Chapter One

Introduction

1.1 General View

In last decades, intelligent control systems faced increasing challenges to adopt new approach, designed to fit the changed in field of bio medical engineering.

Taking in consideration the importance of biomedical engineering development, it would be very necessary to do adopt our approach on the application of this area.

One of problems in medical life is setting the diagnosis. A lot of applications tried to help human exerts, offering a solution. This study describes how artificial neural networks can improve this domain.

1.2 Problem Statement

Brain tumor can be counted among the most deadly and intractable diseases. Tumors may be embedded in regions of the brain that are critical to orchestrating the body's vital functions, while they shed cells to invade other parts of the brain, forming more tumors too small to detect using conventional imaging techniques, Braintumor location and ability to spread quickly makes treatment with surgery or radiation like fighting an enemy hiding out among minefields and caves.

Conventional system in the area of brain tumordetection seem to be questionable because of its low quality using intelligent systems such as Artificial neural network (ANN) will solve the problems of images diagnostic been very fast and adequate.

Neural network has ability to recognize and model nonlinear relationships between data (image) in biologic system clustering of data and nonlinear relationships are more common than strict linear relationship [15]. Conventional statistical method can be used but they require complex and extensive mathematical modeling.

Neural networks provide a comparatively easier way to do the same type of analysis.

1.3Objective

The main objective of this study to design system used to diagnose brain tumor using artificial neural network, the present work implements an efficient system for the detection of brain tumor from a given brain MRI and recognizes the extracted data for further applications.Implemented project work finds efficient usage under biomedical early brain tumor detection. Work can be efficiently used in the area of medical science such as Computer aided diagnosis.

Proposed work will be very useful under medicines for predicting early brain tumordetections using texture features.

1.4 Methodology

In this study the main purpose is to design a system for brain tumor detection using artificial neural networks and to determine which type of neural networks is the best.

1-5 ThesisLayouts

This thesis consists of six chapters, Chapter one is an introduction. The literature Reviews are presented in chapter two. Chapter three shows the theoretical fundamental,the proposed system used in thisstudy described in Chapterfour. Chapter five described the results and discussion and chapter six show the conclusion and recommendations**.**

Chapter Two

Literature Reviews

Many studies were done and used artificial neural network for purpose of image analysis and recognition, which was introduced in the following:

Eltaher Mohamed Hussein, Dalia Mahmoud Adam Mahmoud, Biomedical [15].

In this study a functional models of Artificial Neural Networks (ANNs) is proposed to aid existing diagnosis methods. ANNs are currently a “hot” research area in medicine, particularly in the fields of radiology, cardiology, and oncology. In this paper an attempt was made to make use of ANNs in the medical field. Hence a Computer Aided Diagnosis (CAD) system using ANNs to classify brain tumors was developed in order to detect and classify the presence of brain tumors according to Magnetic Resonance (MR) Image, and then determined which type of ANNs and activation function for ANNs is the best for image recognition. Also the study aimed to introduce a practical application study for brain tumor diagnosis. Neural network must be able to determine the state of the brain according to MR image. In all procedures, image processing and ANNs design, MATLAB was incleded. From each MR Image a Harlick texture features was extracted to prepare training data which was introduced to neural network as input and target vectors. ANNs was designed using MATLAB tool "nntool". Results obtained explain Elman Network, with log sigmoid activation function, surpassing other ANNs with a performance ratio of 88.24%

ANN Approach Based On Back Propagation Network and Probabilistic Neural Network to Classify Brain Cancer ShwetaJainShubha Mishra [18].

This paper presents the artificial neural network approach namely Back propagation network (BPNs) and probabilistic neural network (PNN) it's used to classify the type of tumor in MRI images of different patients with Astrocytoma type of brain tumor. The image processing techniques have been developed for detection of the tumor in the MRI images. Gray Level Co-occurrence Matrix (GLCM) is used to achieve the feature extraction. The whole system worked in two modes firstly Training/Learning mode and secondly Testing/Recognition mode. Index Terms Brain Cancer, MRI, Gray Level Co-occurrence Matrix, Texture Features, Back Propagation Network and Probabilistic Neural Network.

Images Using Neuro Fuzzy Model Mr. Lalit P. Bhaiya Ms. Suchitagoswami Mr. VivekPali Associate professor [19].

It is difficult to identify the abnormalities in brain specially in case of Magnetic Resonance Image brain image processing. Artificial neural networks employed for brain image classification are being computationally heavy and also do not guarantee high accuracy. The major drawback of ANN is that it requires a large training set to achieve high accuracy. On the other hand fuzzy logic technique is more accurate but it fully depends on expert knowledge, which may not always available. Fuzzy logic technique needs less convergence time but it depends on trial and error method in selecting either the fuzzy membership functions or the fuzzy rules. These problems are overcome by the hybrid model namely, neurofuzzy model. This system removes essential requirements since it includes the advantages of both the ANN and the fuzzy logic systems. In this paper the classification of different brain images using Adaptive neurofuzzy inference systems (ANFIS technology) Experimental results illustrate promising results in terms of classification accuracy and convergence rate.

Shweta Jain / Brain Cancer Classification Using GLCM Based Feature Extraction in Artificial Neural Network Shweta Jain M.Tech (I.T.) LNCT Sem BHOPAL India [20].

Brain tumor is one of the major reasons of death among people. It is indication that the Chances of survival can be greater than before if the tumor is detected correctly at its early stage. This paper classifies the type of tumor using Artificial Neural Network (ANN) in MRI images of different patients with Astrocytoma type of brain tumor. The extraction of texture features in thedetected tumor has been achieved by using Gray Level Co-occurrence Matrix (GLCM). This paper gives a brief overview to Brain Cancer, MRI, Co-occurrence Matrix, Artificial Neural Network and Back Propagation Network.Index Terms Brain Cancer, MRI, Co-occurrence Matrix,Artificial Neural Network (ANN)and Back Propagation Network.

An Artificial Neural Network for Detection of Biological Early Brain Cancer Mrs.MamataS.Kalas, M.Tech (CST), Department Of IT, BharatiVidyapeeth's[21].

Human analysis on medical images is a difficult task due to very minute variations. Due to Co-resemblance between affected & original biological part & due to larger data set for analysis.This makes the biological analysis for prediction of affects. The problem goes more complicated under cancer predictions basically in brain cancer. It is a challenging task to develop an automated recognition system which could process on a large information of patient and provide a correct estimation. So we are going to develop an automated cancer recognition system for MRI images. We implement the neuro fuzzy logic for the classification and estimation of cancer effect on given MRI image. Keywords: Co-resemblance, MRI images, Neuro fuzzy logic, Biological analysis.

Robert M Haralick,KShanmugam, textural feature for image classification [22].

Texture is one of the important characteristics used in identifying objects or regions of interest in an image, whether the image is a photomicrograph, an aerial photograph or a sateDite image. This paper describes some easily computable textural features based on gray- tone spatial depeodancies, and illustrates their application in category- identification tasks of three different kinds of image data: photo- micrographs of five kinds of sandstones, 1:20 000 panchromatic aerial photographs of eight land-use categories, and Earth Resources Technology SateUite (ERTS) multi special imagery containing seven land-use categories. We use two kinds of decision rules: one for which the decision regions are convex polyhedra (a piecewise linear decision rule), and one For which the decision regions are rectangular paraUelpipeds (a min-max decision rule). In each experiment the data set was divided into two parts, a training set and a test set. Test set identification accuracy is 89 percent for the photomicrographs, 82 percent for the aerial photo, Graphic imagery and 83 percent for the satellite imagery. These results indicate that the easily computable textural features probably have a general applicability for a wide variety of image-classification applications.

Chapter Three

Theoretical Background

3.1 Artificial Neural Network

3.1.1 Introduction

Ever since eternity, one thing that has made human beings stand apart from the rest of the animal kingdom is, its brain .The most intelligent device on earth, the "Human brain" is the driving force that has given us the ever-progressive species diving into technology and development as each day progresses.

Due to his inquisitive nature, man tried to make machines that could do intelligent job processing, and take decisions according to instructions fed to it. What resulted was the machine that revolutionized the whole world, the "Computer" (more technically speaking the Von Neumann Computer). Even though it could perform millions of calculations every second, display incredible graphics and 3-dimentional animations, play audio and video but it made the same mistake every time.Practice could not make it perfect. So the quest for making more intelligent device continued. These researches lead to birth of more powerful processors with high-tech equipment's attached to it, super computers with capabilities to handle more than one task at a time and finally networks with resources sharing facilities. But still the problem of designing machines with intelligent self-learning, loomed large in front of mankind. Then the idea of initiating human brain stuck the designers who started their researches one of the technologies that will change the way computer work Artificial Neural Networks. [5]

In general, Neural Networks are simply mathematical techniques designed to accomplish a variety of tasks. Neural Networks uses a set of processing elements (or nodes) loosely analogues to neurons in the brain (hence the same, neural

networks). These nodes are interconnected in a network that can then identify patterns in data as it is exposed to the data. In a sense, the network learns from the experience just as people do. Neural networks can be configured in various arrangements to perform a range of tasks including pattern recognition, data mining, classification, and process modeling. [6]

3.1.2 Neurons

The conceptual constructs of a neural network stemmed from our early understanding of the human brain. The brain is comprised of billion and billions of interconnected neurons. The fundamental building blocks of this massively parallel cellular structure are really quite simply when studied in isolation. A neuron receives incoming electrochemical signals from its dendrites and collects these signals at the neuron nucleus. The neuron nucleus has a internal threshold that determines if neuron itself tires in response to the incoming information. If the combined incoming signals exceeds this threshold then neuron fires and an electrochemical signal is sent to all neurons connected to the firing neuron on its output connections or axons. Otherwise the incoming signals are ignored and the neuron remains dormant.

