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Augmented Reality Assisted Brain Tumor Identification Using Hamming Distance

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ABSTRACT

In this paper, augmented reality assisted hamming distance based brain tumor area and position identification is proposed. Brain tumor image is compared with acquired brain tumor image in the context minimum hamming distance. Proposed system use extracted data in raw form for analysis (as a .wav format) and does not affect the image further with transformations and feature extraction algorithms. Proposed system identify the brain tumour position by identify minimum hamming distance value. If the similarity between acquired brain tumour and feature vectors of patient brain tumour image increases then hamming distance decreases.

Keywords: Brain tumor, Hamming Distance, Augmented reality and segmentation

1. INTRODUCTION

Existing automated brain tumor detection from MRI images needs brain image segmentation, which is one of the most significant and challenging part of computer aided clinical diagnostic tools. In brain MRI images, multiplicative noises are present. The accuracy of the system is destroyed by the presence of noise and removal of noise from MRI image adds more complexity to the system. But, precise segmentation of the MRI images is very essential for the exact identification of brain tumor by computer aided clinical tools. However, most of the existing automated brain tumor detection accuracy depends on training method, training data and extensive supervision. In this work, augmented reality based tumor identification from MRI images of brain (using Hamming distance) is done.

2. RELATED WORK

[1] In this paper testing and training based brain tumor identification & classification the stages is proposed. Spatial FCM technique is used for segmentation of MRI image. Noise removal from the MRI image is achieved by median based filters and SWT technique.

[2] In this paper, three features of image such as level-set shape, fractal texture, and intensity are used in segmentation of posterior-fossa (PF) tumor for pediatric patients. Three feature of image is not sufficient for to differentiate among the brain tissues such as GM, WM, CSF from tumor, and edema. In this paper, additional features are needed for differentiating among tumor, nontumor, and edema.

In [3] a comprehensive review of methods for analysis of MRI images and methods for detection tumor from it. The review focuses, specifically, on important phases of MRI image analysis like feature extraction, segmentation and classification techniques. The challenges while processing brain MRI images as well as merits and demerits of existing methods for tumor analysis have been discussed.

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[4] This paper focuses on the automatic edema segmentation in FLAIR images. The method proposed in this work is fully automatic. The detection process is independent on the type of the tumor. It can correctly detect anomalies in images containing a tumor, a tumor with edema or only an edema. But the segmentation step relies on higher intensity of a pathological area and can be used for areas manifesting as a hyperintense area in FLAIR images, such as edema.

3. AUGMENTED REALITY

Variation of virtual elements (VE) is called as augmented reality. User perception and interaction with real world enhanced by augmented reality. Synchronization between camera and tumor image (target image) is needed to eliminate the relative log between virtual and real components. Initially, target image is created from CT and MR scan. Operating speed of augmented reality is 30 frames/sec in real time. AR is responsible for tumor identification. For tumor identification pixel values are calculated from target image. In this paper brain tumor detection is done using the Hamming distance measure between the acquired wave file (i.e. brain tumor image with artifacts) and the tumor images (known brain tumor image) already stored in the database. Target image is converted into frame which is matrix representation of images with pixels values (small portion of image converted into a single value). Known brain tumor image classified as three parts namely such as first 625 pixel values, mid 625 pixel values and the end 625 pixel values. The acquired tumor image has 25 pixel values, and acquired tumor image pixel values

