');
        nablaSW = imfilter(diff_im,hSW,'conv');
        nablaNW = imfilter(diff_im,hNW,'conv');

        % Diffusion function.

        if option == 1
            cN = exp(-(nablaN/kappa).^2);
            cS = exp(-(nablaS/kappa).^2);
            cW = exp(-(nablaW/kappa).^2);
            cE = exp(-(nablaE/kappa).^2);
            cNE = exp(-(nablaNE/kappa).^2);
            cSE = exp(-(nablaSE/kappa).^2);
```

Retrieval Number: 100.1/ijitee.H91640711822
DOI: 10.35940/ijitee.H9164.0711822
Journal Website: www.ijitee.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

```
            cSW = exp(-(nablaSW/kappa).^2);
            cNW = exp(-(nablaNW/kappa).^2);
        elseif option == 2

            cN = 1./(1 + (nablaN/kappa).^2);
            cS = 1./(1 + (nablaS/kappa).^2);
            cW = 1./(1 + (nablaW/kappa).^2);
            cE = 1./(1 + (nablaE/kappa).^2);
            cNE = 1./(1 + (nablaNE/kappa).^2);
            cSE = 1./(1 + (nablaSE/kappa).^2);
            cSW = 1./(1 + (nablaSW/kappa).^2);
            cNW = 1./(1 + (nablaNW/kappa).^2);
        end

        % Discrete PDE solution.

        diff_im = diff_im + ...
                  delta_t*(...
                  (1/(dy^2))*cN.*nablaN + (1/(dy^2))*cS.*nablaS + ...
                  (1/(dx^2))*cW.*nablaW + (1/(dx^2))*cE.*nablaE + ...
                  (1/(dd^2))*cNE.*nablaNE + (1/(dd^2))*cSE.*nablaSE + ...
                  (1/(dd^2))*cSW.*nablaSW + (1/(dd^2))*cNW.*nablaNW );


end
```

V. MAIN PROGRAM:

```
clc;
close all;
clear all;

%% Input
[I,path]=uigetfile('*.jpg','select a input image');
str=strcat(path,I);
s=imread(str);

figure;
imshow(s);
title('Input image','FontSize',20);

%% Filter
num_iter = 10;
    delta_t = 1/7;
    kappa = 15;
    option = 2;
    disp('Preprocessing image please wait . . .');
    inp = anisodiff(s,num_iter,delta_t,kappa,option);
    inp = uint8(inp);

inp=imresize(inp,[256,256]);
if size(inp,3)>1
    inp=rgb2gray(inp);
```

Retrieval Number: 100.1/ijitee.H91640711822
DOI: 10.35940/ijitee.H9164.0711822
Journal Website: www.ijitee.org

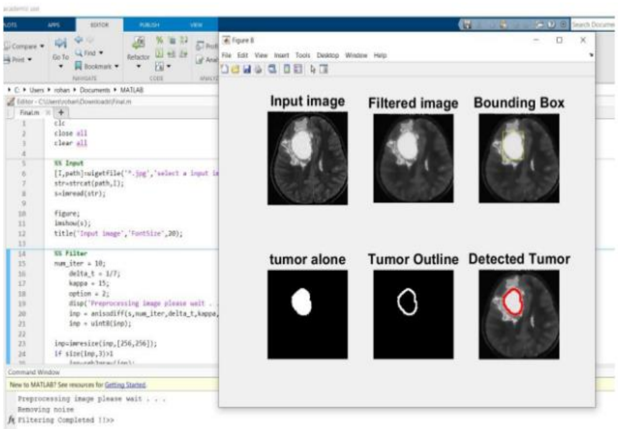
Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

```
end
figure;
imshow(inp);
title('Filtered image','FontSize',20);

%% thresholding
sout=imresize(inp,[256,256]);
t0=60;
th=t0+((max(inp(:))+min(inp(:)))./2);
for i=1:1:size(inp,1)
    for j=1:1:size(inp,2)
        if inp(i,j)>th
            sout(i,j)=1;
        else
            sout(i,j)=0;
        end
    end
end


%% Morphological Operation


label=bwlabel(sout);
stats=regionprops(logical(sout),'Solidity','Area','BoundingBox');
density=[stats.Solidity];
area=[stats.Area];
high_dense_area=density>0.6;
max_area=max(area(high_dense_area));
tumor_label=find(area==max_area);
tumor=ismember(label,tumor_label);

if max_area>100
   figure;
   imshow(tumor)
   title('tumor alone','FontSize',20);
else
    h = msgbox('No Tumor!!','status');
    %disp('no tumor');
    return;
end