There are many types of neurons or cells. From a neuron body (soma) many fine branching fibers, called dendrites, protrude. The dendrites conduct signals to the soma or cell body. Extending from a neuron's soma, at a point called axon hillock (initial segment), is a long giber called an axon, which generally splits into the smaller branches of axonal arborization. The tips of these axon branches impinge either upon the dendrites, somas or axons other neurons or upon effectors. [7]

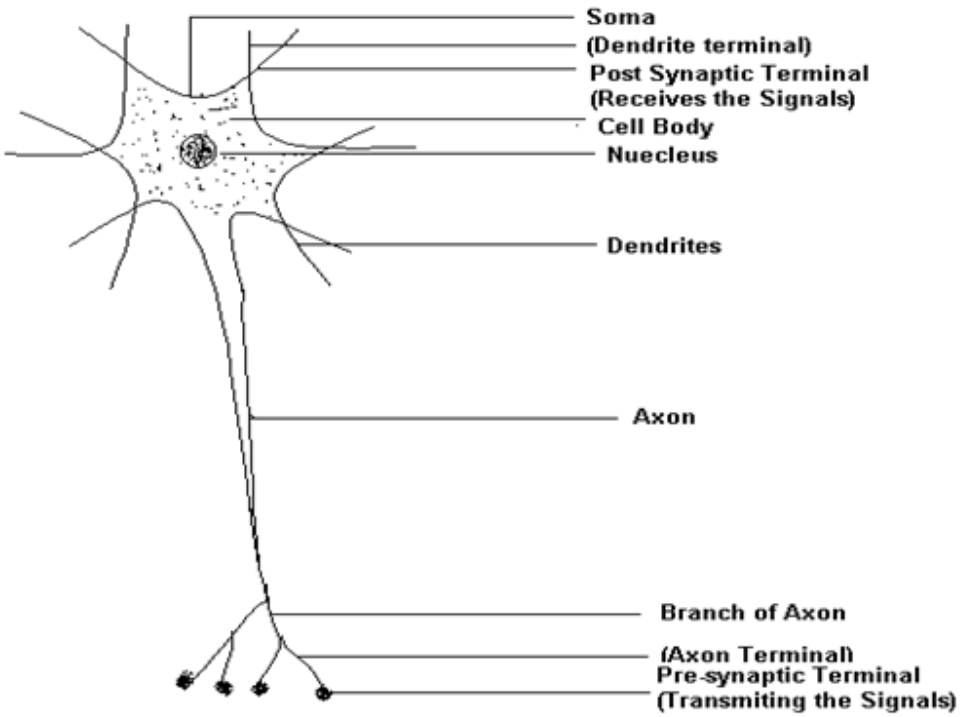


Figure (3.1-2):Showsa Biological Neuron [7]

3.1.3 Basics of Artificial Neural Models

The human brain is made up of computing elements, called neurons, coupled with sensory receptors (affecters) and effectors. The average human brain, roughly three pounds in weight and 90 cubic inches in volume, is estimated to contain about 100 billion cells of various types. A neuron is a special cell that conducts and electrical signal, and there are about 10 billion neurons in the human brain. The remaining 90 billion cells are called glial or glue cells, and these serve as support cells for the neurons. Each neuron is about one-hundredth size of the period at the end of this sentence. Neurons interact through contacts called synapses. Each synapse spans a gap about a millionth of an inch wide. On the average each neuron receives signals via thousands of synapses.

The motivation for artificial neural network (ANN) researches is the belief that a human's capabilities, particularly in real-time visual perception, speech understanding, and sensory information processing and in adaptively as well as intelligent decision making in general, come from the organizational and computational principles exhibited in the highly complex neural network of the human brain. Expectations of faster and better solution provide us with the challenge to build machines using the same computational and organizational principles, simplified and abstracted from neurobiological of the brain. [8]

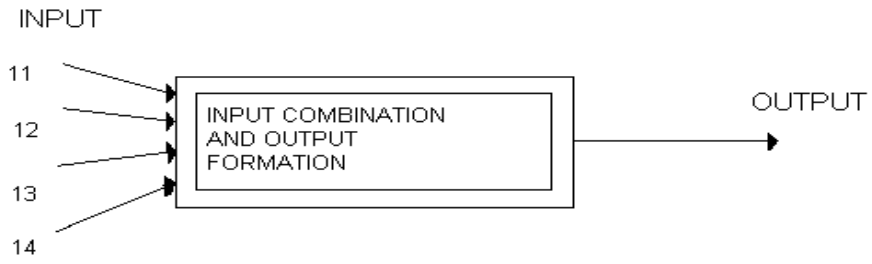


Figure (3.1-3): Shows anArtificial Neural Network Model [8]

3.1.4 Artificial Neural Network

Artificial neural network (ANNs), also called parallel distributed processing systems (PDPs) and connectionist systems, are intended for modeling the organization principles of the central neurons system, with the hope that the biologically inspired computing capabilities of the ANN will allow the cognitive and logically inspired computing capabilities of the ANN will allow the cognitive and sensory tasks to be performed more easily and more satisfactory than with conventional serial processors. Because of the limitation of serial computers, much effort has devoted to the development of the parallel processing architecture; the function of single processor is at a level comparable to that of a neuron.

ANN structures, broadly classified as recurrent (involving feedback) or non-recurrent (without feedback), have numerous processing elements (also dubbed neurons, neuroses, units or cells) and connections (forward and backward interlayer connections between neurons in different layers, forward and backward interlayer connections or lateral connections between neurons in the same layer, and self-connections between the input and output layer of the same neuron. Neural networks may not have differing structures or topology but are also distinguished from one another by the way they learn, the manner in which computations are performed (rule-based, fuzzy, even nonalorithmic), and the component characteristic of the neurons or the input/output description of the synaptic dynamics). These networks are required to perform significant processing tasks through collective local interaction that produces global properties.

Since the components and connections and their packaging under stringent spatial constraints make the system large-scale, the role of graph theory, algorithm, and neuroscience is pervasive. [7]

3.1.5 Perceptron:

At the heart of every Neural Network is what is referred to as the perceptron (sometimes called processing element or neural node) which is analogous to the neuron nucleus in the brain. The second layer that is very first hidden layer is known as perceptron. As was the case in the brain the operation of the perceptron is very simple; however also as is the case in the brain, when all connected neurons operate as a collective they can provide some very powerful learning capacity.

Input signals are applied to the node via input connection (dendrites in the case of the brain.) The connections have “strength” which changes as the system learns. In neural networks the strength of the connections are referred to as weights. Weights can either excite or inhibited the transmission of the incoming signal.

Mathematically incoming signals values are multiplied by the value of those particular weights.

At the perceptron all weighted input are summed. This sum value is than passed to a scaling function. The selection of scaling function is part of the neural network design. [9]

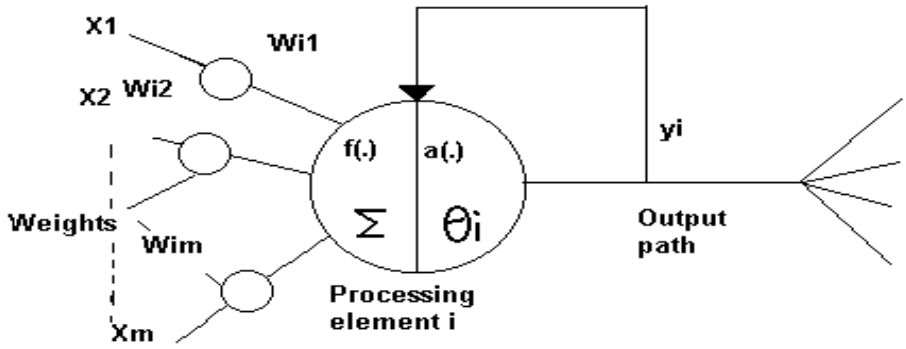


Figure (3.1-4):Shows the Perceptron [5]

3.1.6 Basic Structure of artificial neural network

3.1.6.1 Input layer:

The bottom layer is known as input neuron network in this case x1 to x5 are output neurons input layer neurons.

3.1.6.2 Hidden layer:

The in-between input and output layer the layers are known as hidden layers where the knowledge of past experience.

3.1.6.3 Output Layer:

The top most layer which give the final output. In this case z1 and z2 are [9]

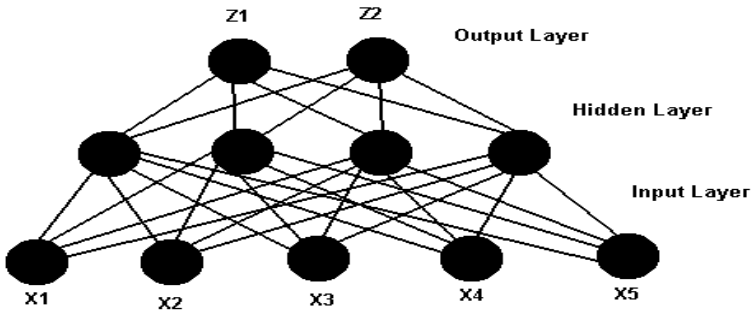


Figure (3.1-5):Shows the Basic structure of Artificial Neural Network [9]

3.1.7 Network Architectures

1) Single Layer Feed Forward Networks:

In this layered neural network the neurons are organized in the form of layers.In this simplest form of a layered network, we have an input layer of source nodes those projects on to an output layer of neurons, but not vise-versa. In other words, this network is strictly a feed forward or acyclic type [5]. It is as shown in figure:

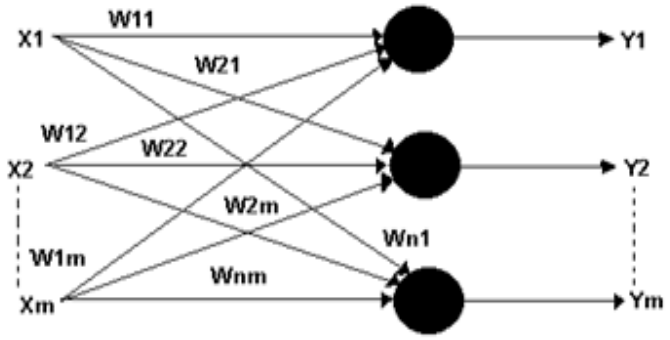


Figure (3.1-6): Shows a Single –layer feed forward Network [6]

Such a network is called single layered network, with designation "single later" referring to the o/p layer of neurons.

2) Multilayers Feed Forward Networks:

The second class of the feed forward neural network distinguishes itself by one or more hidden layers, whose computation nodes are correspondingly called neurons

or units. The function of hidden neurons is intervene between the external i/p and the network o/p in some useful manner. The ability of hidden neurons is to extract higher order statistics is particularly valuable when the size of i/p layer is large.

The i /p vectors are feed forward to 1st hidden layer and this pass to 2nd hidden layer and so on until the last layer i.e. output layer, which give actual network response [5].

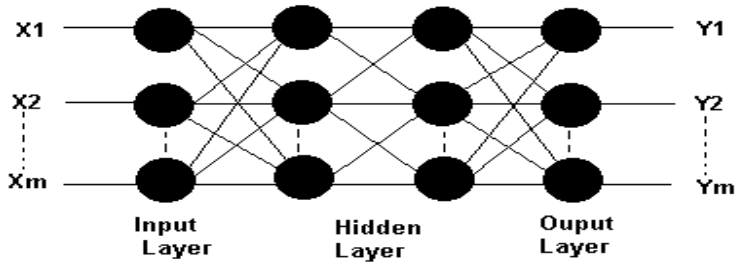


Figure (3.1-7):Shows A Multilayer feed forward network [5]

3) Recurrent networks:

A recurrent network distinguishes itself from feed forward neural network, in that it has least one feed forward loop. As shown in figures output of the neurons is fed back into its own inputs is referred as self-feedback

A recurrent network may consist of a single layer of neurons with each neuron feeding its output signal back to the inputs of all the other neurons. Network may have hidden layers or not.

