Chapter 81
CAD-Based Machine Learning Project for Reducing Human-Factor-Related Errors in Medical Image Analysis

Adekanmi Adeyinka Adegun
Landmark University, Nigeria

Roseline Oluwaseun Ogundokun
https://orcid.org/0000-0002-2592-2824
Landmark University, Nigeria

Marion Olubunmi Adebiyi
https://orcid.org/0000-0001-7713-956X
Landmark University, Nigeria & Covenant University, Nigeria

Emmanuel Oluwatobi Asani
https://orcid.org/0000-0002-6774-8529
Landmark University, Nigeria

ABSTRACT

Machine learning techniques such as deep learning methods have produced promising results in medical images analysis. This work proposes a user-friendly system that utilizes deep learning techniques for detecting and diagnosing diseases using medical images. This includes the design of CAD-based project that can reduce human factor-related errors while performing manual screening of medical images. The system accepts medical images as input and performs segmentation of the images. Segmentation process analyzes and identifies the region of interest (ROI) of diseases from medical images. Analyzing and segmentation of medical images has assisted in the diagnosis and monitoring of some diseases. Diseases such as skin cancer, age-related fovea degeneration, diabetic retinopathy, glaucoma, hypertension, arteriosclerosis, and choroidal neovascularization can be effectively managed by the analysis of skin lesion and retinal vessels images. The proposed system was evaluated on diseases such as diabetic retinopathy from retina images and skin cancer from dermoscopic images.

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INTRODUCTION

Automatic segmentation of the medical images is important in the detection of a number of diseases (Sharma, Anchal, & Shaveta Rani, 2016). Recently state-of-the-arts techniques such as deep learning have been applied in this segmentation processes. Computer-aided detection (CADe) and diagnosis (CAD) project for analysis medical images has evolved and is rapidly growing (Doi, K., & Huang, H. K., 2007). This includes the design of CAD techniques that ease the rigorous task of manual screening of medical images which is susceptible to human errors in disease diagnosis. Machine learning technique such as deep learning methods have produced promising results in medical images analysis. It has been shown that image analysis and segmentation carried out based on deep learning methods has produced improved results with a very high accuracy percentage as against the manual screening method that is characterized with human factor errors (Abràmoff, M. D., Garvin, M. K., & Sonka, M., 2010). This chapter proposes a human-friendly project that utilizes deep learning techniques for detecting and diagnosing diseases using medical images. The system accepts medical images as input and performs segmentation of the images. Segmentation process analyses and identifies the region of interest (ROI) of diseases from medical images. The proposed system was evaluated on diseases such as diabetic retinopathy from retina images and skin cancer from dermoscopic images. Retina vessels images and dermoscopic images datasets were used to test and evaluate the performance of the system. The output gave a promising result. This paper proposes better human interfacing tools for the proposed project in the future work.

RELATED WORKS

In the last decade, there have been a lot of research about the application of deep learning to medical image analysis. Some works have been particularly carried out in the segmentation process of medical image analysis state-of-the arts techniques. The performance of the deep learning projects has been compared with manual approach with so much human factors related errors. This section performs the review of related works in this aspect.

Deep learning method was utilized for detection and segmentation of colorectal liver metastases by (Vorontsov et al., 2019). They applied three-dimensional automated segmentations to resolve deficiencies of fully automated segmentation for small metastases and it was faster than manual three-dimensional segmentation. They compared the performance of fully automated and user-corrected segmentations with manual segmentations. Chen, L., Bentley, P., & Rueckert, D. (2017) proposed framework to automatically segment stroke lesions images. The framework was made up of two convolutional neural networks to evaluate the lesions detected in order to remove potential disease.

Vesal, S., Ravikumar, N., & Maier, A. (2018) proposed a convolutional neural network (CNN) project called SkinNet that employed dilated and densely block convolutions to incorporate multi-scale and global context information for skin lesion segmentation. Baur, C., Wiestler, B., Albarqouni, S., & Navab, N. (2019). combined the advantages of supervised and unsupervised methods into a novel framework for learning from both labeled & unlabeled data for the challenging task of White Matter lesion segmentation in brain MR images. They proposed a semi-supervised setting for tackling domain shift which is a known problem in MR image analysis. Chlebus et al., (2018) developed a fully automatic method for liver tumor segmentation in CT images based on a 2D fully convolutional neural network with an object-based post-processing step. The system was compared with human performance.