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An hybrid of PET and NIRS of non-invasive technique with clustering for detecting brain tumor

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ABSTRACT

Segmentation is the process of partitioning the digital image into many segments which depends on pixels. It helps to identify objects or an irrelevant object in a particular area. The segmentation was based on color, texture and threshold methods. The main focus of this work is not only identifying the defected area in the brain but also analyzing the approximate location. So the clustering method is applied for grouping the similar objects. The non-invasive technique is a safe imaging technique uses today in research facilities and hospitals throughout the world. The comparing of non-invasive techniques like Positron Emission Tomography (PET) scan and a hybrid of Near-Infrared Spectroscopy (NIRS) and Electro-Encephalography (EEG) brain interfaces gives the best result to find the approximate location of the defected area in the brain with accuracy and stability.

Keywords: *Clustering, Positron Emission Tomography (PET), Near-Infrared Spectroscopy (NIRS), Electro-Encephalography (EEG).*

1. INTRODUCTION

Medical image segmentation is referred to the segmentation of known anatomic structures and digital image with different medical techniques. Normally, the medical data researches are more complicated and an exclusive structures. This computer-aided diagnosis is used for assisting doctors in evaluating medical imagery and recognizing abnormal detection in a medical image. To integrate the specialized knowledge for medical data processing is helpful to form a real useful healthcare decision-making system**.**

Clustering is the process of arranging a group of specific objects into classes of similar objects. Clustering analysis is mainly used in many applications such as market researching, pattern recognizing, data analyzing, and digital image processing. In the field of biology, it can be used to analyze plant and animal taxonomies, differentiate their genes with similar functionalities and gains deeper into structures inherent to populations. so, here the affected area are clustered based on the segmentation.

The ability to induce and sustain angiogenesis is regarded as one of the highlights of cancer growth. Non-invasive cancers stay within the cells. They do not grow into or invade normal tissues within or beyond the layer. Non-invasive cancers are sometimes called carcinoma in situ.

Cancer is a complex disease which occurs when cells in the body begin to grow more. Normally, cells grow, separate, and develop more cells to keep the body healthy and functioning properly. Sometimes, the process goes vary, cells keep separating when new cells are not necessary. Some types of cells in our body are more prone to abnormal growth than others. The number of extra cells forms a growth or tumor, which can be a starting stage. Benign stage of the tumor is not cancer. It can often be removed and, in most cases, they do not return back. Cells in starting stage of tumor do not spread to other parts of the body. More importantly, benign tumor is rarely life-threatening.

PET/CT Scans and Cancer: Positron Emission Tomography (PET) and Computed Tomography (CT) imaging have become most important diagnostic tools physicians use to identify the presence and to know the effect of cancers. PET/CT imaging helps physicians to detect cancer, evaluate the exact presence of disease, select the available and appropriate treatments, determine if the therapy is necessary, and detect the approximate tumor.

PET/CT scans provide information to identify physicians:

- place the location of the cancer
- Determine the specific size of the tumor

- Differentiate starting stage from the current growth stage
- Identifying if cancer has spread
- Select treatments that are similar to be appropriate
- Monitor the pinnacles of therapy
- Detect any recurrent tumor

Near-Infrared Spectroscopy (NIRS): Near-infrared spectroscopy (NIRS) is a non-invasive optical technology that specifies the relative identification of biological tissues to near-infrared light to specify tissue oxygenation. Oxy and deoxyhemoglobin and cytochrome aa3 that had distinct absorption characteristics in the near-infrared Spectrum. By reorganization of wavelength absorption of both oxy- and deoxy- hemoglobin and cytochrome aa3 is mainly possible to determine the concentrations of oxyhemoglobin, deoxyhemoglobin, the total percentage of hemoglobin, and oxy-deoxy cytochrome aa3. By analyzing the concentrations of oxyhemoglobin, Deoxyhemoglobin, and a number of total hemoglobin, hemoglobin-O2 saturation are also be calculated.

Electroencephalogram: An electroencephalogram (EEG) is a practical experiment used to diagnose epilepsy. It is used when the doctors suggest patients who have epilepsy. The electroencephalogram recognizes and records the electrical activity of the neurons in the brain. An EEG will produce report healthcare provider if there is different activity applied in the brain and the types of abnormal growth are located. Diagnosing epilepsy, an EEG will help doctors to identify some other brain abnormalities, such as an unconditional presence, brain death, or the presence of different types of tumor or a stroke.

In this paper, the non-invasive techniques are used for detecting the affected areas of the tumor. The hybrid of PET and NIRS techniques are used for identifying approximate position of the tumor in the brain when compared to EEG technique. Therefore the result proves that hybrid approach gives more scalable than EEG.

