DESIGN OF AUTOMATED COMPUTER AIDED CLASSIFICATION FOR BRAIN TUMOR USING DEEP LEARNING

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This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours

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DEDICATION

This thesis is committed to my parents, who have raised me to be a person I am today. You have been with me at all times, times and terrible. Much obliged to you for all the genuine love, direction, and bolster that you have given me, helping me to progress and ingraining in me the certainty that I can do anything I put my psyche to. Much obliged to you for everything. I additionally need to offer my thank to my boss and co-chief, Dr. Syafeeza binti Ahmad Radzi and Dr. Norhashimah binti Mohd Saad for their inspiration and keeping me in-line, and on-track.

ABSTRACT

In this recent years, health issues have inescapably become the center of attention from many researchers. A brain tumor is now a leading cause of death among medically certified deaths. Brain image diagnosis is manually examined by the neurologist. It is time-consuming and may lead to errors. The general idea of this project is to analyse the brain tumor based on the Magnetic Resonance Imaging (MRI) of medical images. The design of this system is aimed at classifying the MRI samples. The system uses computer-based procedures to classify the type of tumor to the malignant, benign or normal brain using Tensor flow in MRI images of different patients. A promising method to perform the design is through a deep learning process. Deep learning is currently a well-known and superior method in the pattern recognition field. The performance measure for detection would be false acceptance rate (FAR), Equal Error Rate (EER) and false rejection rate (FRR). A framework's FAR commonly is expressed as the proportion of the number of false acknowledgments partitioned by the quantity of distinguishing proof endeavors. A framework's FRR commonly is expressed as the proportion of the number of false dismissals separated by the number of ID endeavors. EER is a biometric security framework calculation used to foreordain the edge esteems for its false dismissal rate and its false acknowledgment rate. At the point when the rates are equivalent, the regular esteem is alluded to as the 'equivalent mistake rate'. The lower the EER esteem, the higher the precision of the biometric framework would be. The samples are already available coming from a standard database. A comparison will be done between different methods for classification of a brain tumor.

ABSTRAK

Dalam tahun-tahun kebelakangan ini, isu-isu kesihatan telah menjadi pusat perhatian dari ramai penyelidik. Barah otak kini menjadi punca utama kematian di kalangan kematian yang disahkan dalam sektor perubatan. Pengenalan penyakit daripada imej otak diperiksa oleh pakar neurologi secara manual. Pengenalan penyakit secara manual memakan masa yang panjang dan boleh mengakibatkan kesilapan. Idea umum projek ini adalah untuk menganalisis tumor otak berdasarkan imej perubatan resonans pengimejan (MRI). Reka bentuk sistem ini bertujuan untuk mengklasifikasikan sampel MRI. Sistem ini menggunakan prosedur berasaskan komputer untuk mengklasifikasikan jenis tumor kepada malignan, benigna atau otak biasa dengan menggunakan Tensor flow. Kaedah yang menjanjikan untuk melaksanakan reka bentuk adalah pembelajaran mendalam. Pengalaman mendalam kini merupakan kaedah yang terkenal dan unggul dalam bidang pengiktirafan corak. Ukuran prestasi untuk pengesanan adalah kadar penerimaan palsu (FAR), kadar penolakan palsu (FRR) dan Kadar Kesalahan Equal (EER). FAR sistem biasanya dinyatakan sebagai nisbah bilangan penerimaan palsu yang dibahagikan dengan bilangan cubaan pengenalan. FRR sistem biasanya dinyatakan sebagai nisbah jumlah penolakan palsu dibahagikan dengan jumlah percubaan pengenalan. Kadar ralat sama (EER) adalah algoritma sistem keselamatan biometrik yang digunakan untuk menentukan nilai ambang untuk kadar penerimaan palsu dan kadar penolakan palsu. Apabila kadar adalah sama, nilai biasa dirujuk sebagai kadar ralat sama. Semakin rendah nilai kadar ralat sama, semakin tinggi ketepatan sistem biometrik. Sampel yang diguna adalah dari pangkalan data standard. Perbandingan akan dilakukan antara kaedah yang berbeza untuk klasifikasi barah otak.

