بسم الله الرحمن الرحيم

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شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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Automatic Detection of Abnormalities in Magnetic Resonance Imaging

A Thesis submitted in partial fulfillment of the requirements of the degree of
Master of Science in Electrical Engineering
(Computer and Systems Engineering)
by
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Date: 05 August 2021

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering, Faculty of Engineering, and Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

The thesis has six chapters organized as follows:

Chapter 1 Introduction: introduces the proposed study for detecting Multiple Sclerosis (MS) using Ensemble Machine Learning, in addition, presents the research scope, the objective of the study, and the contribution to improve the performance of MS automatic early detection.

Chapter 2 Background: discusses the biological and theoretical background of topics involved. These background topics include the MS disease definition, Magnetic Resonance Imaging (MRI) Sequences, Machine Learning methods (Ensemble Support Vector Machines and Ensemble Decision Tree), Feature Extraction Techniques (2D-DWT method, Textural Features).

Chapter 3 Literature Review: shows a survey that covers all studies that presented the automatic segmentation using machine learning methods.

Chapter 4 Methodology: presents the proposed model's details that combine the feature-based with ensemble machine learning methods to create a fully automated model used to detect MS in MR brain image. Additionally, this chapter explains in detail the flow chart of the model (Preprocessing, Processing, Postprocessing) and the function of each step.

Chapter 5 Results & Discussion: discusses the two methods' results and compares results between two models (ESVM, EDT). Additionally, this chapter discusses the challenges and problems we face in the study and how to solve it optimally.

Chapter 6 Conclusion & Future Work: gives a conclusion for the thesis work, and potential directions for future work.

Keywords: Magnetic Resonance Imaging, Multiple Sclerosis, Automatic segmentation, Ensemble support vector machine, Ensemble Decision Tree, Lesions, RUSBOOST , Cost-Sensitive Learning.

Abstract

Multiple sclerosis (MS) is a permanent harmful disease that destroys brain cells. It destroys the control ability of vision, balance, muscle control, and other basic body functions. Recently, Magnetic Resonance Imaging (MRI) is increasingly used nowadays in many medical applications. Manual segmentation of MS lesions in MR images by human specialists is time-consuming, subjective, and inclined to inter-expert inconstancy. In this manner, automatic segmentation is required as an elective to manual segmentation. In any case, utilizing automatic segmentation to distinguish MS lesion is exceptionally challenging. It must be amazingly precise since it influences individuals' lives. A huge research effort has been carried out to automate the detection and diagnosis process of MS lesions using machine learning techniques. Research work in this area especially in large data faces many challenges like time consumption, data acquisition, memory insufficiency and low accuracy. Another important challenge is related to the training data set which is, in most cases, is unbalanced. Imbalanced data refers to a classification problem where the number of observations per class is not equally distributed, often have a large number of observations for one class. This problem exerts a major impact on the value and meaning of accuracy and on certain other well-known performance metrics such as dice similarity and sensitivity. In our study we consider these problem by introducing a new methodology that uses a hybrid machine learning model. This hybrid model combines Ensemble algorithm with a feature-based method to solve the problem of imbalanced classification data without loses. Two-dimension discrete wavelet transform (2D-DWT) and textural features are used to extract local information from MR image analysis. We propose two different hybrids

model: Ensemble Support Vector Machine (ESVM) and Ensemble Decision Tree (EDT). We detect MS twice using both two different models and compare the results. Results shows that the two different model gives the same accuracy. Considering the imbalance data challenge, our method is amongst the top performing solutions. The two proposed methods show high improvements in MS lesion detection compared with other studies provided.

Publications List

The list of publications from the work in this thesis:

1- Randa ElSebely, Ashraf A Salem, Bassem Abdullah and Ahmed Hassan Yossef, "Multiple Sclerosis Lesion Segmentation Using Ensemble Machine Learning". In Saudi Journal of Engineering and Technology on (ISSN 2415-6264), Scholars Middle East Publishers, Dubai, United Arab Emirates, (SJEAT: Volume-5: Issue-4, April, 2020).

2- Randa ElSebely, Ahmed Hassan Yossef , Ashraf A Salem and Bassem Abdullah, "Automatic Segmentation of Multiple Sclerosis Lesions in Brain MR ImagesUsing Ensemble Machine Learning", International Mobile, Intelligent, and Ubiquitous Computing Conference (MIUCC), 978-1-6654-1243-8/21/$31.00 ©2021 IEEE .

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