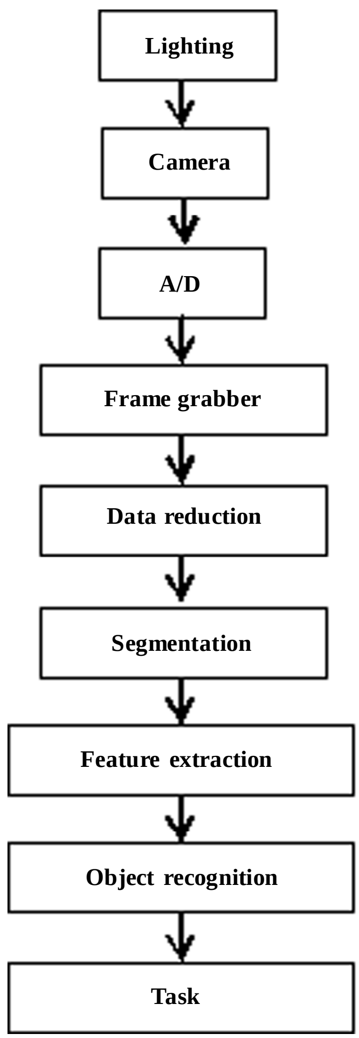

Figure 1: Augmented reality based vision system

is compared with the known brain tumor image pixels values frame by frame in a non-overlapping manner and checked for the Hamming distance. The known brain tumor image which gives the minimum Hamming distance is classified as the best match brain tumor. Four known brain tumor samples were compared with the acquired tumor image and the best match was found. Flow chart of vision system in augmented reality is shown in figure 1.

Input of vision data by means of a camera focused on the target image. Sufficient contrast is obtained by lighting methods. Frame of target image captured from digital image is done by frame grabber. After that, data reduction is processed to change the representation of a frame from several hundred thousand bytes of raw image data to several hundred bytes of feature value data. Functionality of proposed method is shown in figure 2.In augmented reality hamming distance is calculated between all subsets of all feature vectors and the acquired feature vector and hamming distance value whose elements indicate how close the input feature vector is to an acquired feature vector. The sum of hamming distance for each subset of individual input feature vector is calculated. Finally, minimum of hamming distance is considered for finding brain tumor detection.

4. EXTRACT PIXEL VALUE OF IMAGE

In augmented reality, python imaging library (PIL) is used for image processing. PIL supports image file formats like bmp, jpg, pngetc. By using PIL, pixel value is extracted from image and it is stored in matrix. Initially, the tumor image of patient 1 (target image) is open in read mode using image open (“imagename png”, “r”). getdata ( ) function is used to extract pixel value of the image. The conversion of pixel value is beginning at the top-left corner and horizontally from left to right.

5. IMAGE SEGMENTATION

Dividing of image into multiple segments is done by image segmentation. In segmentation, the objective is to group areas of an image having similar characteristics or features into distinct entities representing parts of the image. Thresholding, region growing and edge detection techniques are used in segmentation. The total pixel matrix is represents as S. In segmentation adjacent pixels does not have the similar pixel value, then pixel matrix divided in to quadrants (S1, S2, S3 and S4). If a quadrant does not have similar pixel value, it is sub divided into sub quadrants. After splitting, any sub quadrants and quadrants have near pixel valuethat is merged. Figure 3 shows the portioned image. In order to determine brain tumor position segmentation of pixels value is done.