%% Bounding box

box = stats(tumor_label);
wantedBox = box.BoundingBox;
figure
imshow(inp);
title('Bounding Box','FontSize',20);
hold on;
rectangle('Position',wantedBox,'EdgeColor','y');
hold off;


%% Getting Tumor Outline - image filling, eroding, subtracting
% erosion the walls by a few pixels
```

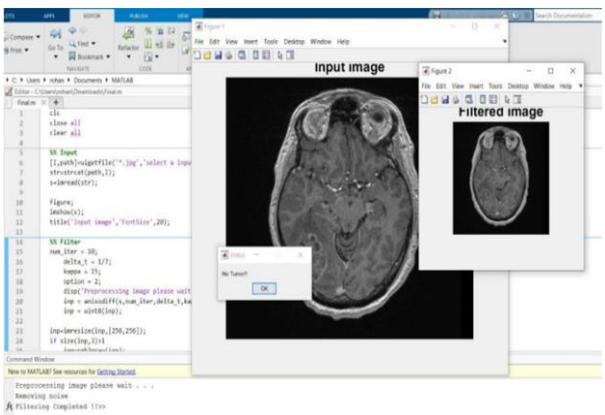
```
blue = rgb(:,:,3);
blue(tumorOutline)=0;

tumorOutlineInserted(:,:,1) = red;
tumorOutlineInserted(:,:,2) = green;
tumorOutlineInserted(:,:,3) = blue;


figure

imshow(tumorOutlineInserted);
title('Detected Tumer','FontSize',20);

%% Display Together


figure
subplot(231);imshow(s);title('Input image','FontSize',20);
subplot(232);imshow(inp);title('Filtered image','FontSize',20);


subplot(233);imshow(inp);title('Bounding Box','FontSize',20);
hold on;rectangle('Position',wantedBox,'EdgeColor','y');hold off;


