IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Biomedical Image Processing Using Machine Learning Approaches

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ABSTRACT

Biomedical imaging concentrates on the capture of images for both diagnostic and therapeutic purposes. Snapshots of in vivo physiology and physiological processes can be gathered through advanced sensors and computer technology. Biomedical imaging technologies utilize either x-rays (CT scans), sound (ultrasound), magnetism (MRI), radioactive pharmaceuticals (nuclear medicine: SPECT, PET) or light (endoscopy, OCT) to assess the current condition of an organ or tissue and can monitor a patient over time over time for diagnostic and treatment evaluation. Biomedical image processing is a very broad field,it covers biomedical signal gathering, image forming, picture processing, and image display to medical diagnosis based on features extracted from images. Image reconstruction and modeling techniques allow instant processing of 2D signals to create 3D images.

Keywords—Biomedical, machine learning, Images

I. INTRODUCTION

Image processing:

- Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it.
- The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods.
- Image processing systems include electronic document management, presentation graphics and multimedia systems.

Elements involved in image processing:

- Adjust contrast and brightness
- Remasking-Correcting misregistered images
- Pixel shifting
- Edge enhancement-Edges of the vessels can be enhanced so that small details can be made more obvious.
- Image Zoom
- Land masking-A small amount of original image is added into the subtracted image.
- Noise Smoothing-operates by reducing the statistical fluctuations in each pixel by averaging the pixel with its closet neighbors.

There are five main types of image processing:

- Visualization - Find objects that are not visible in the image.
- Recognition - Distinguish or detect objects in the image.
- Sharpening and restoration - Create an enhanced image from the original image.
- Pattern recognition - Measure the various patterns around the objects in the image.
- Retrieval - Browse and search images from a large database of digital images that are similar to the original image.

Benefits of Image Processing:

- The digital image can be made available in any desired format (improved image, X-Ray, photo negative, etc).
- Information can be processed and extracted from images for machine interpretation.
- The pixels in the image can be manipulated to any desired density and contrast.
- Images can be stored and retrieved easily.

When the original CT scanner was invented, it literally took hours to acquire one slice of image data and more than 24 hours to reconstruct that data into a single image. Today, this acquisition and reconstruction occurs in less than a second. Depending on the imaging technique and what diagnosis is being considered, image processing and analysis can be used to determine the diameter, volume and vasculature of a tumour or organ; flow parameters of blood or other fluids and microscopic changes that have yet to raise any otherwise discernible flags.

Magnetic resonance imaging (**MRI**) is a medical imaging technique used in radiology to form pictures of the organisms of the body and the physiological processes of the body.

- MRI scanners use strong magnetic fields, magnetic field gradients, andradio waves to generate images of the organs in the body.
- It is a non-invasive imaging technology that produces three dimensional detailed anatomical images.
- It is often used for disease detection, diagnosis, and treatment monitoring.
- MRI scanners are particularly well suited to image the non-bony parts or soft tissues of the body.

II. LITERATURE SURVEY

AUTHOR	TITLE	ALGORITHMS	CONCLUSION
Bhagyashri H. Asodekar, Sonal A. Gore, A. D. Thakar	Brain Tumour analysis Based on Shape Features of MRI using Machine Learning	Support Vector Machine Random Forest	**1)**The aim of study is to analyze the effectiveness of shape feature in classification of brain tumor as benign and malignant tumor. **2)**Proposed method achieved 86.66% accuracy with random forest algorithm. Applications related to this approach are like object detection, medical, classification, security etc.
MohdShahajad, Deepak Gambhir, Rashmi Gandhi	Features extraction for classification of brain tumour MRI images using support vector machine	Support Vector Machine	**1)**The presented results prove that with increase in no. of features the percentage accuracy of SVM classifier increases, however beyond

