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A Hierarchical Clustering Algorithm Based Computer Aided Molecular Modeling with Haematoxylin & Eosin Images of Colon Cancer

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Abstract: *Color Image segmentation plays a crucial role in many medical imaging applications. In this paper we present a novel algorithm for computer aided molecular modeling in MATLAB R2012, a real time simulation environment. This manuscript presents a novel algorithm for color image segmentation of Haematoxilin and Eosin images of colon cancer. With help of this algorithm we can classify the differences between benign and malignant tumor cells.*

Keywords: - *Color segmentation, Hierarchical Clustering, Real Time Simulation Environment, Molecular Modeling.*

I. INTRODUCTION

In this manuscript we compare the existing k-means clustering based Computer Aided Molecular Modeling approach of H & E (Haematoxilin & Eosin) images of Colon Cancer as illustrated in [1] with the current hierarchical clustering based approach. Ideally image segmentation is defined as the separation of an image into non-overlapping, constituent regions which are homogeneous with respect to some characteristics such as intensity or texture [2]. In present research work, we developed computer image-processing techniques for classifying colon cancer and non-malignant tissue in digital histological images acquired from tissue sections captured using scanning electronic microscope (SEM) acquired with high resolution charged coupled device (CCD) camera from regions of interest (ROI) marked by pathologists on colon tissue sections [5].

II. DESIGN OF ALGORITHM

The different steps involved in the design of algorithm are explained as follows:

a. The input color image will be coarsely represented using 25 bins.
b. Coarse representation uses the spatial information from a Histogram based windowing process.
c. Hierarchical clustering is used to cluster the coarse image data.
d. Parameters Used
    Input Color Image
    Number of bins for coarse representation
    Window size for histogram processing
    Number of classes
    Output segmented image