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LIST OF SYMBOLS AND ABBREVIATIONS

CNN	:	Convolutional Neural Network
EER	:	Equal error rate
FAR	:	False acceptance rate
FLAIR	:	Fluid-Attenuated Inversion Recovery
FN	:	False negative
FP	:	False positive
FRR	:	False rejection rate
TN	:	True negative
TP	:	True positive

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This chapter discusses the subject matters and problems statement, objectives, scope, and significance of this project. Firstly, the project background and problem statements such as lack of human resource and the challenges of doctors in classify the brain tumors are discussed in this chapter. The methodology of this project will be shown in the flowchart and discuss briefly. A summary that shows the organization of this thesis is provided at the end of this chapter.

.

1.1 Project Background

The problem of the brain tumor in Malaysia is growing in recent years. It is now a leading cause of death among medically certified deaths. According to the statistics reported by Central Brain Tumor Registry of the United States (CBTRUS), between 2009 and 2013, there were 368,117 cases of primary central nervous system and brain tumors [1]. A brain tumor occurs when cells lose the ability to control their growth, they divide too often and without any order. Tumors can be classified as benign which is called as low-grade tumors and malignant which is called as high-grade tumors.

Magnetic Resonance Imaging (MRI) is propelled restorative imaging method utilized as a part of healing facilities to frame high resolution of pictures of organs and structures inside the body. MRI assumes a significant part of brain tumor diagnosis and treatment arranging procedures [2]. There are two different modalities of MRI which are Diffusion Tension Imaging (DTI) and Fluid Attenuation Inversion Recovery (FLAIR) [3]. The function of these modalities is to produce the high level of contrast of the brain image, to enhance the image quality and data gained. FLAIR image provides the better result for the edema and tumor.

Fluid Attenuation Inversion Recovery is commonly used in the diagnosis of brain tumors. This is because of its points of interest that permits simple identification of little and generally low difference injuries, stifle the ventricles of the cerebrum, cerebral spinal liquid (CSF) and makes the neurotic piece of the mind is obviously observed. Besides that, the FLAIR images have higher contrast and resolution and describe the lesion precisely compare to other MRI modalities.

Arthur Samuel, an American pioneer in the field of computer gaming and artificial intelligence, described "machine learning" as the field of study that gives computers the ability to learn without being expressly programmed. Deep learning is part

of machine learning methods based on learning data representations. While Convolutional Neural Networks (CNN) is a class of deep learning. Recently, CNN has been quite effective in computer vision [4]. CNN consists of one or more convolutional layers, subsampling layers and followed by one or more fully connected layers. Pattern recognition of CNN can be divided into three types which are detection, segmentation, and classification. In this project, CNN will be used in the classification of the brain tumor.

1.2 Problem Statement

A brain tumor is classified as a major disease that leads to the death of the human. However, there is less amount of doctor that knows the process of manual classification of the brain tumor. On the other hand, the diagnosis of brain tumor is a challenging task to doctors. There are some processes and tests for doctors to diagnose the brain tumor. The doctors can identify the problem and the cause of the problem. Doctors can determine which is the best way to treat the patient according to the results of the test.

The quantity of instances of neurological disease is expected to ascend in the following 10 years, making this the second driving reason for horribleness and mortality after heart disease in Malaysia. The absence of human resources in the neurological field as of now serving the Malaysian population may cause an inadequacy in particular care, particularly in rustic zones where neurological and neurosurgical care might need.

One of the tests that can identify the brain tumor is magnetic resonance imaging (MRI) which is the common imaging test used in hospitals. Classification of brain tumor requires the efficient knowledge of pathology and understanding the

intensity and shape of MRI image. The classification of brain tumor is challenging due to the images of brain tumors is vast disparity and contain extremely complex information such as the size, location, and intensities of brain tumors. Therefore, an automated computer system is needed to help doctors in diagnosis in order to prevent misdiagnosis and prioritize difficult patient diagnoses.

1.3 Objectives

The objectives of this thesis are:

1. To develop an automated system for classification of brain tumor from magnetic resonance imaging (MRI) using deep leaning.
2. To analyze the method of Convolutional Neural Networks which suitable for classification of brain tumors.
3. To verify the performances of classification using false acceptance rate (FAR), Equal Error Rate (EER), false rejection rate (FRR) and accuracy.