			certain no. of features, the accuracy stagnates. **2)**Pre-processing of image to compute the GLCM features also plays an important role in the final accuracy in system
Xiaoxiao Li, Yuan Zhouc , NichaDvornek	BrainGNN: Interpretable Brain Graph Neural Network for fMRI Analysis	BrainGNN Clustering	**1)**BrainGNN takes graphs built from neuroimages as inputs, and then outputs prediction results together with interpretation results. **2)** With the built-in interpretability, BrainGNN not only performs better on prediction than alternative methods, but also detects salient brain regions associated with predictions and discovers brain community patterns. **3)**Overall, our model shows superiority over alternative graph learning and machine learning classification models.
Wasudeo Rahane, Himali Dalvi, Yamini Magar, Anjali Kalane, SatyajeetJondhale	Lung Cancer Detection Using Image Processing and Machine Learning HealthCare	Support Vector Machine	**1)**In our proposed system we are describing the lungs cancer and its stages using different image processing and machine learning algorithms such as, grayscale conversion, noise reduction and binarization. **2)** For pre-processing stages, median filter and segmentation gives accurate result. **3)** For grouping purpose Support Vector Machine (SVM) classifier classifies the positive and negative samples of lung cancer images in this system.
Lalaatika Sharma ,Gaurav Gupta,Varun Jaiswal	Classification and development of tool for heart diseases(MRI images)using machine learning	PCA-LDA WND	**1)**The images cant be used for machine learning directly so CellProfiler is used for feature extraction **2)**In the projected study CP-CHARM is cast-off for the model building using MRI images with this model 80-85% accuracy is achieved with the 25 image set and 97% accuracy by merging imaging using Amide.

HebaMohsen, EI-Sayed Ahmed EI-Dahshan, Abdel-Badeeh M. Salem	A Machine Learning Technique for MRI Brain Images	**1)**Feedback pulse-coupled neural network **2)**Discrete wavelet transform **3)**Principal component analysis **4**)Feed forward backpropagation neural network	**1)**This technique first applies feedback pulse-coupled neural network (FPCNN) as a front-end processor for image segmentation and detecting the region of interest (ROI) and then employs the discrete wavelet transform (DWT) to extract features from MRI images **2)**The principal component analysis (PCA) is performed to reduce the dimensionality of the wavelet coefficients which results in a more efficient and accurate classifier
Dinggang Shen,Guorong Wu and Heung-Il Suk.	Deep Learning in Medical Image Analysis	Convolutional Neural Networks (CNN)	1)Applying deep learning to investigate the underlying patterns in images such as fMRI, due to the black-box like characteristics of deep models. 2)While the data-driven feature representations, especially in an unsupervised manner, helped enhance accuracy, it is also desirable to devise a new methodological architecture.
Xiaoqing Liu,Kunlun Gao and Bo Liu.	Advances in Deep Learning-Based Medical Image Analysis	Convolutional Neural Networks (CNN)	1)The recent progress of CNN-based deep learning techniques in clinical applications including image classification, object detection, segmentation, and registration. 2)More detailed image analysis-based diagnostic applications in four major systems of the human body involving the nervous system, the cardiovascular system, the digestive system, and the skeletal system were reviewed. 3)State-of-the art works for different diseases including brain diseases, cardiac diseases, and liver diseases, as well as orthopedic trauma, are discussed
Pravin R.K shirsagar, Anil N. Rakhonde and	MRI IMAGE BASED BRAIN TUMOR DETECTION USING	Convolutional Neural Networks (CNN) and FCM algorithm.	1) The texture based skills are extracted the use of grey diploma co-incidence matrix.

Pranav Chippalkatti.	MACHINE LEARNING		2)The texture abilities of the picture Considered at some stage in this proposed paintings include electricity, evaluation, correlation, homogeneity.
Hasnae Zerouaoui1 & Ali Idri1	Reviewing Machine Learning and Image Processing Based Decision-Making Systems for Breast Cancer Imaging	Convolutional Neural Networks (CNN) Multi-layer Perceptron (MLP) Deep Neural Networks (DNN)	1)The use of ML and IP for BC is gaining more interest in the last years by researchers, and the number of published articles has significantly increased since 2015. Moreover, the majority of the papers where published in journals (71%) which indicates a high level of maturity within the community. 2)The SLR found out that the diagnosis is the most investigated BC task with 73%, followed by screening (17%), treatment and prognosis with 6% each.

III. MACHINE LEARNING ALGORITHM DISCUSSION

Machine learning and deep learning algorithms have achieved better results in biomedical image classification. Examples are:

- Support Vector Machine(SVM)
- Neural network
- Convolutional Neural Network Artificial Neural Networks

IV. TOOLS

- Python
- Photoshop
- Matlab
- Matlab Simulink
- FPGA-Virtex 2 Pro

APPLICATIONS

1) Clinical neurology:
- ➢ Segmentation and classification
- ➢ Measuring volumes of brain structures
- ➢ Multiple sclerosis, neurodegeneracy, stroke, …

2) Cardiology:
- ➢ Either need to image fast, or deal with heart motion

3) Cancer:
- ➢ Breast, colorectal, liver, prostate, …

4) Soft tissue damage:
- ➢ Cartilage, ligaments, etc..

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