SCHOOL OF ELECTRONICS ENGINEERING

B.TECH – BIOMEDICAL ENGINEERING

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BIOMEDICAL IMAGING – ECE 1023

PROJECT REPORT

TOPIC: DIGITAL SUBTRACTION ANGIOGRAPHY

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ABSTRACT

There is good evidence for the use of colour in tasks that require both visual search (identification) and visual recognition (searching tasks require that an observer detect a previously defined object or objects recognition tasks require not only detection but also categorization of an unknown object or objects). Advantages offered by color-coding of a display increase as the search and recognition tasks become more complex. It was our purpose to examine the impact of a color-coding algorithm on the interpretation of 2D-DSA acquisitions by experienced and inexperienced observers. We have demonstrated some of the potential benefits derived from application of a temporal and intensity color-coded algorithm to standard DSA acquisitions.

INTRODUCTION

Early in the development of DSA, there were multiple descriptions of techniques for the extraction and display of temporal information that could then be used to create parametric images of the patterns of blood flow through the vasculature.3,4 Such parametric images provided a means to demonstrate functional aspects of the circulation that could not be grasped from viewing either standard DSA image series or single DSA images.3,4 The potential value of the use of colour in the display of these parametric images was recognized but was not, to our knowledge, ever exploited into widespread clinical use.3-5 Recently, an algorithm for creation of a composite color-coded time-of-arrival image from a DSA sequence has been described.6 Today, DSA is primarily used either for evaluation of complex vascular abnormalities that cannot be adequately assessed by using CT angiography or MR angiography or for monitoring and guidance of minimally invasive endovascular interventions. It was our hypothesis that application of a temporal and intensity color-coded algorithm to DSA acquisitions of a variety of central nervous system vascular lesions would add value to the ability both to diagnose and determine the effects of therapeutic interventions. This report describes our observations in the use of this algorithm.

METHODOLOGY:

The contrasted and enhanced Digital Subtraction Angiographic (DSA) image of the Vertebrobasilar and Posterior Cerebral Circulation is obtained through the Image Processing Toolbox of MATLAB 2020R software using the Parametric Color Coding Technique.

Parametric Color-Coding of DSA enhances the complicity of findings on DSA images. It is particularly useful in situations in which there was a complex flow pattern and in evaluation of pre and post treatment acquisitions.

STEPS INVOLVED:

1. A DSA image showing a transverse projection of the vertebrobasilar and posterior cerebral circulation was given as input to the MATLAB software.
2. The input Gray-scale image was converted into a coloured image of which the MATLAB code is given below.

MATLAB CODE:

```
clc;
clear all;
close all;
%Reads the input image
k=imread('dsa.jpeg');
[x y z]=size(k);
k=double(k);
for i=1:x
```

```
for j=1:y
if k(i,j)>=0 & k(i,j)<50
m(i,j,1)=k(i,j,1)+5;
m(i,j,2)=k(i,j)+10;
m(i,j,3)=k(i,j)+10;
end
if k(i,j)>=50 & k(i,j)<100
m(i,j,1)=k(i,j)+35;
m(i,j,2)=k(i,j)+28;
m(i,j,3)=k(i,j)+10;
End
if k(i,j)>=100 & k(i,j)<150
m(i,j,1)=k(i,j)+52;
m(i,j,2)=k(i,j)+30;
m(i,j,3)=k(i,j)+15;
end
if k(i,j)>=150 & k(i,j)<200
m(i,j,1)=k(i,j)+50;
m(i,j,2)=k(i,j)+40;
m(i,j,3)=k(i,j)+25;
end
if k(i,j)>=200 & k(i,j)<=256
m(i,j,1)=k(i,j)+120;
m(i,j,2)=k(i,j)+60;
m(i,j,3)=k(i,j)+45;
end
end
end
%Plotting of input images.
subplot(2,2,1)
imshow(uint8(k),[]);
title('INPUT DSA IMAGE');
```

```
subplot(2,2,2)
imshow(uint8(m),[]);
title('COLOURED DSA IMAGE');
```

3. Colour Coding Technique is implemented in which a colour (blue) is added to the image to for better interpretation of which the MATLAB code is given below:

<u>MATLAB CODE:</u>

```
%COLOUR CODED DSA IMAGE
x=imread('output_angio.jpeg');
r(:,:,:)=255-x(:,:,:);
subplot(2,2,3)
imshow(r);
title("COLOUR CODED DSA IMAGE");
```

4. Noise is removed from the above image and the image is enhanced for more clarity of the veins and vessels.

<u>MATLAB CODE:</u>

```
%ENHANCED DSA IMAGE
x=imread("review2_output.jpeg")
z=0.8*(x-55);
subplot(2,2,4)
imshow(z);
title("ENHANCED DSA IMAGE");
```

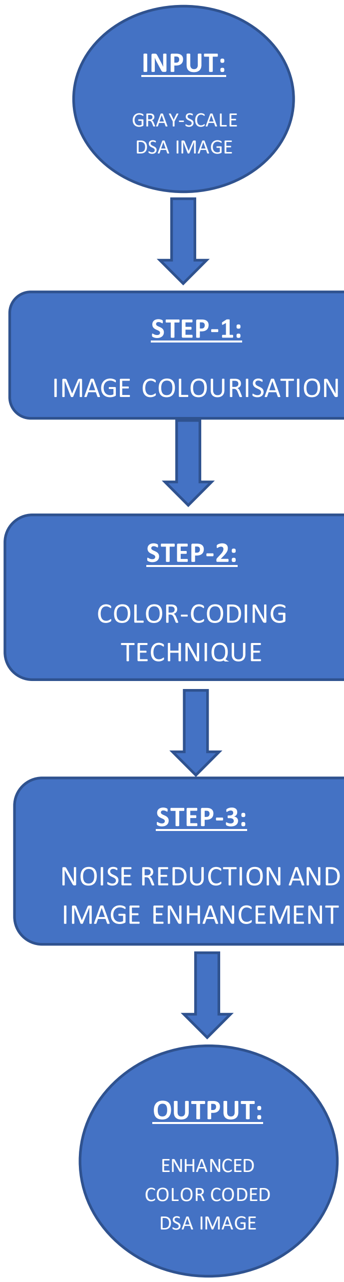
5. Now, all the images obtained are potted and viewed for comparison of the images of which the MATLAB code is given below.

<u>MATLAB CODE:</u>

```
%PLOTTING OF IMAGES SEPERATELY
figure;
imshow(uint8(k),[]);
```

```
title('INPUT DSA IMAGE');
figure;
imshow(uint8(m),[]);
title('COLOURED DSA IMAGE');
figure;
imshow(r);
title("IMPROVED DSA IMAGE");
figure;
imshow(z);
title("ENHANCED DSA IMAGE");
```

BLOCK DIAGRAM:



RESULTS:

After executing the above-mentioned codes in MATLAB the following output is obtained:

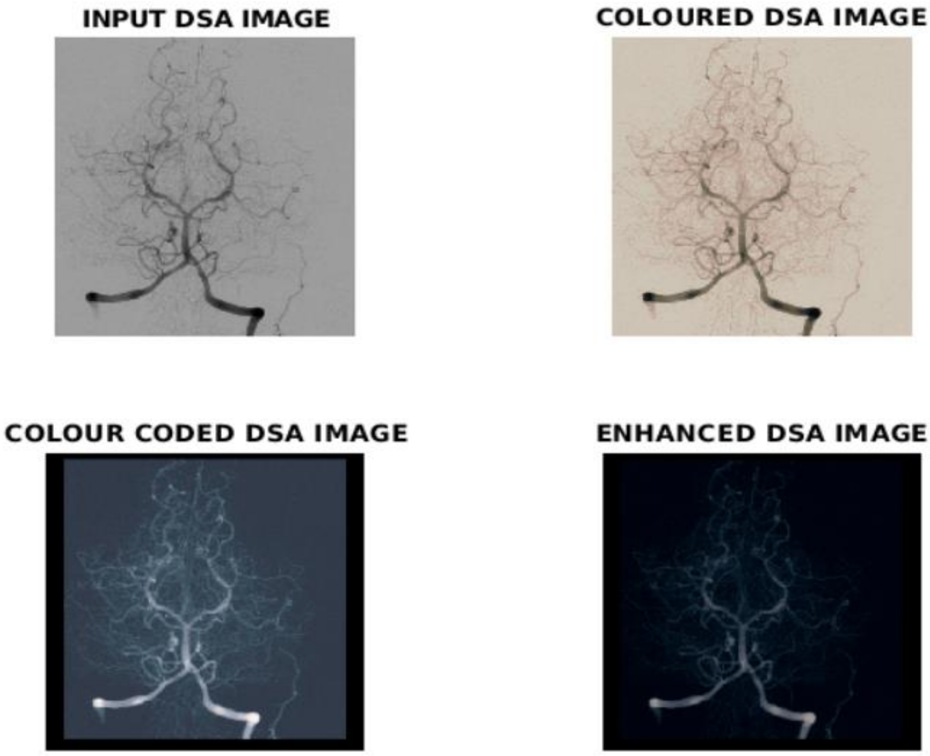


IMAGE-1 (INPUT IMAGE):

IMAGE-2 (IMAGE COLOURING)

IMAGE-3 (COLOR CODED IMAGE):

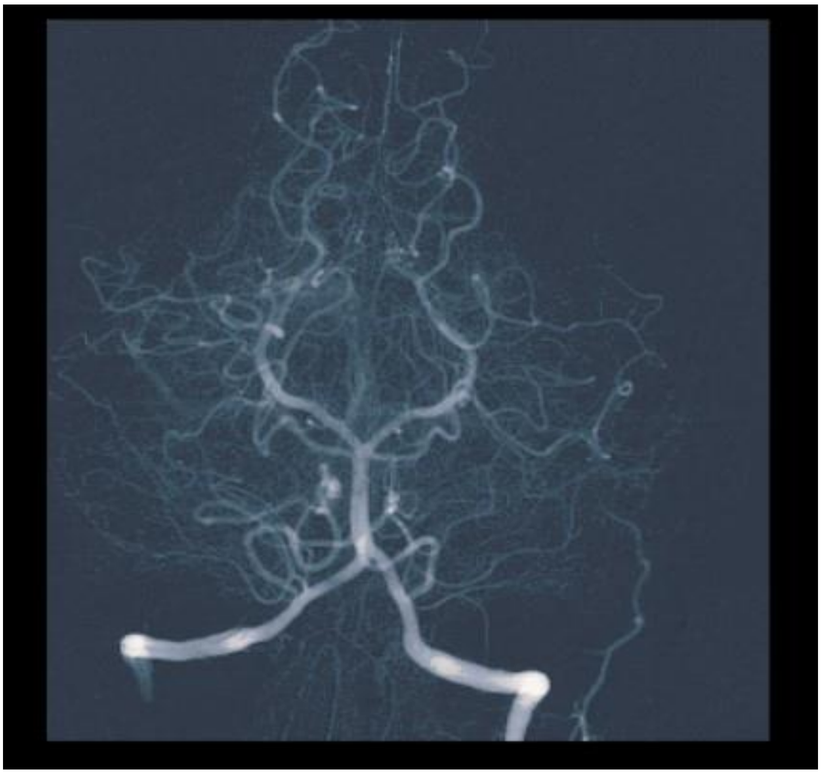


IMAGE-4 (OUTPUT – ENHANCED NOISE REDUCTED IMAGE):

It can be clearly seen that the output obtained offers very high clarity of the veins and vessels for ease in diagnosis and interpretation.

In 40% of the cases , both experienced and naïve observers found that the color-coded images enhanced their ability to determine whether a therapeutic intervention had been successful.

In these cases, the readers found that the composite color-coded image made it easier for them to understand both the anatomy and the flow characteristics of the lesions.

CONCLUSIONS:

The benefit of the color-coded images extended to making both diagnosis and treatment planning easier for all readers in 20% of the cases, while also improving the observers confidence in their diagnoses compared with using DSA alone.

At no additional cost in x-ray dose or contrast medium, color-coding of DSA acquisitions enhanced the complicity of findings. It was particularly useful in situations in which there were complex flow patterns and in the evaluation of pre- and posttreatment acquisitions.

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