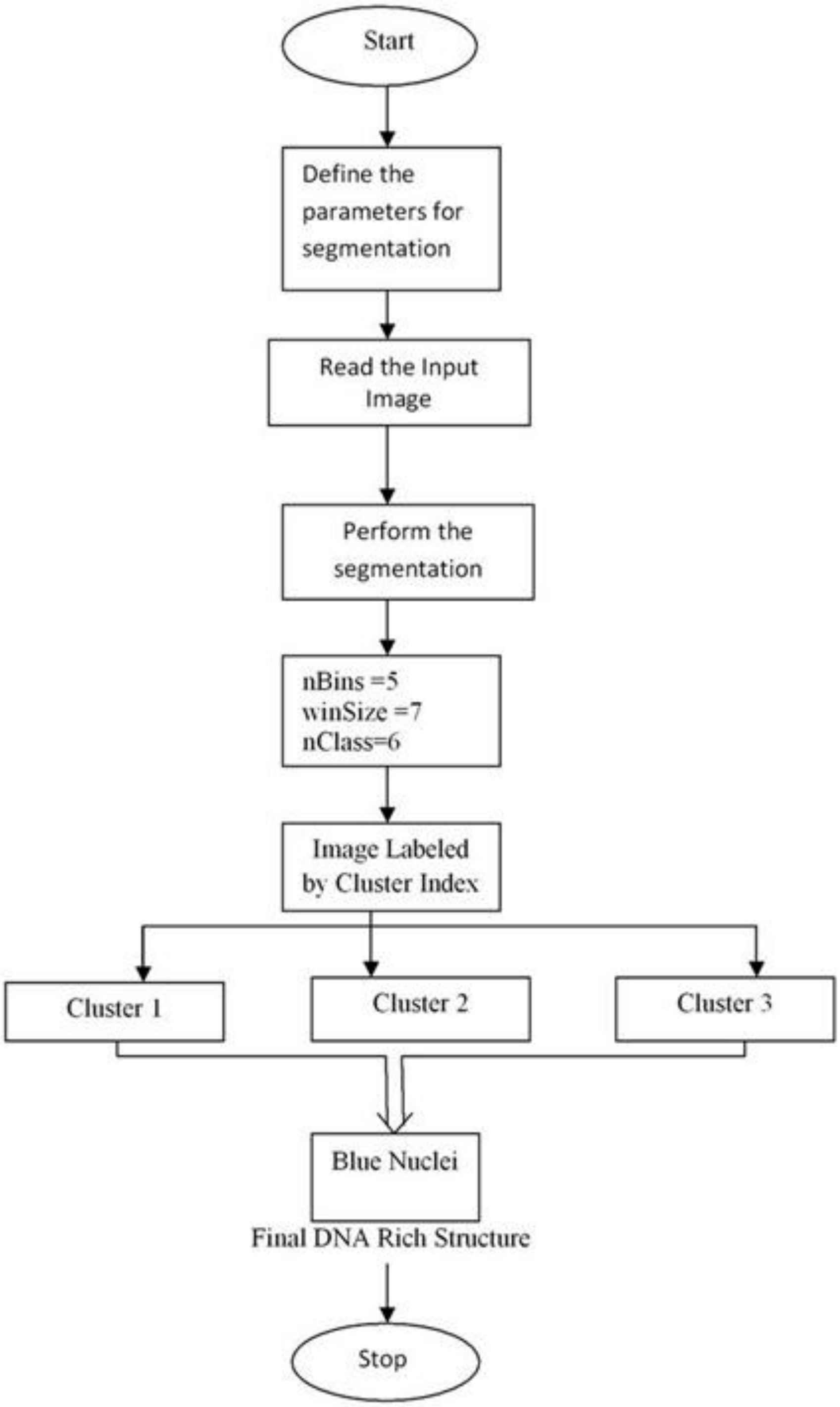
The coding part is illustrated as shown in the below code snippet, this coding part is done in MATLAB R2012 - a real time simulation environment [6].

```
%Clear Memory & Command Window
clc;
clear all;
close all;
%Parameters for the Segmentation
nBins=5;
winSize=7;
nClass=6;
%Read Input Image
x = imread('DSS.PNG');
figure;imshow(x);title('Input Image');
%Segmentation
outImg = colImgSeg(x, nBins,winSize,nClass);
%Displaying Output
```

```
figure;imshow(outImg);title('Image labled by cluster index');
%colormap('default');
%Image segmentation using Hierarchical clustering algorithm
xr = x(:, :, 1);
xg = x(:, :, 2);
xb = x(:, :, 3);
figure , imshow(xr, [ ]);title('objects in cluster1');
figure ,imshow(xg, [ ]);title('objects in cluster2');
figure ,imshow(xb, [ ]);title('objects in cluster3');
se = strel('disk', 3);
f = imopen(xg, se);
%figure ,imshow(f, [ ]);
xgd = im2double(f);
w = fspecial('average');
xgd2 = imfilter(xgd, w, 'replicate');
%figure ,imshow(xgd2, [ ]);
wg = fspecial('gaussian',[9 9], 1.8);
xgd3 = imfilter(xgd2, wg,'conv', 'replicate');
%figure ,imshow(xgd3, [ ]);
wm = fspecial('average',[69 69]);
xgb = imfilter(xgd3,wm, 'replicate');
%figure ,imshow(xgb, [ ]);
d = 255*xgd3-255*xgb;
%figure ,imshow(d, [ ]);
dmat = mat2gray(d);
isc = im2uint8(dmat);
%figure ,imshow(isc, [ ]);
ginmax = max(max(isc));
[m, n] = size(isc);
giimax = max(isc);
for i = 1:m
for j = 1:n
g = double(isc(i,j))+128-ginmax;
if g<0
ih(i,j) = 0;
elseif g>255
ih(i,j) = 255;
else
ih(i,j) = g;
end
end
end
figure ,imshow(ih, [ ]);
title('blue nuclei');
```

Modeling steps involved are from reading the image to segmentation of the nuclei into a separate image [3]. Further there are also intermediate steps that are involved between reading the image and segmenting the nuclei into a separate image in MATLAB real-time simulation environment [4].

Flow chart is designed as follows



III. RESULTS AND DISCUSSIONS

The resulting output flow diagram as shown in Figure 1 is derived from the algorithm based on the above steps.