Figure (3.1-8):Shows a Single Node with Feedback to it self [5]

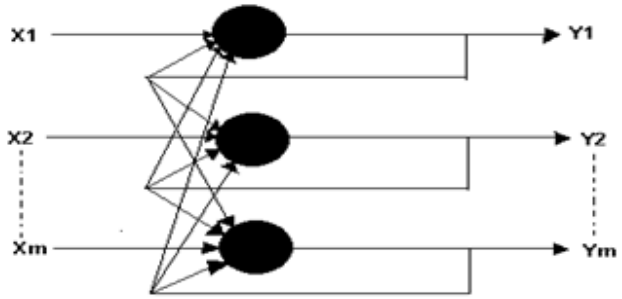


Figure (3.1-9): Shows Multilayer Recurrent Network [5]

3.1.8 Training of ANN

3.1.8.1 Supervised training

- Supplies the neural network with the input and desired output.

- Response of the network is measured.

3.1.8.2 Unsupervised Training

- Only supplies input without desired output.

- The neural network adjusts its own weighs so that similar input causes similar output [7].

3.1.9 Advantages of Neural Networks

- Networks start processing the data without any preconceived hypothesis. They start random with weight assignment to various input variables. Adjustments are made based on the difference between predicted and actual output. This allows for unbiased and batter understanding of data.
- Neural networks can be retained using additional input variables and number of individuals. Once trained they can be called on to predict in a new patient.
- There are several neural network models available to choose from in a particular problem.

- Once trained, they are very fast.
- Due to increased accuracy, results in cost saving.
- Neural networks are able to represent any functions. Therefore they are called '**Universal Approximates**'.
- Neural networks are able to learn representative examples by back propagating errors.

3.1.10 Application of Artificial Neural Network

1- Classification

Pattern recognition, feature extraction, image matching.

2- Noise reduction

Recognize pattern in the input and produce noiseless outputs.

3- Prediction

Extrapolation based on historical data. [10]

3.2The Human brain

3.2.1Overview

Nothing in the world can compare with the human brain. This mysterious three pound organ controls all necessary functions of the body, receives and interprets information from the outside world, and embodies the essence of the mind and soul. Intelligence, creativity, emotion, and memories are a few of the many things governed by the brain. The brain receives information through our five senses: sight, smell, touch, taste, and hearing often many at one time. It assembles the messages in a way that has meaning for us, and can store that information in our memory. The brain controls our thoughts, memory and speech, movement of the

arms and legs, and the function of many organs within our body. It also determines how we respond to stressful situations (such as taking a test, losing a job, or suffering an illness) by regulating our heart and breathing rate

3.2.2Nervous system

The nervous system is divided into central and peripheral systems. The central nervous system (CNS) is composed of the brain and spinal cord. The peripheral nervous system (PNS) is composed of spinal nerves that branch from the spinal cord and cranial nerves that branch from the brain. The PNS includes the autonomic nervous system, which controls vital functions such as breathing, digestion, heart rate, and secretion of hormones.

3.2.3The Skull

The purpose of the bony skull is to protect the brain from injury. The skull is formed from 8 bones that fuse together along suture lines. These bones include the frontal, parietal temporal, sphenoid, occipital and ethmoid[16] .The face is formed from 14 paired bones including the maxilla, zygoma, nasal, palatine, lacrimal, inferior nasal conchae, mandible, and vomer.Inside the skull are three distinct areas: anterior fossa, middle fossa, and posterior fossa (Doctors sometimes refer to a tumor's location by these terms, e.g., middle fossa meningioma.Similar to cables coming out the back of a computer, all the arteries, veins and nerves exit the base of the skull through holes, called foramina. The big hole in the middle (foramen magnum) is where the spinal cord exits.

3.2.4 Brain anatomy

The brain is composed of the cerebrum, cerebellum, and brainstem.

•The cerebrumis the largest part of the brain and is composed of right and left hemispheres. It performs higher functions like interpreting touch, vision and

hearing, as well as speech, reasoning, emotions, learning, and fine control of movement.

•The cerebellumis located under the cerebrum. Its function is to coordinate muscle movements, maintain posture, and balance.

•The brainstemincludes the midbrain, pons, and medulla. Itacts as a relay center connecting the cerebrum and cerebellum to the spinal cord. It performs many automatic functions such as breathing, heart rate, body temperature, wake and sleep cycles, digestion, sneezing, coughing, vomiting, and swallowing. Ten of the twelve cranial nerves originate in the brainstem.The surface of the cerebrum has a folded appearance called the cortex. The cortex contains about 70% of the 100 billion nerve cells. The nerve cell bodies color the cortex grey brown giving it its name gray matter beneath the cortex are long connecting fibers between neurons, called axons, which make up the white matter [16].

The folding of the cortex increases the brain's surface area allowing more neurons to fit inside the skull and enabling higher functions. Each fold is called a gyrus, and each groove between folds is called a sulcus. There are names for the folds and grooves that help define specific brain regions.

Right brain -left brain

The right and left hemispheres of the brain are joined by a bundle of fibers called the corpus callosum that delivers messages from one side to the other. Each hemisphere controls the opposite side of the body. If a brain tumor is located on the right side of the brain, your left arm or leg may be weak or paralyzed. Not all functions of the hemispheres are shared. In general, the left hemisphere controls speech, comprehension, arithmetic, and writing. The right hemisphere controls creativity, spatial ability, artistic, and musical skills. The left hemisphere is dominant in hand use and language in about 92% of people [16].

3.2.5Lobes ofBrain

The cerebral hemispheres have distinct fissures, which divide the brain into lobes. Each hemisphere has 4 lobes: frontal, temporal, parietal, and occipital each lobe may be divided, once again, into areas that serve very specific functions. It's important to understand that each lobe of the brain does not function alone. There are very complex relationships between the lobes of the brain and between the right and left hemispheres.> 3Messages within the brain are carried along pathways. Messages can travel from one gyrus to another, from one lobe to another, from one side of the brain to the other, and to structures found deep in the brain (e.g. thalamus, hypothalamus).

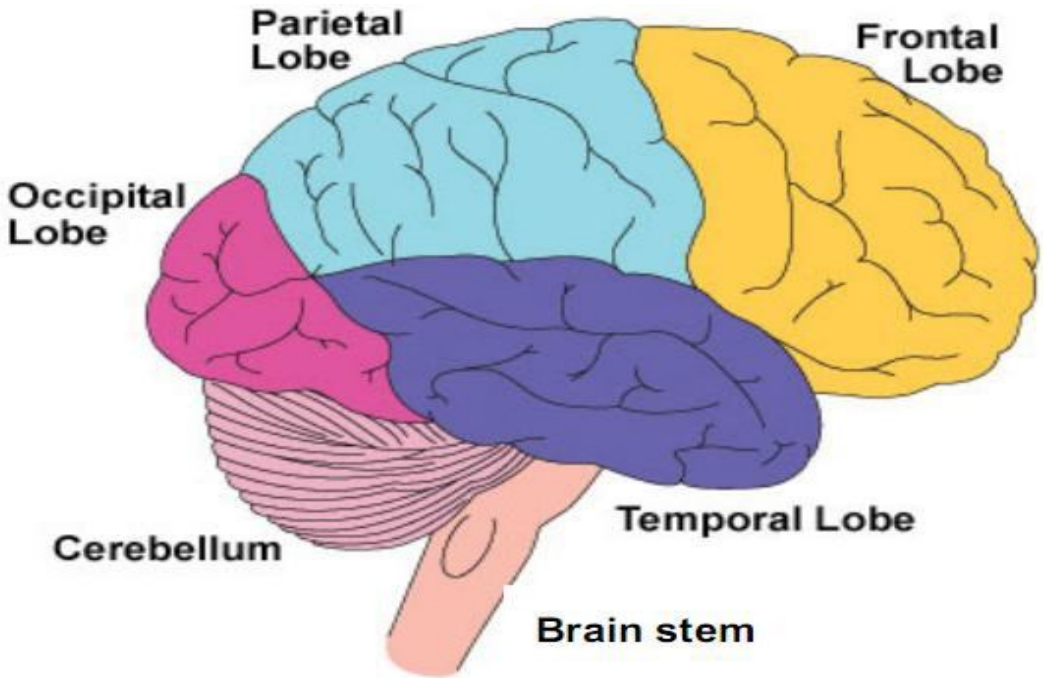


Figure (3.9):thehumanbrainlobes, [16]

1-Deep Structures:

Hypothalamus-is located in the floor of the third ventricle and is the master control of the autonomic system. It plays a role in controlling behaviors such as hunger, thirst, sleep, and sexual response. It also regulates body temperature, blood pressure, emotions, and secretion of hormones.

Pituitary gland-lies in a small pocket of bone at the skull base called the sellaturcica. The pituitary gland is connected to the hypothalamus of the brain by the pituitary stalk. Known as the "master gland," it controls other endocrine glands in the body. It secretes hormones that control sexual development, promote bone and muscle growth, respond to stress, and fight diseases.

2-Pineal Gland:

-is located behind the third ventricle. It helps regulate the body's internal clock and circadian rhythms by secreting melatonin. It has some role in sexual development.

Thalamus -serves as a relay station for almost all information that comes and goes to the cortex it plays a role in pain sensation, attention, alertness and memory.

3-Basal Ganglia:

-includes the caudate, putamen and globuspallidus. These nuclei work with the cerebellum to coordinate fine motions, such as fingertip movements

4-Limbic System:

-is the center of our emotions, learning, and memory. Included in this system are the cingulate gyri, hypothalamus, amygdala (emotional reactions) and hippocampus (memory).

5-Cranial Nerve:

The brain communicates with the body through the spinal cord and twelve pairs of cranial nerves ten of the twelve pairs of cranial nerves that control hearing, eye movement, facial sensations, taste, swallowing and movement of the face, neck, shoulder and tongue muscles originate in the brainstem. The cranial nerves for smell and vision originate in the cerebrum.

