BRAIN LESION CLASSIFICATION BASED ON STATISTICAL DISCRIMINATION
FOR MAGNETIC RESONANCE IMAGING (MRI) IMAGE

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MRI   -   Magnetic Resonance Imaging

ROI   -   Region Of Interest

GUI   -   Graphical User Interface

I declare that this project report entitled "*Brain lesion classification based on statistical discrimination for magnetic resonance imaging (MRI) image*", is the result of my own research except as cited in the references.

Signature: ……………………………………………………

Name: SYED MOHD SYAFIQ BIN ABU BAKAR

Date: 6th JUNE 2014

I hereby declare that I have read this project report and in my opinion this thesis is sufficient in terms of scope and quality for the award of degree of Bachelor of Electronic Engineering (Computer Engineering).

Signature: ……………………………………………………

Name of Supervisor: NORHASHIMAH BINTI MOHD SAAD

Date: 6th JUNE 2014

Special dedicated to my late beloved father, my beloved mother, and little sister

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ABSTRACT

Computer technology covers a wide range of medical area such as cancer research, heart diseases and brain diseases. Magnetic Resonance Imaging (MRI) uses magnetic fields and radio waves to produce high-quality two or three dimensional images of body. This imaging technique is non-radioactive and pain-free technique for visualizing and detecting brain lesion without any human involvement. It gives the detailed information regarding the abnormal tissue. The aim of this project is to classify the lesion based on statistical discrimination of abnormalities. In this project, the image that captured by MRI will be used as database that need to process for classification. From the image, the region of lesion was segment manually using handfree tool from MATLAB software to proceed the classification process. The segment region is analyzed by taking statistical calculation to obtain the value of feature extraction. The different statistical values of abnormalities are classified using ruled based classification technique. It will show the characterization of region of interest (ROI) of different types of lesion. After the classification processing done, the system is verified to ensure the expected results are achieved. The performance of this classification system was shown using graph by taking several database that is 30%, 50%, 70% and 90%. Finally, the Graphical User Interface (GUI) was developing to make the system more attractive and user friendly.

ABSTRAK

Teknologi komputer meliputi pelbagai bidang perubatan dalam penyelidikan seperti kanser, penyakit jantung dan penyakit otak. Magnetic Resonance Imaging (MRI) menggunakan teknik pengimejan menggunakan medan magnet dan gelombang radio untuk menghasilkan dua atau tiga dimensi imej berkualiti tinggi pada bahagian tubuh badan . Teknik pengimejan ini tidak mempunyai radioaktif dan tidak sakit semasa mengimbas penyakit otak. Ianya dilakukan tanpa penglibatan manusia . Ia memberikan maklumat terperinci mengenai tisu otak yang tidak normal. Tujuan projek ini adalah untuk mengelaskan penyakit otak berdasarkan diskriminasi statistik yang tidak normal. Dalam projek ini, imej yang ditangkap oleh (MRI) akan digunakan sebagai data untuk proses pengelasan . Daripada imej data, bahagian penyakit telah disegmen secara manual menggunakan peralatan handfree MATLAB untuk meneruskan bahagian mengklasifikasi. Bahagian segmen tersebut akan dianalisis dengan mengambil pengiraan statistik untuk mendapatkan nilai ciri pengekstrakan. Nilai statistik yang berbeza bagi penyakit otak yang tidak normal akan dikelaskan menggunakan teknik Rule Based. Ciri-ciri statistik untuk bahagian penyakit akan dianalisis . Selepas pengelasan dilakukan, sistem akan diuji untuk memastikan hasil pengelasan yang dibuat adalah betul. Prestasi sistem pengelasan ini akan ditunjukkan menggunakan graf dengan mengambil beberapa data iaitu 30 %, 50 %, 70 % dan 90 %. Akhir sekali , grafik antara pengguna (GUI) telah dibuat untuk menjadikan sistem lebih menarik dan mesra pengguna.

CHAPTER 1

INTRODUCTION

1.1 Project Background

Magnetic resonance imaging (MRI) is a medical imaging technique used in radiology to visualize internal structures of organ tissue in detail. It is widely used for brain disease diagnosis. MRI can create more detailed images of the human brain than any possible devices such as Computed Axial Tomography (CAT) [1]. An MRI scanner is a device in which a patient lies within a large, powerful magnet where the magnetic field is used to align the magnetization of some atomic nuclei in the body or brain, and radio frequency magnetic fields are applied to alter the alignment of this magnetization with hydrogen atom in tissue molecule[2].