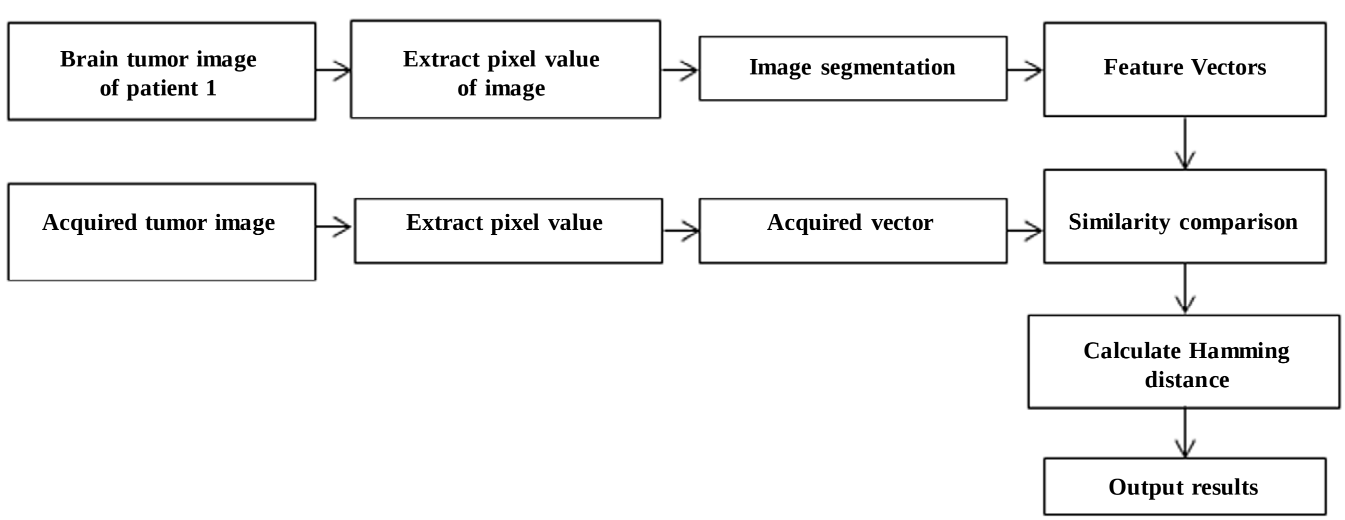

Figure 2:

<table>
<tr><td>S_{11}</td><td>S_{12}</td><td rowspan="2">S3</td></tr>
<tr><td>S_{12}</td><td>S_{14}</td></tr>
<tr><td colspan="2">S_2</td><td>S4</td></tr>
</table>

Figure 3:

5.1. Example Illustration

In figure 4, the tumor image segmented by pixel values. Three feature vectors extracted by image segmentation. This three feature vectors are compared with the acquired tumor image feature vectors.

1	1	1	1	1	1	1	2
1	1	1	2	2	2	2	2
1	1	2	2	2	2	1	2
3	3	1	2	2	2	1	2
3	3	1	2	2	2	1	2
3	3	1	1	1	1	1	1

Figure 4:

6. COMPUTING HAMMING DISTANCE FOR SIMILARITY COMPARISON

Hamming distance is used to calculate similarity between feature vectors brain tumor image of patient1 and feature vector of acquired vector. The length of the features vectors for brain tumor of patient1 is represents as n. Feature vectors for brain tumor of patient1 is considered as V_1, V_2, V_3….. The length of the feature vector of acquired brain tumor is represents as m. Hamming distance calculated, at all positions in the feature vectors of brain tumor of patient1 between 0 and n-m, whether an incidence of the vectors starts there or not. Then after each step, it shifts $V_1$by exactly one position to the right. In this process, there is no need any preprocessing. Hamming distance can be calculated in any order. Time complexity of the hamming distance calculation is O(mn).For every shift, the total hamming distance is calculated for every feature vectors for brain tumor of patient1.

Feature vector for brain tumor of patient1 (V_1)

52 53 23 53 25 53 23 53 25 55 25 45

Feature vector of acquired brain tumor (d)

53 23 25 55 45 54 25 51

Length of V_1 = 12

Length of d = 8

7. AUGMENTED REALITY DEVELOPMENT

Augmented Reality is a view of real world with some additional virtual elements (augmentations) that adds (augments) to the reality. Augmented reality is developed by Vuforia Unity Extension and Unity. In Augmented Reality app, the app scans the target image. Target image (brain tumor image of patient1) consider reference for positioning the virtual elements such as videos in the augmented reality app. Target

Hamming distance calculation

Shift in positions (n-m)	Compare V_1 with d								Hamming distance
0	52	53	23	53	25	53	23	53	**8**
	53	23	25	55	45	54	25	51	
1	53	23	53	25	53	23	53	25	
	53	23	25	55	45	54	25	51	**6**
2	23	53	25	53	23	53	25	55	
	53	23	25	55	45	54	25	51	**6**
3	53	25	53	23	53	25	55	25	
	53	23	25	55	45	54	25	51	**7**
4	25	53	23	53	25	55	25	45	
	53	23	25	55	45	54	25	51	**7**
	Total Hamming distance								34