6-Meninges:

The brain and spinal cord are covered and protected by three layers of tissue called meninges. From the outermost layer inward they are:

The dura mater, arachnoidmater, and piamater.Thedura mater is a strong, thick membrane that closely lines the inside of the skull; its two layers, the periosteal and meningeal dura, arefused and separate only to form venous sinuses. The dura creates little folds or compartments. There are two special dural folds, the falx and the tentorium. The falx separates the right and left hemispheres of the brain and the tentorium separates the cerebrum from the cerebellum. The arachnoid mater is a thin, web-like membrane that covers the entire brain. Thearachnoid is made of elastic tissue.The space between the dura and arachnoid membranes is called the subdural

space.Thepiamaterhugsthesurfaceofbrainfollowingitsfoldsandgrooves.Thepiamater hasmanybloodvesselsthatreachdeepintothebrain.subarachnoid space. It is here where the cerebrospinal fluid bathes and cushions the brain.

3.2.6Ventricles andCerebrospinal Fluid

The brain has hollow fluidfilled cavities called ventricles inside the ventricles is a ribbon-like structure called the choroid plexus that makes clear colorless cerebrospinal fluid (CSF). CSF flows within and around the brain and spinal cord to help cushion it from injury. This circulating fluid is constantly being absorbed and replenished.There are two ventricles deep within the cerebral hemispheres called the lateral ventricles. They both connect with the third ventricle through a separate opening called the foramen of Monro. The third ventricle connects with the fourth ventricle through a long narrow tube called the aqueduct of Sylvius. From the fourth ventricle, CSF flows into the subarachnoid space where it bathes and cushionsthe brain. CSF is recycled (or absorbed) by special structures in the superior sagittal sinus called arachnoid villi.A balance is maintained between the amount ofCSF that is absorbed and the amount that isproduced. A disruption or blockage in the system can cause a buildup of CSF, which can cause enlargement

of the ventricles (hydrocephalus) or cause a collection of fluid in the spinal cord (syringomyelia).

3.2.7Blood Supply

Blood is carried to the brain by two paired arteries, the internal carotid arteries and the vertebral arteries the internal carotid arteries supply most of the cerebrum. The vertebral arteries supply the cerebellum, brainstem, and the underside of the cerebrum.

After passing through the skull, the right and left vertebral arteries join together to form the basilar artery.The basilar artery and the internal carotid arteries "communicate" with each other at the base of the brain called the Circle of Willis the communication between the internal carotid and vertebral-basilar systems is an important safety feature of the brain. If one of the major vessels becomes blocked, it is possible for collateral blood flow to come across the Circle of Willis and prevent brain damage The venous circulation of the brain is very different than the rest of the body. Usually arteriesand veins run together as they supply and drain specific areas of the body. So one would think there would be a pair of vertebral veins and internal carotid veins. However, this is not the case. The major vein collectors are integrated into the dura to form venous sinuses -not to be confused with the air sinuses in the face and nasal region. The venous sinuses collect the blood from the brain and pass it to the internal jugular veins. The superior and inferior sagittal sinuses drain the cerebrum, the cavernous sinuses drains the anterior skull base. All sinuseseventually drain to the sigmoid sinuses which exit the skull as the jugular veins.The two jugular veins are the only drainage of the brain

3.2.8Language

In general, the left hemisphere of the brain is responsible for language and speech and is called the "dominant" hemisphere. The right hemisphere plays a large part in interpreting visual information and spatial processing. In about one third of individuals who are left-handed, speech function may be located on the right side of the brain. Left-handed individuals may need special testing to determine if their speech center is on the left or right side prior to any surgery in that area. Aphasia is a disturbance of language affecting production, comprehension, reading or writing, due to brain injury –most commonly from stroke or trauma. The type of aphasia depends on the brain area affected.

Broca's area lies in the left frontal lobe If this area is damaged, one may have difficulty moving the tongue or facial muscles to produce the sounds of speech. The individual can still read and understand spoken language but has difficulty in speaking and writing (i.e. forming letters and words, doesn't write within lines) – called Broca's aphasia.

Wernicke's area lies in the left temporal lobe Damage to this area causes Wernicke's aphasia. The individual may speak in long sentences that have no meaning, add unnecessary words, and even create new words. They can make speech sounds, however they have difficulty understanding speech and are therefore unaware of their mistakes.

3.2.9Memory

Memory is a complex process that includes three phases: encoding (deciding what information is important), storing, and recalling. Different areas of the brain are involved in memory depending on the type of memory.Short-term memory, also called working memory, occurs in the prefrontal cortex. It stores information for about one minute and its capacity is limited to about 7 items.

For example, it enables you to dial a phone number someone just told you. It also intervenesduring reading, to memorize the sentence you have just read, so that the next one makes senseLong-term memory is processed in the hippocampus of the temporal lobe and is activated when you want to memorize something for a longer time.

This memory hasUnlimited content and duration capacity it contains personal memories as well as facts and figures.Skill memory is processed in the cerebellum, which relays information to the basal ganglia. It stores automatic learned memories like tying a shoe, playing an instrument, or riding a bike.

3.2.10Cells oftheBrain

The brain is made up of two types of cells:

1-nerve cells (neurons)

2-glia cells.

3.2.10.1Nerve Cells

There are many sizes and shapes of neurons, but all consist of a cell body, dendrites and an axon. The neuron conveys information through electrical and chemical signals. Try to picture electrical wiring in your home. An electrical circuit is made up of numerous wires connected in such a way that when a light switch is turned on, a light bulb will beam. A neuronthat is excited will transmit its energy to neurons within its vicinity Neurons transmit their energy, or “talk”, to each other across a tiny gap called a synapse A neuron has many arms called dendrites, which act like antennae picking up messages from other nerve cells. These messages are passed to the cell body, which determines if the message should be passed along. Important messages are passed to the end of the axon where sacs containing neurotransmitters open into the synapse. The receiving nerve cell, which stimulates that cell to pass on the message.

3.2.10.2 Glia Cells

Glia (Greek word meaning glue) is the cells of the brain that provide neurons with nourishment, protection, and structural support. There are about 10 to 50times more glia than nerve cells and are the most common type of cells involved in brain tumors.,Astroglia or astrocytes transport nutrients to neurons, hold neurons in place, digest parts of dead neurons, and regulate the blood brain barrier. Oligodendroglia cells provide insulation (myelin) to neurons; Ependymal cells line the ventricles and secrete cerebrospinal fluid (CSF).Microglia digest dead neurons and pathogens.

3.2.11Brain Diseases

When the brain is healthy it functions quickly and automatically. However, when a problem occurs,the results can be devastating some of the major types of disorders include:

1-Neurogenetic diseases e.g. Huntington's disease and muscular dystrophy;

2-Developmental disorders, e.g. cerebral palsy;

3-Degenerative diseases of adult life e.g.oakinson's disease and Alzheimer's disease;

4-Metabolic diseases, e.g. Guacher'sdisease;

5-Cerebrovascular diseases e.g. stroke and vascular dementia ;

6- Trauma e.g. spinal cord and head injury;

7- Convulsive disorders e.g. epilepsy;

8- Infection diseases e.g. AIDS dementia; and

9- Brain tumors

3.2.12Brain Tumor

A brain tumor is an abnormal growth of tissue in the brain or central spine that can disrupt proper brain function. Doctors refer to a tumor based on where the tumor cells originated, and whether they are cancerous (malignant) or not (benign).

Benign: The least aggressive type of brain tumor is often called a benign brain tumor. They originate from cells within or surrounding the brain, do not contain cancer cells, grow slowly, and typically have clear borders that do not spread into other tissue.

Malignant: Malignant brain tumors contain cancer cells and often do not have clear borders. They are considered to be life threatening because they grow rapidly and invade surrounding brain tissue.

Primary: Tumors that start in cells of the brain are called primary brain tumors. Primary brain tumors may spread to other parts of the brain or to the spine, but rarely to other organs.

Metastatic: Metastatic or secondary brain tumors begin in another part of the body and then spread to the brain. These tumors are more common than primary brain tumors and are named by the location in which they begin.

There are over 120 types of brain and central nervous system tumors. Brain and spinal cord tumors are different for everyone. They form in different areas, develop from different cell types, and may have different treatment options.

3.2.12.1Types of brain tumors

We can divide brain tumors according to the place of creation to primary and secondary tumors.

Primary tumors are tumors begin there creation inside the brain.

Secondary tumors are tumors which begin in other part of human body and then traveled to the brain like lung cancer and breast cancer.

Primary brain tumors have special property which they can't move outside brain.

Also we can divide brain tumors based on what cells are affected and how they appear under a microscope. Tumors can be classified into four general categories:

1-Gliomas:These tumors occur in the glial cells, which help support and protect critical areas of the brain. Gliomas are the most common type of brain tumor in adults, responsible for about 42% of all adult brain tumors. Gliomas are further characterized by the types of cells they affect:

1) Astrocytoma and the astrocytoma's graded from I to IV depending on the speed of progression.

Grade I(pilocytic astrocytoma)

Grade II(diffuse astrocytoma)

Grade III(anaplastic/malignant astrocytoma)

Grade IV(glioblastomamultiforme,GBM)

2)Oligodendroglioma

3)Ependymoma

2-Meningiomas:These tumors affect the meninges, the tissue that forms the protective outer covering of the brain and spine.

3-Schwannomas:

Shwann's cells are found in the sheath that covers nerve cells.

4-Medullaoblastoma:Medullaoblastoma is a common brain tumor in children, usually diagnosed before the age of 10.these tumor occurs in the cerebellum, which has a crucial role in coordinating muscular movement.

3.2.12.2Symptoms and Diagnosis

Brain tumor symptoms can vary according to tumor type and location. There are times a person may have no symptoms when their brain tumor is discovered

1-Recurrent headaches

2-Issues with vision

3-Seizures

4-Changes in personality

5-Short-term memory loss

6-Poor coordination

Difficulty speaking or comprehending

Whatever symptoms you have, discuss them fully with your physician so everyone has the most accurate information. Diagnosing a brain tumor can be a complicated process and involve a number of specialists, depending on where you live or where you seek medical attention. A brain scan, most often an MRI, is the first step.

A biopsy may be necessary, so a pathologist can be brought in to help identify the brain tumor type also people with tumors or potential are image for detection classification , staging, and comparison , detection can be subdivided into diagnosis , case finding and screening depending on the level of suspicion . People are usually referred for diagnosis because they have signs and symptoms suggestive of cancer. Case finding occurs when a test is performed to find a disease before it becomes clinically evident and thus easier to treat and cure. A physician may order or perform a diagnostic test in a person who does not have definite symptomless to sure that the person is healthy. Case finding should not be confused with population screening which involves examining a predefined population for one specific disease without performing any other diagnostic examinations such a population typically will have a low prevalence of cancer.