The objectives stated in this section are to provide the solution for the aforementioned issue. The purpose is to provide the solution in medical imaging process such as classification of the brain tumor using deep learning.

1.4 Scope of Work

This project is to design an automated computer system to classify brain tumors using deep learning. The type of software, sources of data samples, data sample sizes, type of medical image, method, performance measurement are shown in the table below:

Table 1.1: Scope of works

Software	Tensor flow
Method	Deep Learning Convolutional Neural Networks (CNN)
Type of Brain Tumor	Glioma
Type of Medical Images	Magnetic Resonance Imaging (MRI) (FLAIR)
Performance Measurement	False Acceptance Rate (FAR) False Rejection Rate (FRR) Equal Error Rate (EER) Accuracy
Sources of Data Samples	BRATS online database
Data Samples Sizes	7040 samples (240×240 pixels)

1.5 Brief Description of the Methodology

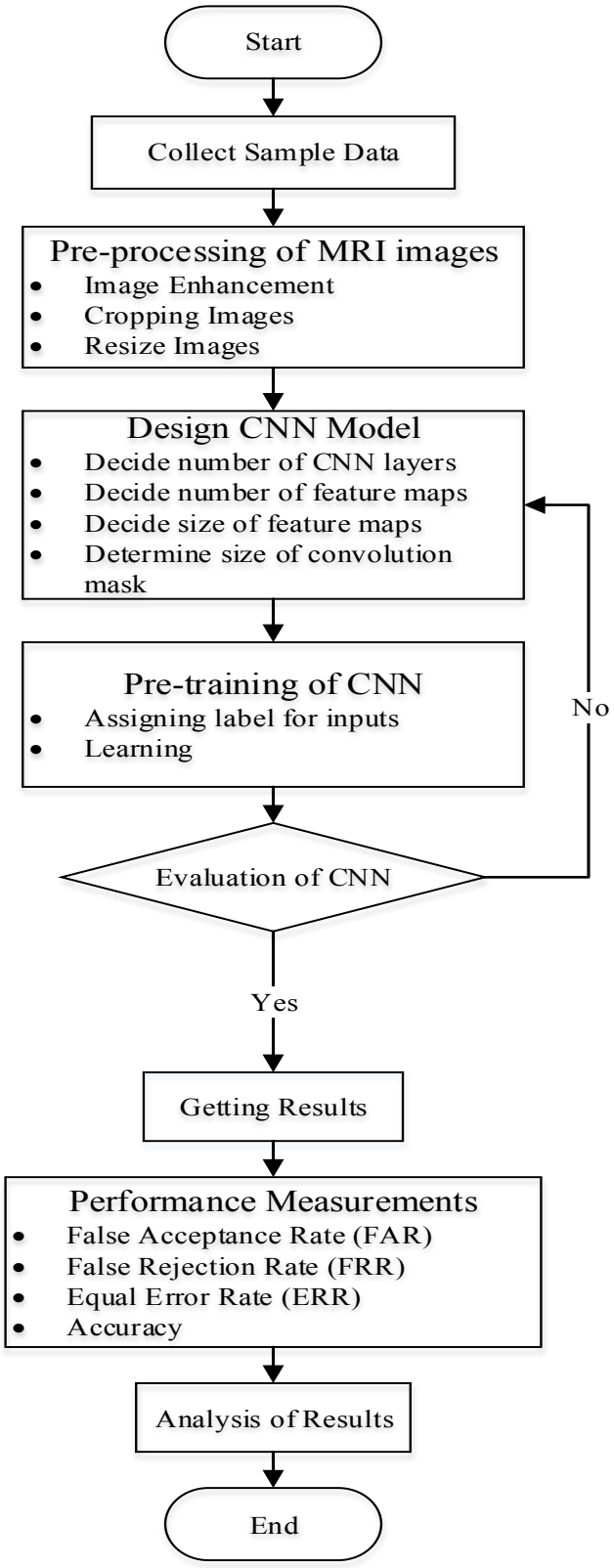

Figure 1.1: Flow Chart of the Methodology