In this project, brain MRI images are analyzed to develop a brain MRI classification system. This project aim is to discriminate brain lesions and diseases in MRI brain images using statistical analysis and digital image processing algorithm. Types of diseases are solid tumor, stroke, chronic stroke and necrosis.

Brain lesion such as tumor is one of the most brain lesions that are affected in the brain cerebrum. Nowadays, tumor and stroke diseases were the third and fourth leading cause of death in Malaysia. Detection and diagnosis of brain lesion is the key for implementing successful therapy and treatment planning. By using the Magnetic Resonance Imaging MRI, the image will show clearly.

The purpose of this project is to classify the lesion based on statistical discrimination of abnormalities. There are many techniques in order to detect types of lesion such as support vector machine (SVM), K-Mean Clustering, Principle Component Analysis (PCA) and etc. In this project, technique that is used to classify the lesion is based on ruled based classifier. From the image, the information will be obtained by taking the statistical calculation of the Region Of Interest (ROI). The information is used as feature and also as input to the classifier.

1.2   Problem Statement

The process of brain diseases diagnostic and classification are done manually by neuroradiologist. The tasks are difficult and time consuming. Therefore, computer analysis and diagnosis system are required to help the radiologist to aid the diagnosis. Currently, radiologists are continuously seeking for computerized tools to ease their diagnosis. Classification using statistical would serve as another option to neuro-radiologists.

1.3   Objective

The objectives in this project is :

1.   To design method of brain MRI features extraction and classification system.
2.   To analyze statistical value of different abnormalities.
3.   To verify the performance of brain classification system.

1.4   Scope Of Project

There are 3 scopes for this project:

1. The segmentation Region Of Interest (ROI) of brain lesion is draw manually and not fully automatic.
2. The classification technique focus only on statistical discrimination technique of different brain lesion.
3. The proposed algorithm of MRI brain classification system will be written in MATLAB software.

1.5   Thesis Methodology

- **MRI brain images**

    In this Project, the MRI brain images was used as database. The brain lesión divided into 4 category which are stroke, tumor, chronic stroke and necrosis.

- **Image Pre-processing**

  Image database are original captured from MRI. It means that the images are not process yet. In this section, the images was normalize before proceed to segmentation.

- **Segmentation**

  Segmentation purpose is to obtain the Region Of Interest (ROI). This process are done manually using handfree tool from MATLAB software.

- **Feature Extraction**

  Feature extraction process is to obtain the information from ROI image. This process was done using statistical approach.

- **Classification**

  The statistic value was used as input to the classifier. The classification technique that be used is rule based classifier.

1.6   Organization

This thesis contains of five chapters. Chapter one describe about introduction, problem statement, objective and scope that described the reasons for developing this project, thesis methodology and organization of the thesis.

Chapter two is the literature review about the Magnetic Resonance Imaging (MRI) and functional block diagram MRI. This chapter also reviews on types of disease that effected in human brain. Then, review on current technology medical imaging.

Chapter three explains about methodology of the project. In this project, there are five stages to complete the classification. Begin with MRI image, pre-processing, manual segmentation, feature extraction and lastly classification. The flow chart of the project and the algorithms use is explained in this chapter.

Chapter four is about the results and discussion. In this part, all the simulation in MATLAB will be explained and showed clearly. Lastly, chapter five will concludes the project findings and recommendation for the future work.

CHAPTER 2

BACKGROUND STUDY

2.1   Magnetic Resonance Imaging (MRI)

Magnetic Resonance Imaging (MRI) is a medical imaging technique that uses magnetism, radio waves, and a computer to produce images of body structures. The MRI scanner is a tube surrounded by a giant circular magnet. The patient is placed on a moveable bed that is inserted into the magnet. The magnet creates a strong magnetic field that aligns the protons of hydrogen atoms, which are then exposed to a beam of radio waves. This spins the various protons of the body, and they produce a faint signal that is detected by the receiver portion of the MRI scanner. The receiver information is processed by a computer, and an image is produced.[2]

The image and resolution produced by MRI is quite detailed and can detect tiny changes of structures within the body. For some procedures, contrast agents, such as gadolinium, are used to increase the accuracy of the images[2].

An MRI scan can be used as an extremely accurate method of disease detection throughout the body and is most often used after the other testing fails to provide sufficient information to confirm a patient's diagnosis. In the head, trauma to the brain can be seen as bleeding or swelling. Other abnormalities often found include brain aneurysms, stroke, tumors of the brain, as well as tumors or inflammation of the spine.