Classification ideally consists of making a tissue diagnosis or at least making a determination of whether the tumor is a manifestation of a benign or malignant disease. Benign disease can include both benign tumors nonneoplastic pathological condition such as granulomas or hyperplastic cysts. The diagnostic is obligated to

classify every suspicious region in an image if there is uncertainty about the classification, additional diagnostic procedure are done these generally start with less invasive imaging procedure and proceed to minimally invasive procedure such as endoscopy and arteriography. When minimally invasive procedures are exhausted, needle biopsy or surgical excision can provide a definitive diagnosis.

Staging is performed to determine the extent of the disease both local and distant. An assessment of local involvement is useful before an excisional surgical procedure to be sure that the entire tumor is included in the resection, staging is important for the selection pa an appropriate treatment regimen and for estimating prognosis. This information is used to assign a stage to the disease. A general definition of the cancer stages is shown in table 4.1. The stage together with an assessment of the degree of differentiation is very important for treatment planning and for determining cancer prognosis. Most statistics about the outcome of cancer treatment are stratified.

Table (3.10) show the stage of diagnosis

stage	**meaning**
0	Atypically cells in normal anatomical configuration
1	Tumor limited to the local anatomical site
2	Involvement of ipsilateral regional lymph nodes
3	Involvement of contra lateral lymph nodes
4	Involvement of distant site

Brain tumors have long been difficult to treat because they occur at the control center for thought emotion and physical function neurosurgeons must be careful not damage healthy brain tissue.

Brain tumor is un normal an arrangable mitosis in brain cells which may cause in pressured another parts in brain and so losses or weakness for one senses or more, unfortunately there are not sure information about what case brain tumor, so no prevention can be made to avoid it.

According to the stage of the disease at the start of treatment Staging usually involve obtaining images or biopsy specimens of regions of the body that are known to have high probability of harboring metastatic tumor.

Comparison imaging is performed after treatment to determine the effect of treatment and check for tumor recurrence. The diagnostic problem frequently involves discriminating between changes caused by the treatment and changes caused by recurrent tumor.

3.3Magnetic Resonance Techniques

3.3.1 Imaging Modality

imaging modalities can be divided into those that show body anatomy and those that show metabolic activity or function, anatomical imaging modalities such as X-ray imaging, ultrasonography, and MRI apply energy to the body and then map the intensity of the interaction of the energy with the body for example, X-rays that enter the body can be scattered, absorbed or directly transmitted. The image shows the description of transmitted and scattered X-rays and by interference the description of absorbing and a scattering material in the body.

Ultrasonography sends a beam of sound into the body and records the returning echoes, the echo images shoe the location of reflecting surfaces in the body, proton MRI images are more complicated, because they show the distribution of a weighed combination of the density of water protons and two water proton relaxation times called T1 and T2 varying the weighting factors at the time of image acquisition can produce a great variety of images. Functional imaging

modalities such as radionuclide imaging and magnetic resonance spectroscopy (MRS) show the distribution of metabolic activity in the body.

3.3.2 Optimal processing of brain MRI

The ultimate goal of medical image analysis in general and brain magnetic resonance imaging (MRI) analysis in particular, is to extract important clinical information that would improve diagnosis and treatment of disease. In the past few years, MRI has drawn considerable attention for its possible role in tissue characterization. The image gray level in MRI depend on several tissue parameters, including proton density (PD); spin-lattice (T1) and spin-spin (T2) relaxation times; flow velocity (v); and chemical shift. a sequence of MRI images of the same anatomical site (an MRI scene sequence) contains information pertaining to the tissue parameters. This implicit information is used for image analysis.

In brain tumors studies existence of abnormal tissue is easily detectable most of the time. However, accurate and reproducible segmentation and characterization of abnormalities are not straightforward for instance a major problem in tumor treatment planning and evaluation is determination of the tumor extent. Clinically, T2-weighted and gadolinium (Gd)-enhanced T1-weighted MRI have been used to indicate regions of tumor growth and infiltration. Conventionally, simple thresholding or region growing techniques have been used on each image individually to segment the tissue or volume of interest for diagnosis, treatmentplanning, and follow up of the patients. These methods are unable to exploit all the information provided by MRI. Advanced image analysis techniques have been and still are developed to optimally use MRI data and solve the problems associated the previous techniques.

Image analysis is performed by comparative and composite analysis of three-dimensional (3-D) brain MRI data the aim of comparative analysis is to measure changes in the normal and tumorous tissue over time.

The aim of composite analysis is to combine complementary information about the brain tissues from multiple MRI protocols to perform tissue segmentation and characterization.

A given cerebral tumor may be composed of confluent areas of coagulation necrosis compact areas of anaplastic cells, and areas of adjacent brain parenchyma infiltrated by tumor cell. This tumor may then be surrounded by reactive astrocytes and a rim of edema. Without considering all of the information obtained from different MRI protocol, segmentation and characterization of the tumor compartment are not feasible.

Chapter Four

The Proposed System

4.1Overview:

One of the major problems in artificial neural networks design is good design for network, because good design and then good learning for ANN leads to get best result in performance.

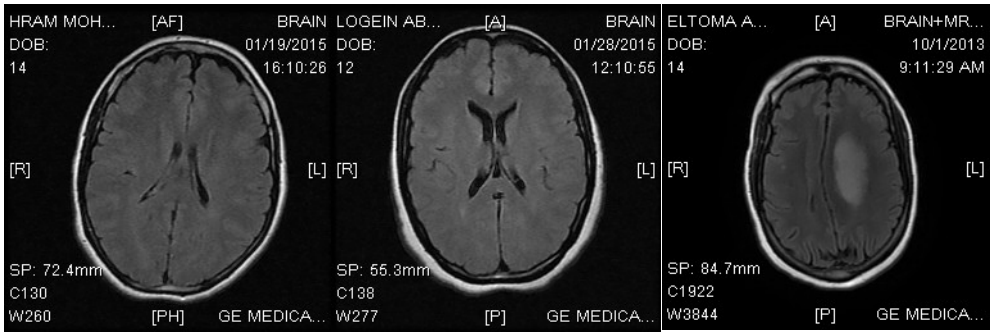
Network design means choosing network type which is most suitable for application, and the choose appropriate network architecture, this involve:Number of hidden layers between input and output layer, number of neurons in each layer and type of transfer function (output activation function) between each layer and the next one. This thesis used the previous studies which explain design methodology according to trial and error record.

4.2Data Set

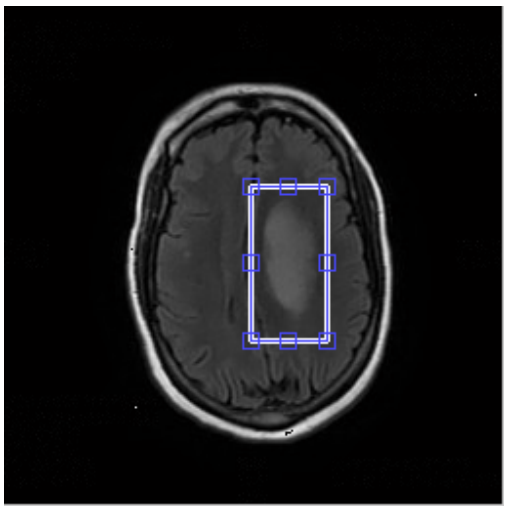
The database used for brain cancer using artificial neural network is collected from many center of diagnostic imaging and hospital. The database has been collected from many patients divided to normal and abnormal, thesis data of image is used for this proposed system.

4.3Selecting ROI

The images collected in this study was diagnosedandreportedbytheradiologistconsultantatModern Medical Center and Antalya Medical Center,thensequences T2 Flair axial was selectedfor. The region of interest was the area which had abnormalities in the image,these images have attributes, and the attributes related with brain cancer indicationand after selection the attributes the second step is image processing for the image was selected with attributes.



Figure(4.1) before selecting the ROI show differnet abnormilities brain at T2 images selecting .



Figure(4.2)selecting the ROI after processing

4.4 Attribute Selection

The data base has many patients according to the normality of patient depend into 10 attributed of brain cancer described as follow:

1-ischaemic brain changes:

Is a condition in which there is insufficient blood flow to the brain to meet metabolic demand? This leads to poor oxygen supply or cerebral hypoxia and thus to the death of brain tissue or cerebral infarction ischemic stroke. It is a sub-type of stroke along with subarachnoid hemorrhage and intracerebral hemorrhage.

2-atrophy:

Brain atrophy means loss of cells or shrinkage. When our brains atrophy, the neurons and their connections waste away and the brain is literally getting smaller.

3-stroke:

Loss of brain function due to a sudden interruption of blood supply in the brain

4-tumor:

A brain tumor is a collection (or mass) of abnormal cells in the brain. The skull is very rigid and the brain is enclosed, so any growth inside such a restricted space can cause problems. Brain tumors can be cancerous (malignant) or non-cancerous (benign).

5-sellar mass:

Are noncancerous tumors that occur in the pituitary gland. Pituitary adenomas are generally divided into three categories dependent upon their biological functioning: benign adenoma, invasive adenoma, or carcinomas, with carcinomas accounting for 0.1% to 0.2%, approximately 35% being invasive adenomas and most being benign adenomas.

6-lesion:

The lesion is an a Type of tumor

7- AVM:

The AVM arteriovenous malformation is an a type of stroke

8- SOL:

The space-occupying lesion of the brain is an a type of tumor

9-TIA:

The Trans ischemic attack is an a type of the stroke

10-MS:

Is an inflammatory disease in which the insulating covers of nerve cells in the brain and spinal cord are damaged?

4.5 Images Processing

A typical image using in this study using artificial neural network is shown in figure 4-1 For all MRI samples images a segmentation logarithm was apply to determine image edges and isolated image from background, then each image will be cut to frames each frame was filtered using enhancement filter to get a clear frame, type of filter using in this work is a median filter, median filter is a nonlinear filter more used to remove the impulsive traditional liner filtering, because it preserve the sharp edges. The order of median filter that gives the best value that trades structural faithfulness and noise reduction be remove background of image and remove the comment in back ground .

4.6 Features Extraction

Digital image contain much data but not much information. Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately, this will simplify the form of image for image ANN system.

For medical images; Robert M. Haralick (1973) determined 13 features which are well describing texture of image, for each image frame 13 Haralick feature was extracted by used two angles 0 and 90, then MATLAB program was written to do image processing and Haralick feature extraction to prepare the training file for ANNs.

4.7 ANN Design

The main purpose of this study is identifying and designs the best ANN type which is more suitable for MRI image,so they are two ANNs was designed which are feed forward (Pattern Recognition tool) and cascade-forward back propagation

network to decide which one has the best performance .then the training file was applied for each ANN as shown in figure 4-3.