Pseudo code

s = acquired brain tumor image \\\\ s is a matrix with pixel values
x = known brain tumor with length of 25
extract sub-blocks
S_1 = first subblocks with length of 625
execute compare loop (S_1)
S_2 = first subblocks with length of 625
execute compare loop (S_2)
S_3 = first subblocks with length of 625
execute compare loop (S_3)
loop: execute
hamming distance = 0
g = length(S1)-length(x)
for length (g)
if (S1[g:g+24]!=x[0:length(x)])
hamming distance++
y = minimum value of hamming distance
if minimum value obtained with S_1
brain tumor is in S_1 region
return ("match occurred there is abnormality")
elseif minimum value obtained with S_2
brain tumor is in S_2 region
return ("match occurred there is abnormality")
elseif minimum value obtained with S_3
brain tumor is in S_3 region
return ("match occurred there is abnormality")
else
return ("match not occurred and normal")

image is added in Vuforia through add target option. The width of image is decided based on unit of augmentation. The height of the image calculated automatically. The target image selected with high star rating. Unity editor is used to create .unitypackage file containing target image. The Target Manager supports target images are either 8 or 24 bit PNG or JPG files. JPG files must be RGB or grey scale. The maximum image file size is 2.25 MB.Unity supports C# and UnityScript. UnityScript is a language designed specifically for use with Unity and modelled after JavaScript. A script makes its connection with the internal workings of unity by implementing a class which derives from the built-in class called MonoBehaviour.

7.1. Development of android application

7.1.1. Workflow

- i. **Set up**: install android SDK, android development tools and android platforms. Create android virtual devices and connect hardware devices that will be used for testing.
- ii. **Development**: create an android project with source code, resource files and android manifest file.
- iii. **Debugging and testing**: build and run application in debug mode. Debug application using the android debugging and logging tools. Test application using the android testing and instrumentation framework.
- iv. **Release mode**: configure, build and test application in release mode.

After launching xamarin, android application is used to create an android application with an activity. Initially mainacticity.cs created which contain source code for the android application development. In layout, axml file is created automatically. The layout of android application designed in axml file. In axml file linear layout, relative layout and buttons like get image, submitimage, show pdf are designed. In mainactivity.cs main variables are declared within event handler. Web reference option is used to add web server with xamarin by given already created web address (URL) in it. Net 2.0 web services is used as framework. References file contains the webserver details. AppDemo.URLaddress.com added as header file for webservice. The operation various buttons are designed.

7.1.2. Getimage button code flow

First total number of reference images is indexed. After, every image displayed on android image count value will be increment by count 1. If imagecount is equal to total number of reference images, then imagecount initiated with value of 0. After that webserver is waiting for submit image button function.

7.1.3. Submitimage button code flow

If user press submit button without image, the android process display “please enter the image” message displayed. User image compared with reference images. If any match occur “match” is displayed and get report button is enabled, otherwise “not match” is displayed.

7.1.4. Report button code flow

If report button is pressed by user, the corresponding report (pdf file) is displayed. The report document is get from the designed URL web service. Pdf path of the report document is metioned.

7.1.5. Deployment on Android

After completion of coding, android phone is connect with computer. The developed android application uploaded to android device.

7.1.6. App as package

Create package is used to application as package. Minimum android version is selected as API level 14. .apk app package is developed.

8. SIMULATION SETUP AND RESULTS

Initially, feature vector extracted for the input brain image is shown in figure 5.

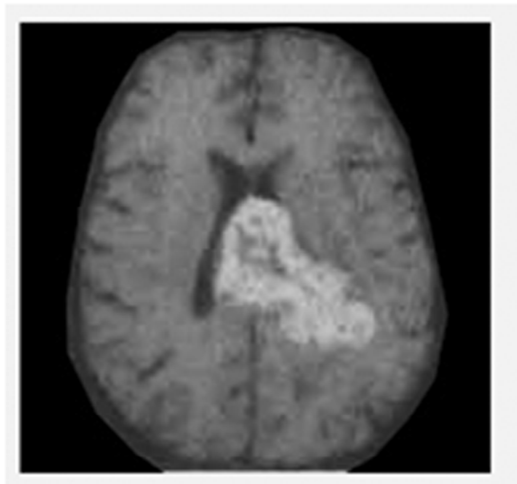

Figure 5:

Feature vector (V_1) : 252 253 253 253 245 253 253 253 253 255 255 245 254 225 251 229 249 248 248 254 180 25 0 0 219

Feature vector (V_2) : 253 253 253 245 255 253 253 253 255 245 245 254 225 251 255 249 248 248 254 227 25 0 0 219 231

Feature vector (V_3) : 253 253 245 255 248 253 253 255 245 255 254 225 251 255 241 248 248 254 227

Acquired brain tumor feature vector (Y):253 253 253 255 245 254 225 251

Figure 6 shows the hamming distance calculation between V_1 and Y. Figure 7 shows the hamming distance calculation between V_2 and Y. Figure 8 shows the hamming distance calculation between V_3 and Y.Minimum hamming distance achieved with V_3shownin figure 9.

