Abstract

Background: Remote radiology is used in the remote areas today to diagnose scanned ultrasound data due to the lack of trained radiologists. The availability of online radiography experts and the availability of portable ultrasound communication facilities are some of the issues in remote radiology for the use of ultrasound scanning in telehealth.

Objectives: The purpose of the present study was to investigate the ability of IoT to detect computer abnormalities of kidneys on ultrasound imaging.

Methods: The study was conducted systematically by searching the Scopus, Science Direct, PubMed, and Google Scholar search engine databases using the PRISMA flow diagram to select articles. The English language input and the time range of 2013 to 2018 were used for the search. There were about 123 articles, 42 of which were included in the study. Then, the qualitative evaluation of articles was done based on the 12-question CASP diagnostic test study checklist and finally, 15 articles related to the study were selected.

Results: The results of studies showed that IoT was more acceptable and satisfactory than other imaging modalities and had a significant role in the diagnosis of kidney disease, in terms of both cost and time.

Conclusion: The results of the study showed that in the absence of a radiologist in the therapeutic environment or the patient's inability to visit the hospital or clinic, using IoT is the best way to solve the mentioned problems.

Keywords: IoT; Kidney Disease; Ultrasound Imaging

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Medical Image Fusion Based on Deep Convolutional Neural Network

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Abstract

Background: Medical image fusion plays an important role in helping doctors for effective diagnosis and treatment.

Objectives: The purpose of image fusion is to combine information from various different medical modalities into a single image with preserving salient features and details of the source image.

Methods: In this article, we present an approach for fusion MRI and CT images based on a deep convolutional neural network with four layers that was trained with medical images. In the beginning, images were decomposed to high and low frequencies by applied nonsubsampled shearlet transform (NSST). Then, for high-frequency sub-band, we used deep convolution neural networks for extracting feature maps. Low-frequency sub-band became fusion using the law of local energy fusion and in the end, the fused images were reconstructed by reverse NSST.

Results: Experimental results indicated that the proposed scheme had better functionality in terms of image preservation, visual quality, and subjective and objective assessment.

Conclusion: In this work, a medical image fusion method based on deep convolutional neural networks was proposed. The main novelty of this approach was the use of a deep convolutional neural network with four layers that was trained to extract source image features. To achieve good results, we used the nonsubsampled shearlet transform technique for multi-scale decomposition. Based on the experimental results, the proposed method achieved the best fusion performance.

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Classification of Brain MRI for Alzheimer's Disease Detection Based on Ensemble Machine Learning

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Abstract

Background: Machine learning is now a powerful tool to help improve medical disorders diagnosis. One of its critical applications is the classification or clustering of neurodegenerative disease by pattern recognition methods based on biomedical signals and medical images. Early detection of these diseases is always useful and vital. In this study, we focused on Alzheimer's disease (AD) as a

type of dementia leading to problems with memory, thinking, and behavior. This disease was named after Dr. Alois Alzheimer in 1906 when he inspected a female patient who died of an unusual mental illness. According to recent studies, four stages are introduced for AD, including pre-dementia, early AD, moderate AD, and advanced AD. There are several methods for AD diagnosis that include mental status evaluation, physical exam, and neurological exam, based on different imaging techniques such as magnetic resonance imaging (MRI). Several methods have been introduced until now for the classification and detection of AD using machine learning algorithms, such as the classification of AD with discrete wavelet transform (DWT) and single linear discriminant analysis (LDA) classifiers and differentiation of AD from normal based on T2-weighted MRI with shearlet transform (ST) and K-nearest neighbors (KNN) classifiers.

Objectives: In this work, we proposed a methodology based on DWT with three-level decomposition feature extraction (Figure 1).

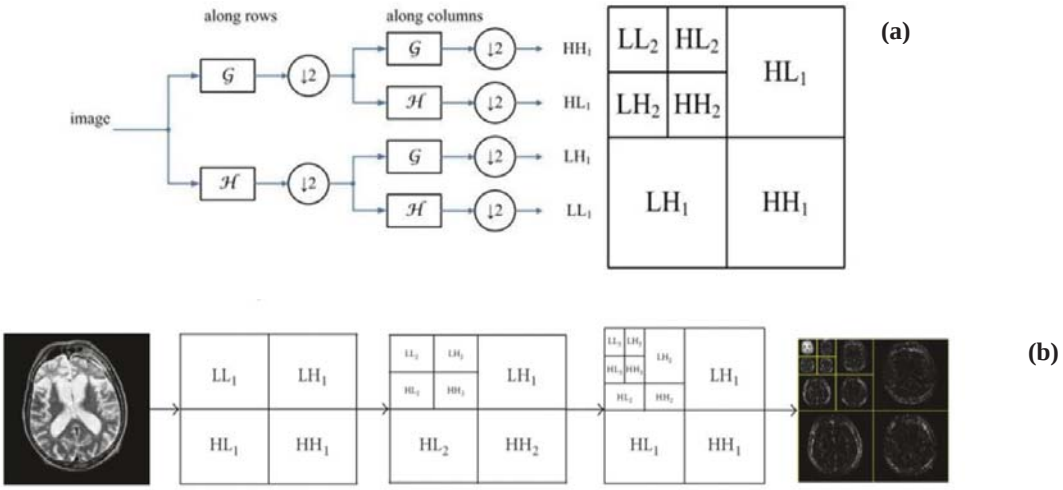

Figure 1. a, DWT decomposition scheme; b, a sample of brain MRI with three levels of wavelet decomposition (Heba Mohsen et al. (2017))