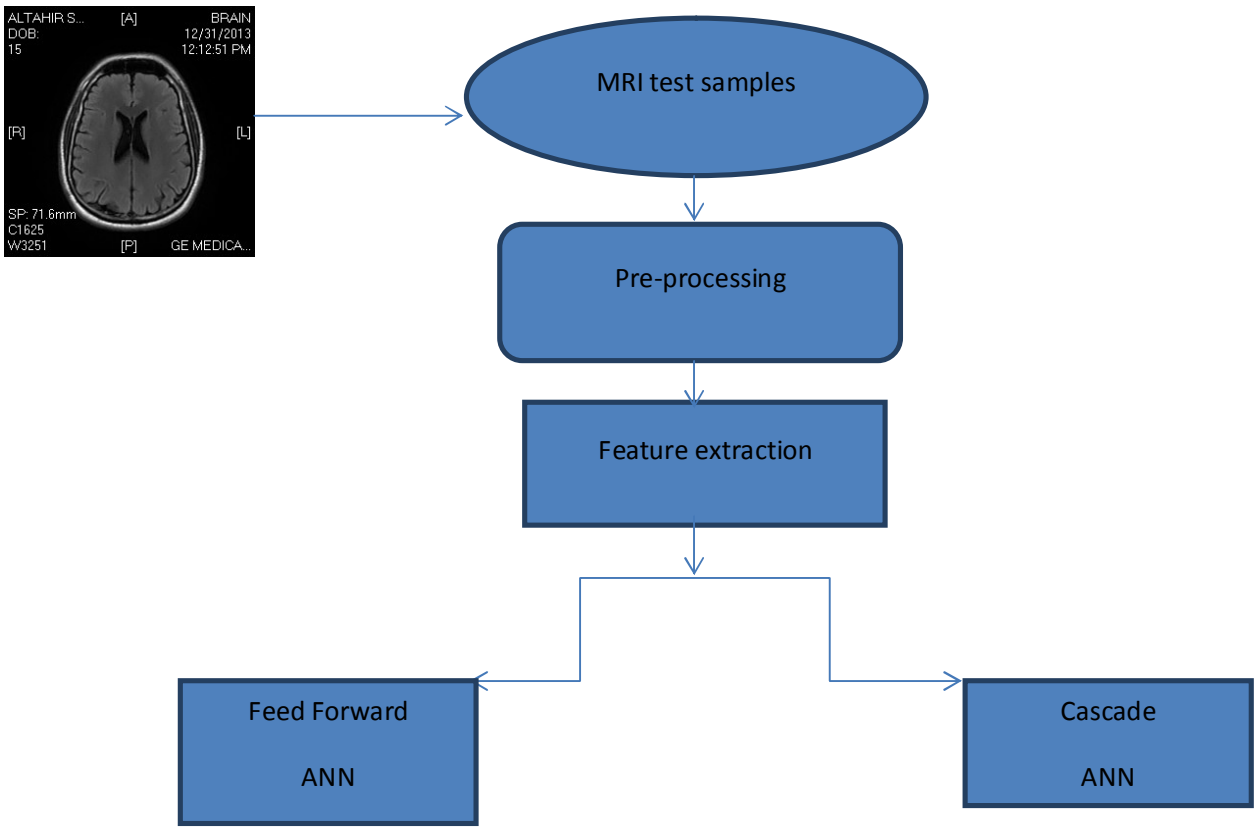


Figure (4.3) tests samples application for ANNs

One of important Goals of Artificial Neural networks is processing information just as people do; actually we use neural network when we need brain capabilities and machine idealistic. Well design and train od neural Network make it qualified for decision maker operations when it faced new data outside training data; this will provide ANNs high reliability exactly like experiment humans.

There are two problems faced designer of ANNs in any application:

1-Network Structure

2-Network Generalization

Network structure

The ANNs a suitable Architecture for the specific application must be well chose, this involve:

1. Choosing suitable network type for application.
2. Number of layer.
3. Number of nodes in hidden layers.
4. Activation functions between layers.

Network Generalization

Designer of ANN always faced about degree of his network generalization i.e. although ANN well designed and trained and performance error decrease to thee least value; ANN fail when handle with new input data and give worst performance.

To handle with this problem and make ANN more general there are two ways:

1. Regularization
2. Early stopping

4.8 Create Neural Network

MATLAB software package version 10 is used to implement the software for the current work. The type of ANN and the data was input to the neural network from the work space. Data were randomly divided into a training sample, validation and test sample, we create tow network in this study Feed Forward NN and Cascade NN and we find the result of it in Chapter Five.

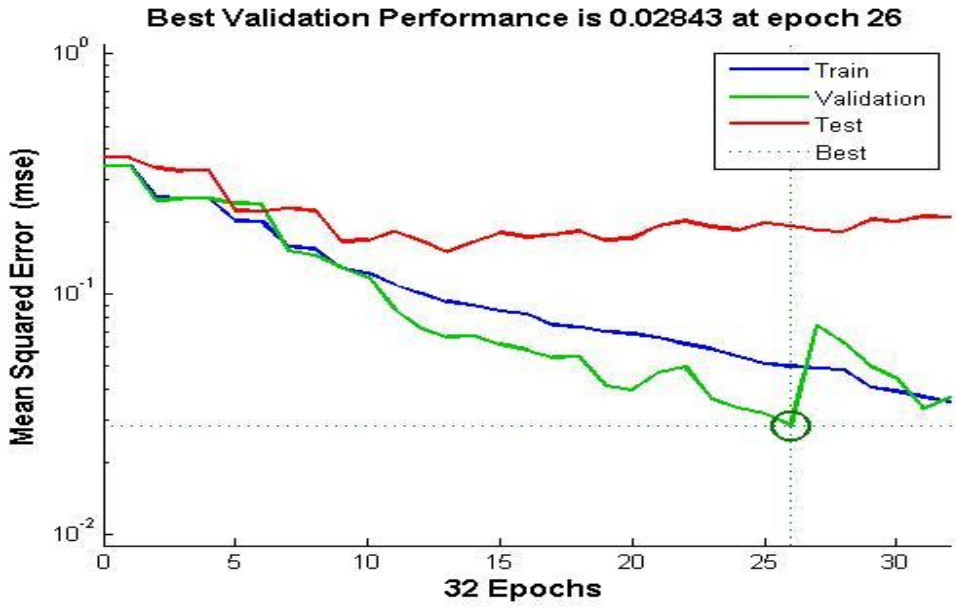
Chapter Five

Results and Discussion

Inthissection,willshow differentfeaturesextractionmethodstwodifferent typesof MRI brainimages,normalimage andabnormal image thefeatureextractionmethodsfor any image divided to 26 features, we get below result after designed tow different model of ANN were show in result.

5.1Feed Forward back propagationNeural Network

Using nprtool in MATLABBPF was designed and trained, first onehidden layer between input and output layer with 7 nodes was choose. Type of activation function which chooses is TRAINSCG (scale conjugate gradient). After training the results and performance error as is shown figure 5-1.



Figure(5.1) result for FFBPNNwith 12 nodes

Then for the same network activation function was replace the number of node decrease from 12 to 11, 10,9,8,7 gradually as shown in figure 5-3, 5-4, 5-5, 5-6, and 5-7.