In the rest of the paper organized as follows. In section II the state of the art techniques adopted for Non-invasive technique and pointing out the limitations they incorporate, the challenges that are currently being faced, and the new applications for medical systems. In section III, we propose a method that is based on a combination of hybrid PET, NIRS and EEG based Non-invasive techniques. This method allows for the computation of missing ratings were to be predicted with scalability. In section IV, we evaluate our proposed scheme and compare it to state of the art techniques, specifically hybrid of PET and NIRS non-invasive techniques and EEG non-invasive technique. In section, V concludes the paper by summarizing the results achieved.

2. RELATED WORK

Clustering is the unsupervised learning that classifies the patterns in terms of observations, data items or feature vectors into groups (clusters). The clustering problem has been addressed in many contexts and by researchers in many areas. This reflects its wide appeal and usefulness of the steps in data analysis. The term "clustering" is used in several research communities to identify methods for grouping of unlabelled data.

Dattolo et al. had presented an approach for detecting groups of similar tags and relationships among them. The authors apply clustering processes to find different categories of related tags, presenting three ways of calculating tag weights within a graph: intersection. GuandongXu et al. have explained a model of clustering based on clustering groups and he proposed a technique in clustering called Kernel information propagation for tag clustering.

Andriy Shepitsen applied hierarchical clustering algorithm for tag clustering. Marco Luca has used Self-Organizing Map (SOM) to cluster tagged bookmarks. Jonathan Gemmell proposes a method to personalize a user's experience within folksonomy using clustering. A personalized view can overcome ambiguity and characteristic tag assignment, giving users with tags and resources that correspond more closely to their aim. Specifically, examine unsupervised clustering methods based on BAT for extracting commonalities between tags.

3. PROPOSED WORK

Phases of Clustering Social Tagging Data

Tag clustering methodology comprises the following steps.

a) Data Extraction
b) Data Formatting
c) Clustering
d) Pattern Analysis

3.1 Data Extraction

The experimental dataset can be extracted from the E-Learning environment, which is a popular Web 2.0 based E-Learning web site that helps users to search relevant resources using tags. Table 1 shows the example dataset extracted from the Primary Tumor environment. In clustering tag data, the users were treated as attributes and the tags are treated as objects.

Table1. Example Dataset

Data Set Characteristics:	Multivariate	Number of Instances:	339	Area:	Life
Attribute Characteristics:	Categorical	Number of Attributes:	17	Date Donated	1988-11-01
Associated Tasks:	Classification	Missing Values?	Yes	Number of Web Hits:	80384

3.2 Data Formatting

The Second step of this work is to convert the data set into matrix representation. Table 2 shows the matrix representation of the tag data set. The Tag data set is normally symbolized by a matrix, with rows corresponding to Tags, and columns corresponding to patients.

In the matrix, n- Represents no of patients
M - Represents tumor problem
W_{ij} - represents weight associated with patients

sno	User1	User2	User3	User4	…….
P1	7	9	18	6	…….
P2	10	14	11	2	…….
P3	0	6	9	41	…….

P4	0	14	23	30	…….
P5	0	1	19	4	…….
P6	5	0	25	3	…….
P7	.	.	.	.	.

3.3 Clustering

Clustering Tag data is the process of grouping the similar Tags into the same cluster based on Tag Weight by applying clustering techniques. This study compares clustering techniques: PET, NIRS, and EEG. These techniques are implemented and tested against our proposed environment dataset.

The objective function for Clustering

The main concept of the clustering algorithm is to handle the intra-cluster and maximize the inter-cluster distance based on the distance which can measures. The function tales place for measuring the validation. On demonstration, it preferred to be the sum of intra cluster distances (SICD) for comparative analysis.

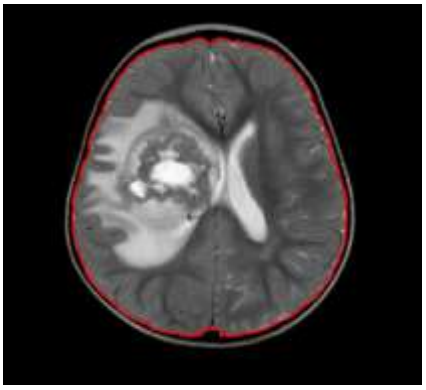

Figure 1. The extracted brain of EEG

PET scan and NIRS image Segmentation

A PET and NIRS image will display in different levels of positrons according to brightness and color. The objects are reconstructed or interpreted by computer analysis and it is used for diagnosing cancer and assessing its spread.