After the MRI scanning is completed, the computer generates images of the area of the body that was scanned. These images can be transferred to film. A radiologist who is specially trained will interpret and diagnose images. The interpretation is transmitted in the form of a report to the practitioner who requested the scan. The diagnosis results will be used for further treatment of the diagnosis. Figure 2.1 below show the MRI scanner hardware capture the brain images.

Figure 2.1 MRI Scanner.

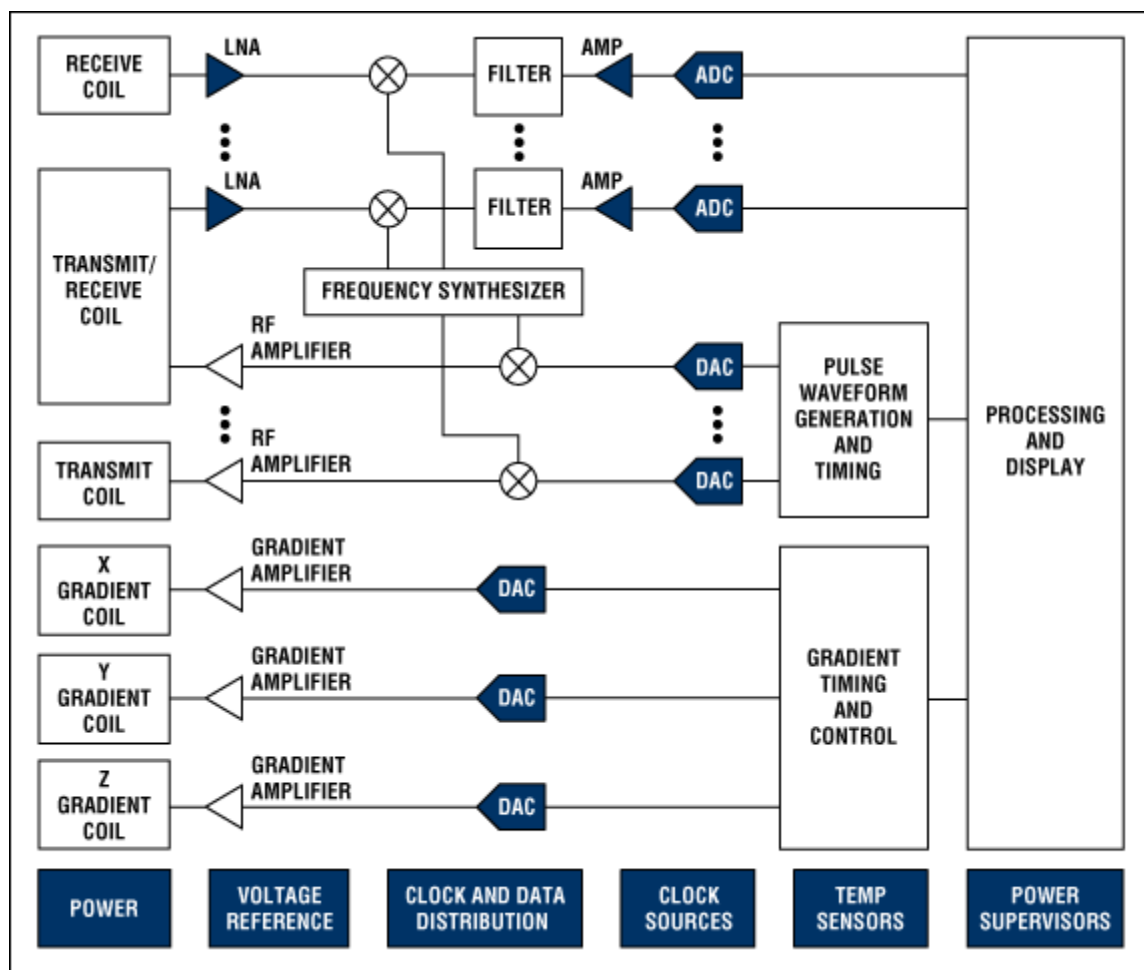**2.2   Funtional Block Diagram (MRI)**

Figure 2.2 Block Diagram MRI

Figure 2.2 above show the block diagram of MRI. This block diagram consist of Static Magnetic Field, Gradient Coil, Transmit / Receive Coil, RF Reciever and Transmitter.