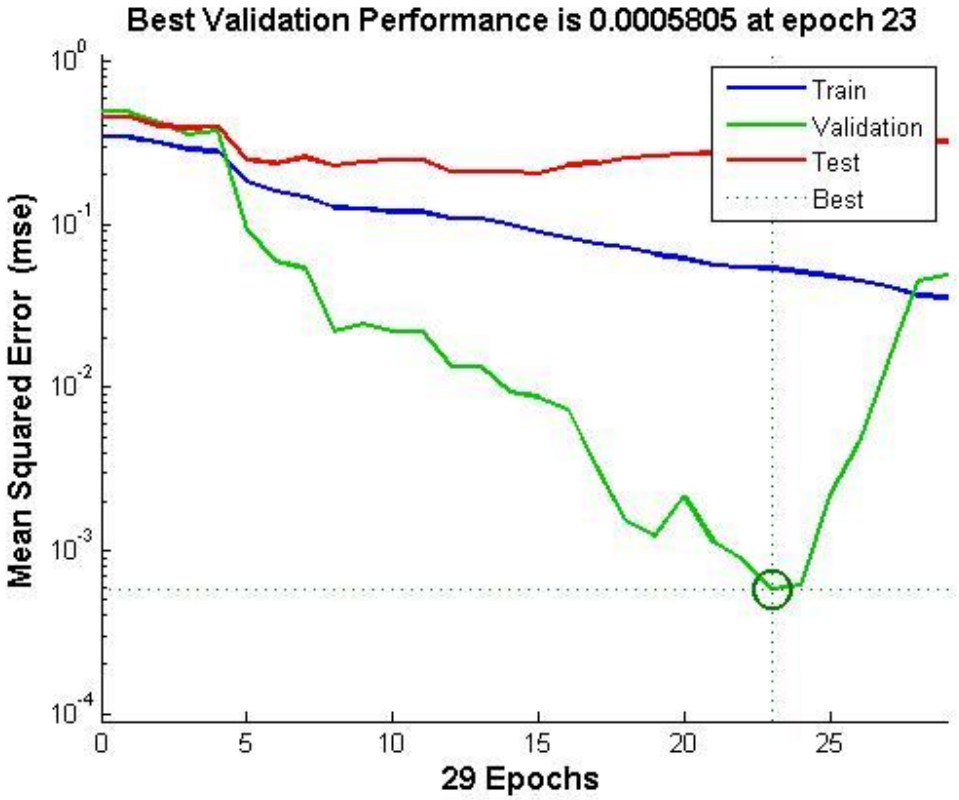


Figure (5.2) result for FFBPNN with 11 nodes

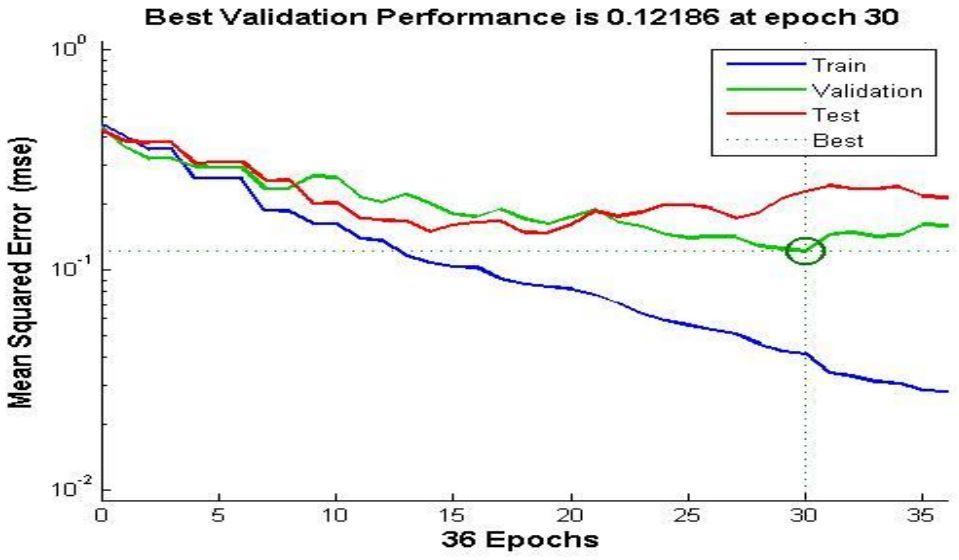


Figure (5.3) result for FFBPNN with 10 nodes

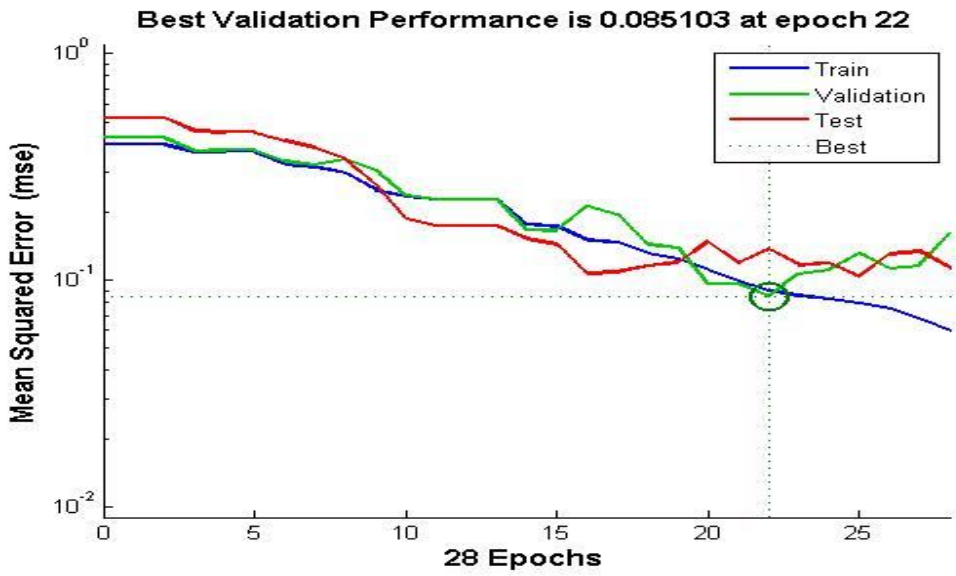


Figure (5.4) result for FFBPNN with 9 nodes

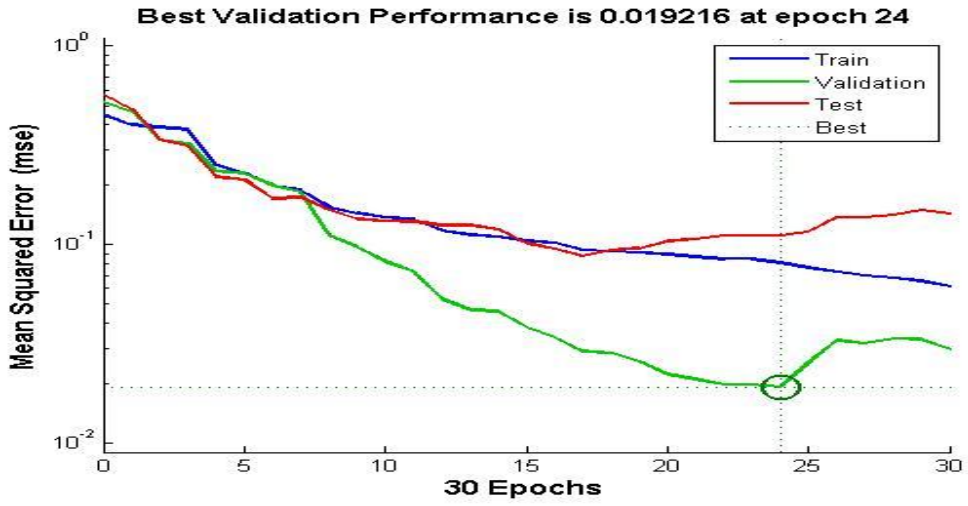


Figure (5.5) result for FFBPNN with 8 nodes

The best performance was achieved when nodes became 8 nodes. The best PR for application and it performance was shown in figure 5-7.

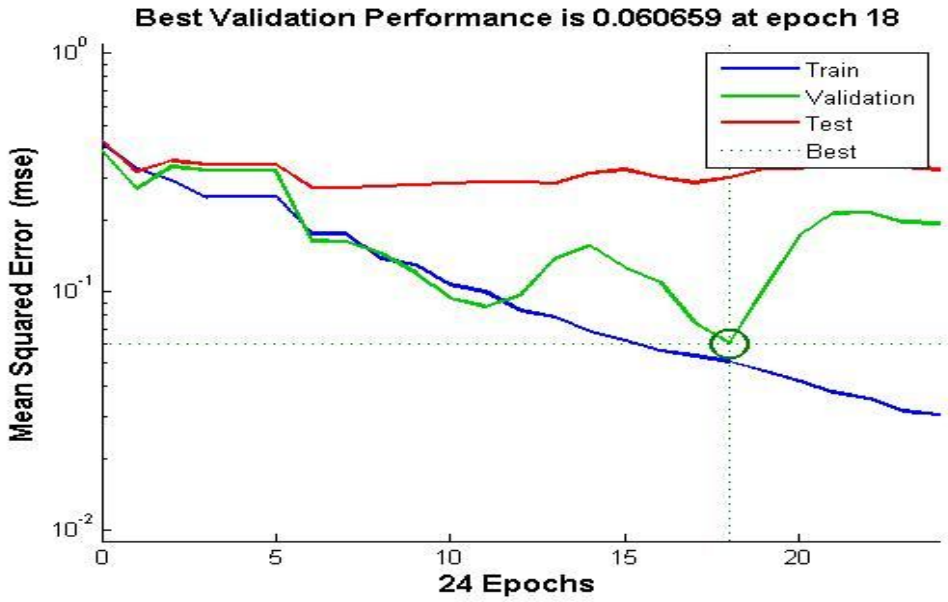
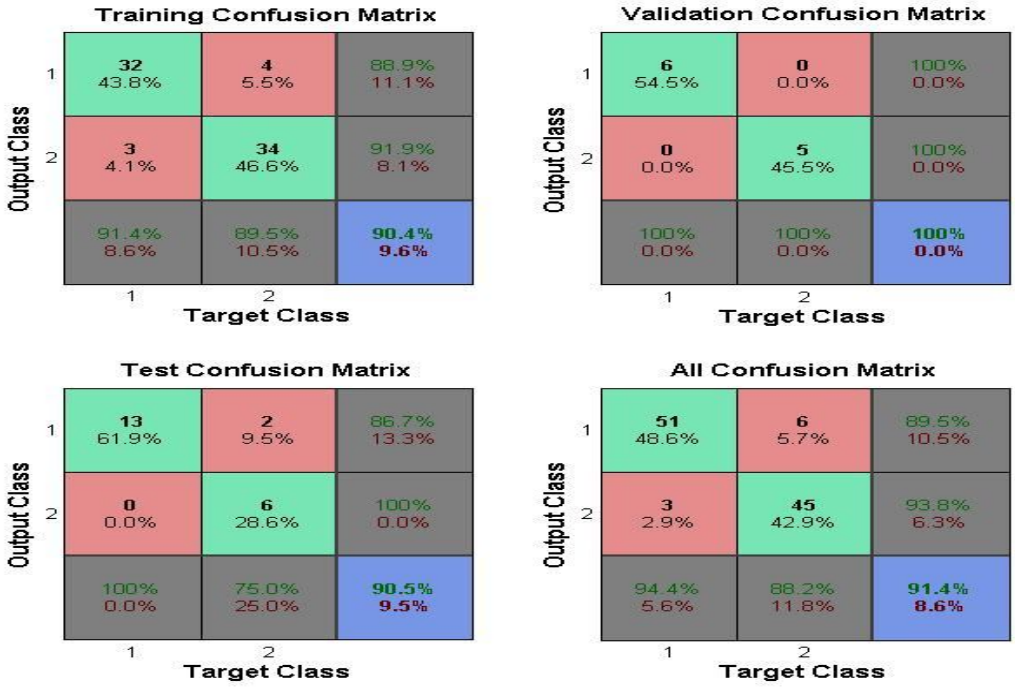


Figure (5.6) result for FFBPNN with 7 nodes

Also the best performance of can describe by confusion matrix shown in figure 5-8,5-9.



Figure(5.7) FFBPNN confusion matrix

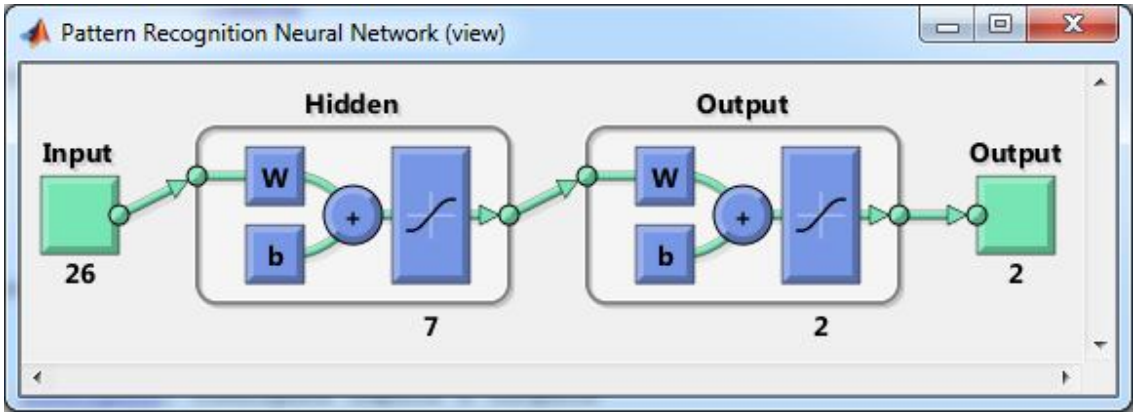


Figure (5.8)the best FFBPNN architecture

5.2 Cascade-Feed Forward Back propagation Design

As done with FFBPNN initial hidden nodes number was 12 nodes and performance error was recorded but with log sigmoid transfer function. Results were shown in figure 5-9.