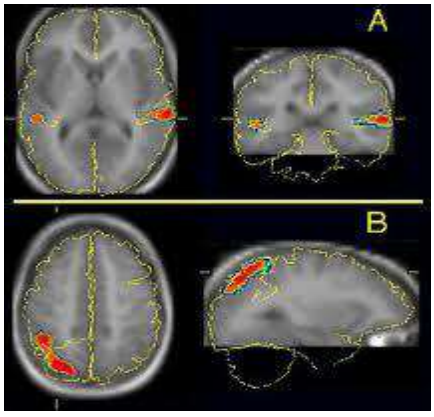

Figure 2: Brain image derived from PET and NIRS scan

3.4 Pattern Analysis

In this segmentation, the validity measures such as SICD are explained. It is an objective Function of the Clustering algorithms. Clustering algorithms which give the minimum SICD value are the algorithm which provides better performance than others.

Sum of intra cluster distance (SICD)

$$J(C_1, C_2, \ldots, C_k) = \sum_{i=1}^{k} \left(\sum_{X_j \in C_i} \|Z_i - X_j\| \right) \qquad (6)$$

The Euclidean distance between each data vector in a cluster and the centroid of that cluster is calculated and summed up. Here K is the number of clusters, Z_i represents cluster centroid, X_j is the data vector.

4. EXPERIMENTAL RESULTS

The experimental data set is collected from our proposed environment and delicious. The information about the data sets contains names of the dataset, the number of persons and number of persons affected by the tumor, which are given in Table 3. In clustering tag data, the Users/Bookmarks were treated as attributes and the tags are treated as objects.

S.N	Dataset	Tag	Users
1	gene	42	198
2	tumor	533	1261
3	Breast	283	1047

4.1 Performance Analysis of PET and NIRS clustering algorithms

The performance of PET and NIRS Clustering algorithm is examined SICD validity measures and the consequences are presented in Table 4.

DATASETS	SICD
Gene	17.54
Tumor	19.9
Breast cancer	7.14

Fig 2 depicts the performance of Non-invasive for various Medical System data sets discussed here based on SICD validity measure.

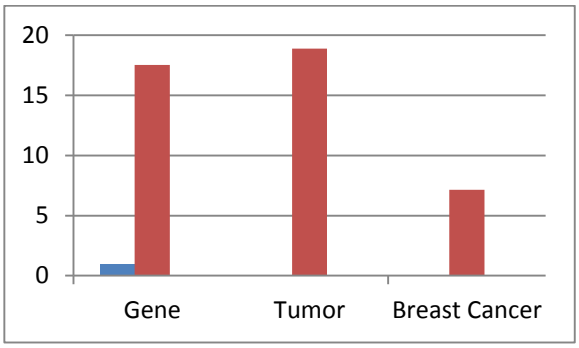

Fig. 2 Performance Analysis of PET and NIRS

4.2 Comparative Analysis

In this section, the comparative analysis of hybrid of PET, NIRS and EEG technique for gene, tumor, and breast cancer datasets using distance measures SICD measures are provided. Table 5 shows the comparative analysis of clustering algorithms based SICD validity measure for all the tagging datasets. The experimental results showed that of

PET, NIRS technique had shown better results than other technique.

DATASET	PET and NIRS	EEG
gene	24.63	21.5
tumor	32.63	28.0
Breast	32.98	31.1

Figure 3 shows the comparative analysis of various clustering approaches for Medical Systems

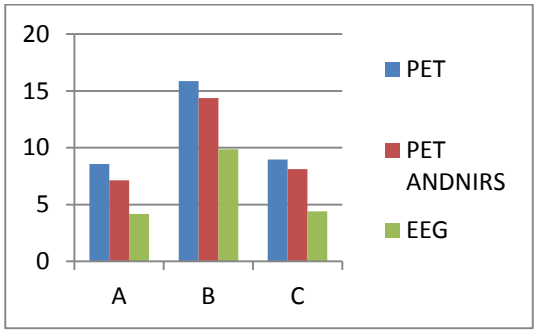

Fig. 4 Comparative Analysis of PET, PET and NIRS, EEG

Interpretations of Result

In this paper, we proposed a clustering approach for Non-invasive technique based on Medical. This study is a first attempt from the different perspective of Non-invasive technique and to best of our cognition. The results obtained are very encouraging, proving the practical applicability of Medical system. The detecting is very useful to explore the resources easily and effectively with the help of data mining techniques. Data mining techniques are widely applied for knowledge extraction in whole fields. Non-invasive technique generated a huge amount of tumor detection in a short period. Clusters are used for future medical information retrieval systems. After clustering the data, the outcome of the most affected area are displayed in our proposed environment.

5. CONCLUSION

The affected area clustering problem in tumor is a real important problem and has attracted much attention of many researchers.This paper has proposed Non-invasive technique for solving the clustering problem which is based on the combination of PET/NIRS and EEG. The proposed Clustering Non-invasive technique compared with PET/NIRS and EEG for Medical Dataset. The goodness of the clusters is obtained applying the well-known standard such as SICD. The comparative analysis shows that hybrid of PET/NIRS had given the best performance over the other two approaches for Medical Dataset.

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