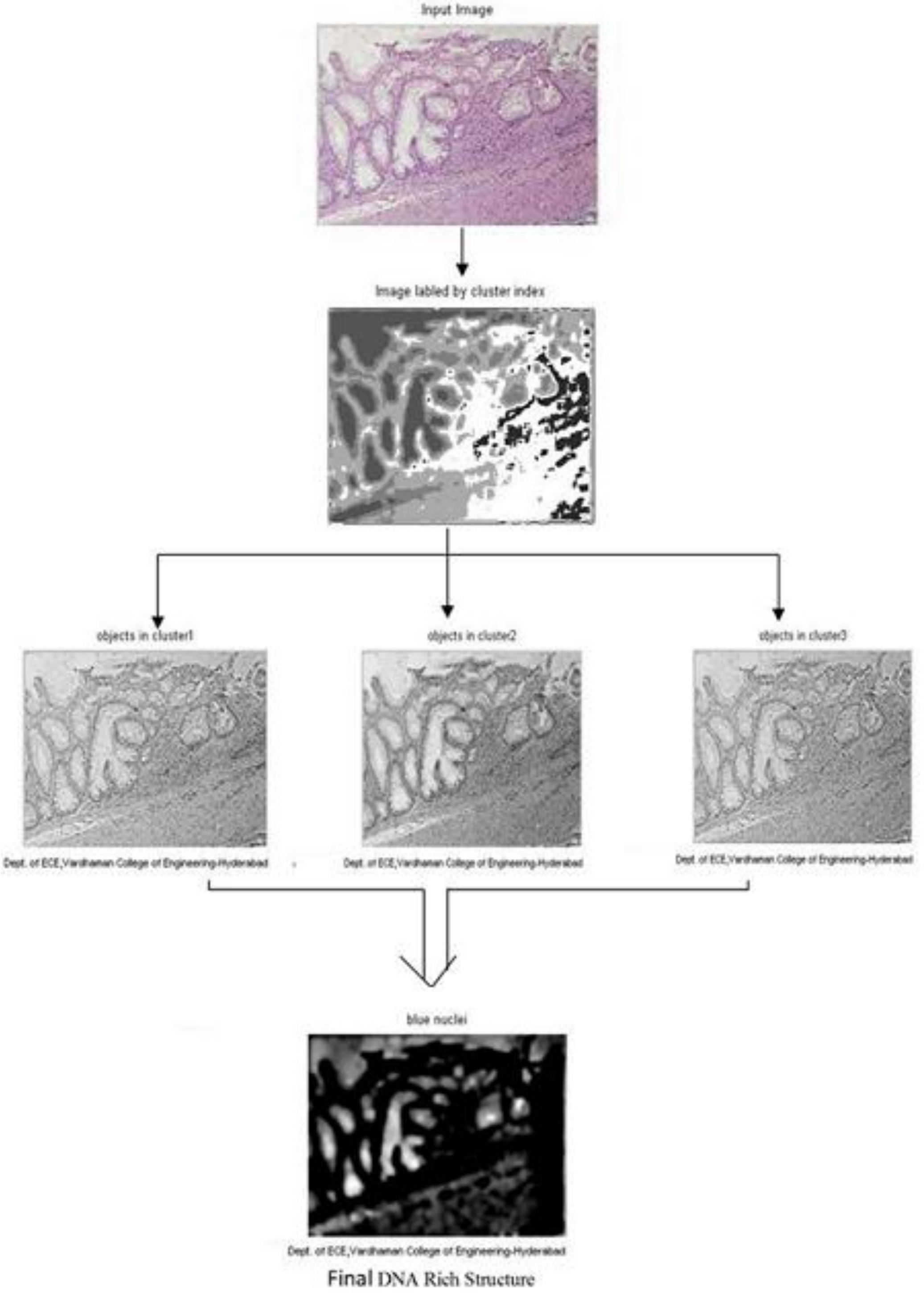


Figure 1: Output Results

IV. CONCLUSIONS

We have proposed a novel algorithm for color segmentation based on hierarchical clustering. Our algorithm improves the color segmentation accuracy more significantly than previous approaches. One distinctive advantage of our approach is that our algorithm also provides an explicit feature for ROI which can be used for classification and recognition of benign and malignant tissues.

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