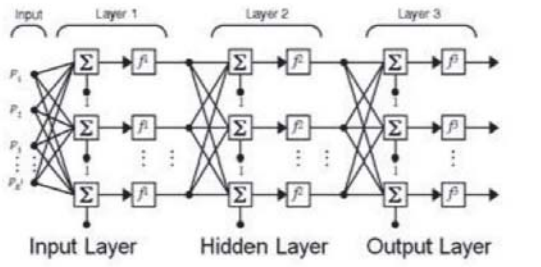

Figure 2. Multilayer perceptron feed forward network (Walaa Hussein Ibrahim et al. (2013))

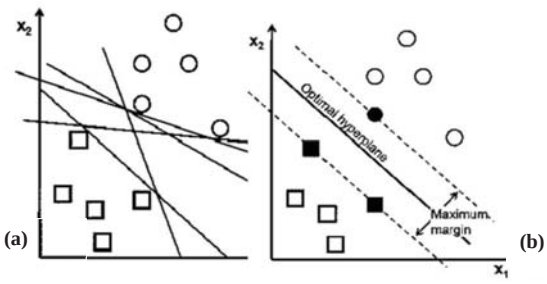

Figure 3. a, classification using linear classifiers; b, classification using linear SVM classifier (Gopi Battineni et al. (2019))

Methods: Based on statistics (mean, variance, skewness) of features and principal component analysis (PCA) for dimension reduction, we used five classifiers, including multi-layer perceptron neural network (MLPNN) (Figure 2), KNN, support vector machine (SVM) (Figure 3), and naïve Bayesian (NB) with the majority vote method to fuse them into one ensemble classifier.

Results: The proposed methodology was evaluated using 100 T2-weighted MRI of AD and cognitive normal (CN) subjects, which were chosen from the Harvard Medical School website. The accuracy, specificity, and sensitivity achieved from our methodology were 95%, 90%, and 100%, respectively by using a 10-fold cross-validation strategy.

Conclusion: Our study showed that the stacking

method for classification of AD and CN was better than using one classifier and comparable with state-of-the-art methods.

Keywords: Ensemble Machine Learning; Alzheimer's Disease; Discrete Wavelet Transform; Principal Component Analysis; Statistics Features; Magnetic Resonance Imaging

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A Proposal to Approach Cloud-Based Enterprise Imaging for Medical Universities in Iran Using Existing DICOM Infrastructure

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Abstract

Background: Exchange and share of different medical images as one of the critical parts of patients' medical records between different departments of the same hospital or even different hospitals have always been in demand in recent years. Medical universities in Iran include affiliated hospitals and medical centers. Most of those hospitals were equipped with picture archiving and communication systems (PACS) from different vendors in the past years. The main challenges concerning the functionality of current PACS-based workflow with those vendors are the lack of functionality to capture, store, and view DICOM and non-DICOM images from other departments other than radiology, as well as the lack of communication and exchange of medical imaging among hospitals since each vendor has its own protocol of communication.

Objective: Some advantages of this demand include allowing healthcare providers for on-demand access to medical imaging acquired at other affiliated hospitals using authentication, reducing unnecessary repeated imaging exams and unnecessary exposure to radiation, better managing the information technology resources in the Cloud environment, satisfying patients and healthcare providers, and providing timely access to patient medical imaging history.

Methods: In this study, we proposed a private Cloud-based enterprise imaging solution for each medical university based on the existing DICOM infrastructure, which was supported by commonly accepted standards of all vendors. In each hospital, non-DICOM medical images were converted via a "Dicomizer" to DICOM and beside native DICOM images were sent via a "Router" module to the Central Archiving solution located in private Cloud of the Medical University. By utilizing the Router module, it was possible to transfer images even in narrow bandwidth lines via lossless/lossy compression under TLS/SSL protocol, making necessary DICOM coercions and adding DICOM tags and facilitating the possibility of having some other useful features. A zero-footprint viewer was considered in the Cloud environment for the purpose of anytime/anywhere viewing of patient studies.

Results: The primary test of the Router module even through the internet network was encouraging. It seemed this module could work much more effective through the intranet of medical universities and the affiliated hospitals.

Discussion: Besides transferring images by Router, this module could add or coerce some necessary DICOM tags, facilitating the categorization of studies, automatic pseudonymization of patient data, and support of all DICOM store classes including non-image classes like structured reports.

Conclusion: The proposed method of archiving Enterprise Imaging in private cloud using the existing DICOM infrastructure seems feasible, cost-effective, and convenient since it does not affect the current workflow of archiving of medical images in affiliated hospitals of medical universities in Iran and there is no concern about different communication protocols. By full implementation of this proposal, each healthcare provider would have on-demand access to patient studies upon authentication without further need to store departmental silos of data.

Keywords: DICOM; PACS; Enterprise Imaging; Cloud Computing

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Automatic Detection and Classification of White Blood Cells in Blood Smear Images Using Convolutional Neural Network

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