subplot(234);imshow(tumor);title('tumor alone','FontSize',20);
subplot(235);imshow(tumorOutline);title('Tumor Outline','FontSize',20);
subplot(236);imshow(tumorOutlineInserted);title('Detected
Tumor','FontSize',20);
```

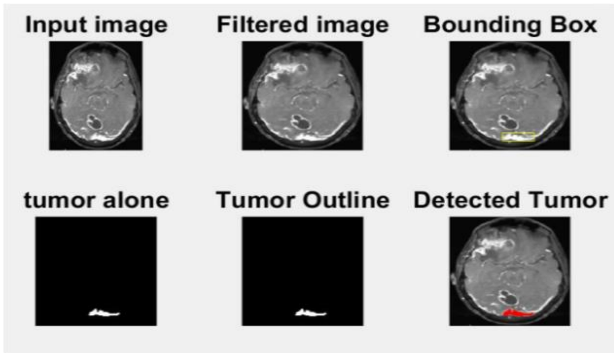
VI. RESULTS

For a brain MRI which has brain tumour [2]:



For a brain MRI which has no brain tumour:





VII. CONCLUSION

In this paper, a brain tumor X-ray picture is applied to pre-handling and after that growth is removed by anisotropic dissemination process. The clinical picture division experiences issues in sectioning complex structure with lopsided shape, size, and properties. In such condition it is better to utilize solo techniques like anisotropic dispersion calculation. For precise analysis of cancer patients, fitting division strategy is expected to be utilized for X-ray pictures to do a gotten to the next level analysis and treatment. The cerebrum cancer location is an extraordinary assistance for the doctors and a shelter for the clinical imaging and ventures dealing with the creation of X-ray imaging [4].

Retrieval Number: 100.1/ijitee.H91640711822
DOI: 10.35940/ijitee.H9164.0711822
Journal Website: www.ijitee.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

REFERENCE

1. D. Reddy, Dheeraj, Kiran, V. Bhavana and H. K. Krishnappa, "Brain Tumor Detection Using Image Segmentation Techniques," 2018 International Conference on Communication and Signal Processing (ICCSP), 2018, pp. 0018-0022, doi: 10.1109/ICCSP.2018.8524235. [CrossRef]
2. W. El Hajj Chehade, R. A. Kader and A. El-Zaart, "Segmentation of MRI images for brain cancer detection," 2018 International Conference on Information and Communications Technology (ICOIACT), 2018, pp. 929-934, doi: 10.1109/ICOIACT.2018.8350721. [CrossRef]
3. S. Chao, D. Tsai, W. Chiu and W. Li, "Anisotropic diffusion-based detail-preserving smoothing for image restoration," 2010 IEEE International Conference on Image [CrossRef] Processing, 2010, pp. 4145-4148, doi: 10.1109/ICIP.2010.5653571.
4. Champka and Ayub, Shahnaz and Kumar, Alok and Baudh, Rishabh Kumar, Analysis of MRI Data for Brain Tumor Detection using MATLAB (April 16, 2020). Proceedings of the International Conference on Advances in Electronics, Electrical & Computational Intelligence (ICAEEC) 2019. [CrossRef]
5. Anju V K,Sreeletha S H,"Segmentation of Brain Tumor using Slic with Tumor Volume Identification",International Journal of Engineering Research & Technology (IJERT),Vol. 8 Issue 06, June-2019.
6. M. Sudharson, S.R. Thangadurai Rajapandiyan and P.U. Ilavarasi,"Brain Tumor Detection by Image Processing Using MATLAB",Middle-East Journal of Scientific Research 24 (S1): 143-148, 2016.
7. Patil, Ms & Pawar, Ms & Patil, Ms & Nichal, Arjun. (2017). A Review Paper on Brain Tumor Segmentation and Detection. IJIREEICE. 5. 12-15. 10.17148/IJIREEICE.2017.5103. [CrossRef]
8. Mat Said, Khairul Anuar & Jambek, Asral & Sulaiman, Nasri. (2016). A study of image processing using morphological opening and closing processes. International Journal of Control Theory and Applications. 9. 15-21.
9. Animesh Hazra,Ankit Dey,Sujit Kumar Gupta,Md. Abid Ansari, "Brain tumor detection based on segmentation using MATLAB"Conference: 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS),DOI: 10.1109/ICECDS.2017.8390202. [CrossRef]

AUTHORS PROFILE

Venkata Nitin Voona, Pursuing Electronics and Communication Engineering (currently in third year) at Vellore Institute of Technology, Vellore. I have completed my Intermediate at Tirumala Junior College with 10 CGPA in both the years (2017-19) in Rajahmundry and my schooling at SML DAV Public school and secured 9.8 CGPA(2017) in Palakonda ,Andhra Pradesh . In my prior semesters I had completed some mini projects related to my core branch subjects that are Electronic Thermometer , IOT based Smart Sewage System , comparing of signals – Audio and Image Recognition, Fake news detection using Machine Learning techniques. I am always curious about learning new things and exploring myself in different domains of Electronics , I'm a quick learner with good problem solving abilities.

Ennapureddy Sathwik, Pursuing Electronics and Communication Engineering (currently in third year) at Vellore Institute of Technology, Vellore. and completed intermediate in Narayana junior college with 90% 2019 in Hyderabad and 10th schooling in Sri Krishnaveni high school with 87% 2017 in Karimnagar , Telangana .I had done some minor projects related to my branch subjects that are laser security alarm system, comparison of signals (audio and image recognition), vehicle indicator using 555 timers , RFID based smart attendance system .Coming to my interpersonal skills i am a team player, problem solving and Flexibility.

Tamire Satya Jayanth, Presently studying Btech (3rd year), Electronics and communication engineering in Vellore institute of technology,Vellore and completed intermediate in sri chaitanya college with 92% in 2019 , Andhra pradesh. I had known java language and completed minor projects on IOT sewage system , Fake news detection using python, Seismic wave analysis in core subject signals and systems . Iam working on Application design in android studio. I like to do more projects. I will use my knowledge and creative skills for the welfare of the society.

Thatikonda Rohan, Pursuing Electronics and Communication Engineering (currently in third year) at Vellore Institute of Technology, Vellore. I have Completed Intermediate education in Sri Chaitanya junior College with 95% 2019 and Schooling in Sri Chaitanya Techno School with 95% 2017 in Hyderabad, Telangana. I had Completed some mini projects that are Ambient Temperature Controller, Comparing of Signals (Audio and Image), IOT based Fire defection and alerting System. I enjoy learning about old methods, and I have good problem-solving skills.