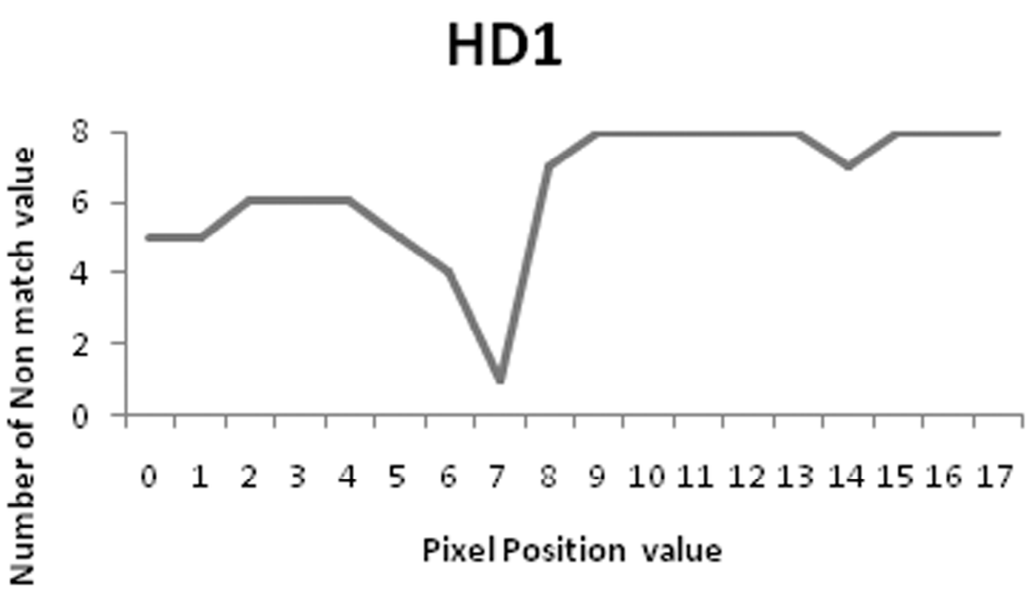

Figure 6:

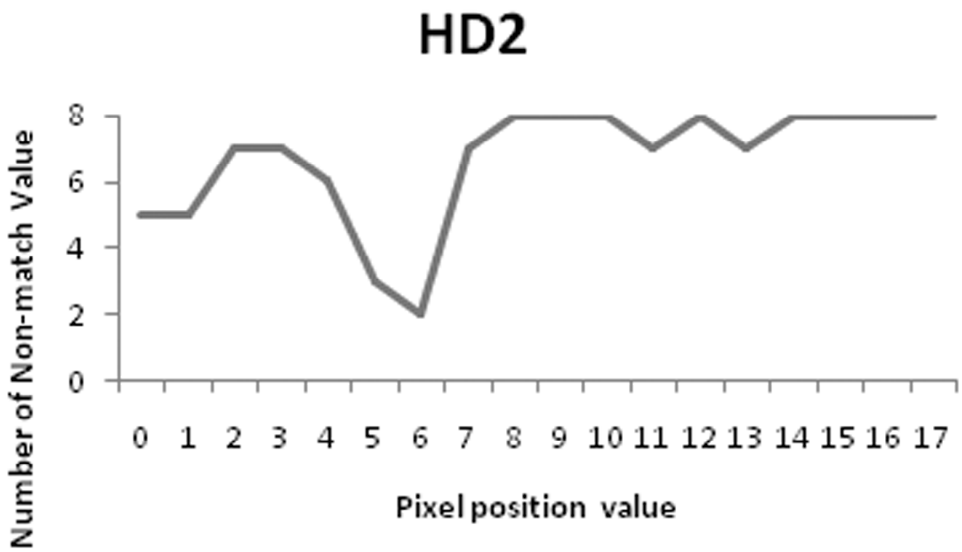

Figure 7:

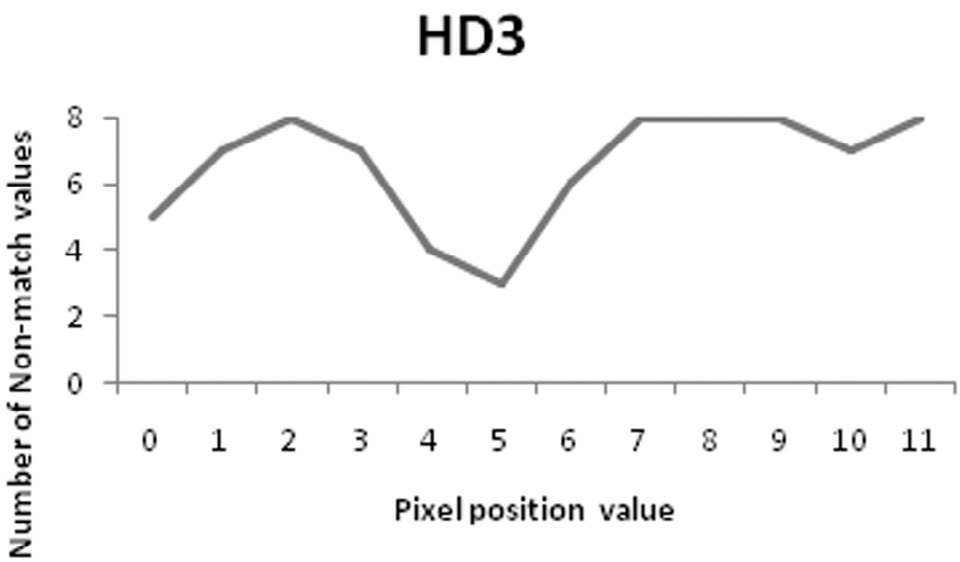

Figure 8:

Figure 9:

Figure 10:

Table 1

Area	*Position value*
144.77 mm2	114.0, 108.0

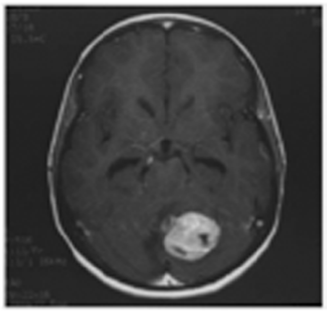

Figure 11:

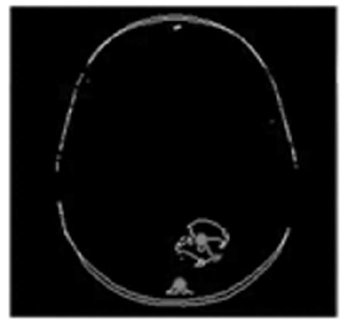

Figure 12:

Table 2

Area	*Position value*
59.13 mm2 (tumor 1)	167.0, 205.0
55.76 mm2 (tumor 2)	148.0, 244.0

The minimum number of non-match and minimum total hamming distance is achieved with feature vector V3. The acquired brain tumor image is matched with feature vector V3. The detected brain tumor position and area for input image (figure 5) is shown in figure 10 and table 1. Another one input image used for analyses the proposed system is shown in figure 11 and the corresponding output value is shown in figure 12 and table 2.

9. CONCLUSION

Proposed system is a mobile based and is well-matched with all existing and upcoming versions of operating system. The accuracy of brain tumor identification is achieved by single acquired brain tumor vector containing all tissue types. The main advantages of the augment assisted brain tumor identification are to make segmentation of MR images more practical by replacing manual outlining, which reduces operator time. The proposed method separates brain tumors from healthy tissues in MR images to aid in the task of tracking tumor size over time. By using proposed method brain tumor image, size and position is predicted more precisely from the MRI image. Augmented reality is utilized to extract feature vectors from the MRI image that will be used for hamming distance calculation. The proposed method has the following features reliability, repeatability, accuracy, robustness and least dependency on the operator.

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