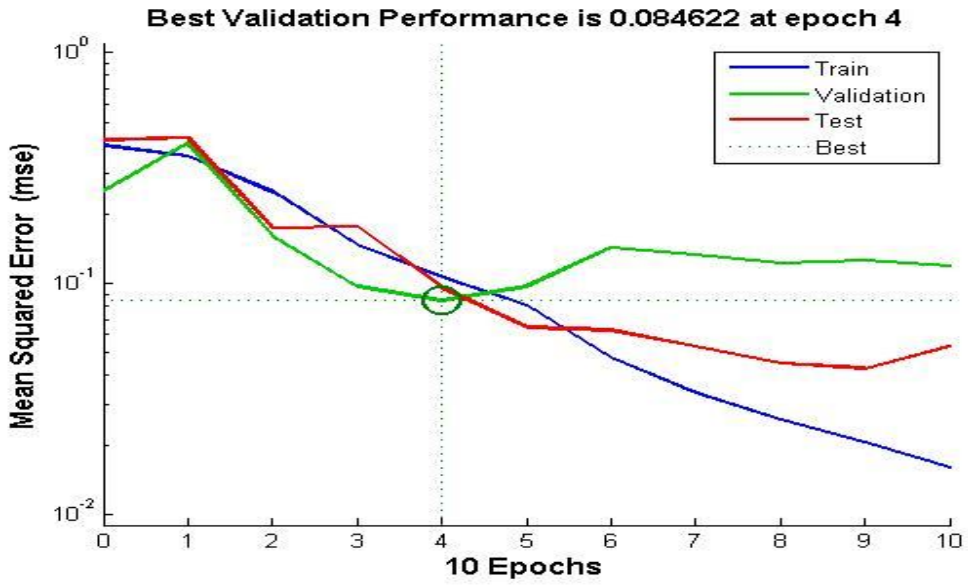


Figure (5.9) result for Cascade with 12 nodes

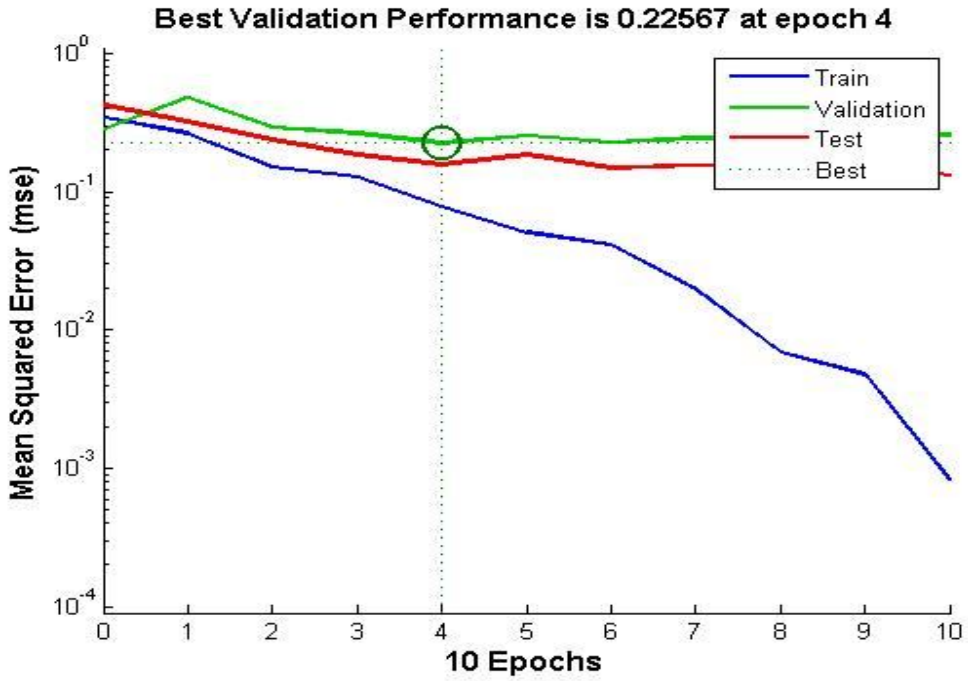


Figure (5.10) result for Cascade with 11 nodes

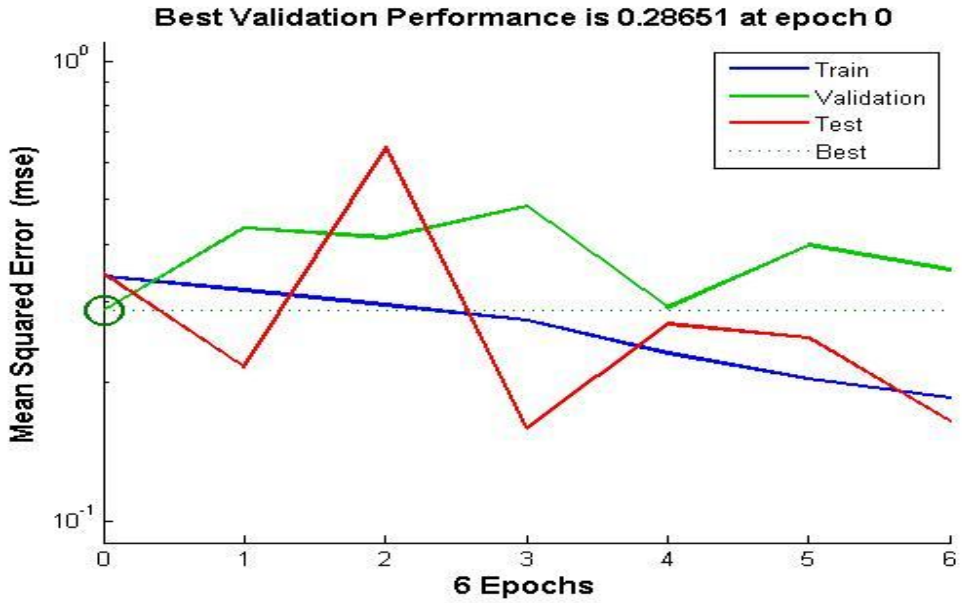


Figure (5.11) result forCascade with 10 nodes

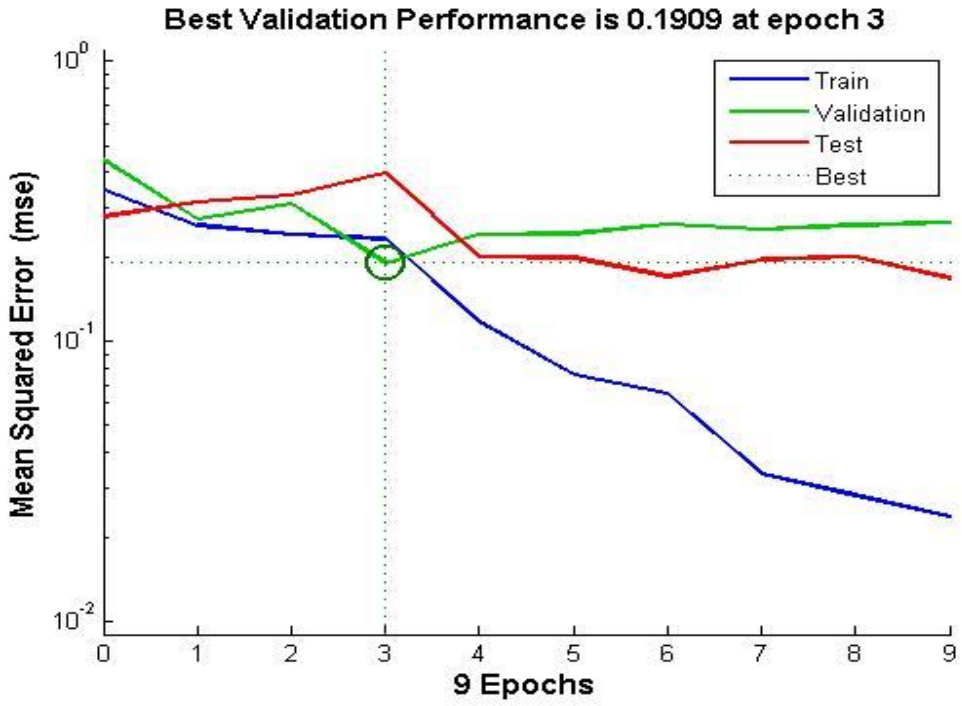


Figure (5.12) result for Cascade with 9 nodes

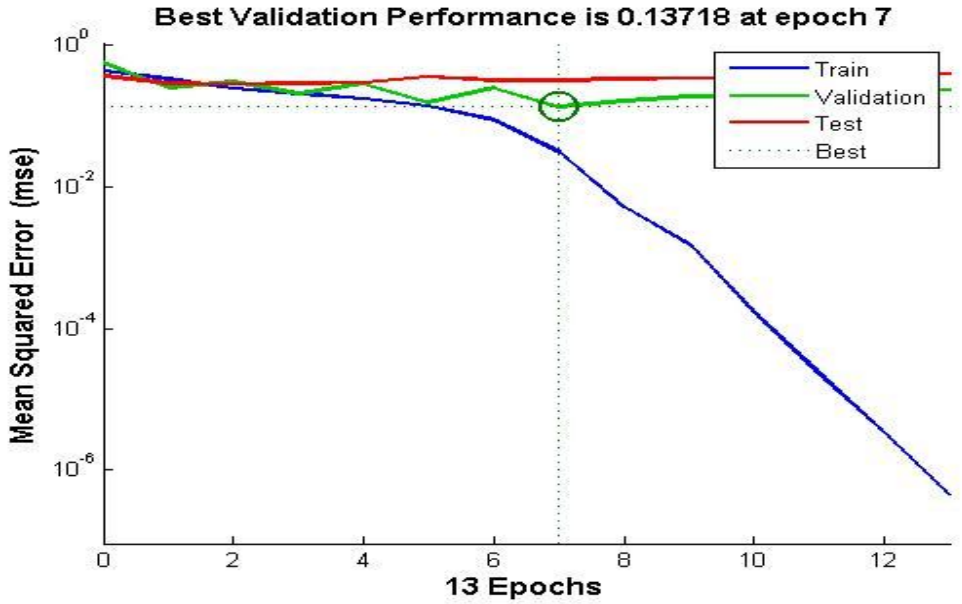


Figure (5.13) result for Cascade with 8 nodes

In this network we notice when increase the the number of nodes we get good performance with transfer function log segmoid and figure 4-15 shown the best architecture for the cascade NN.

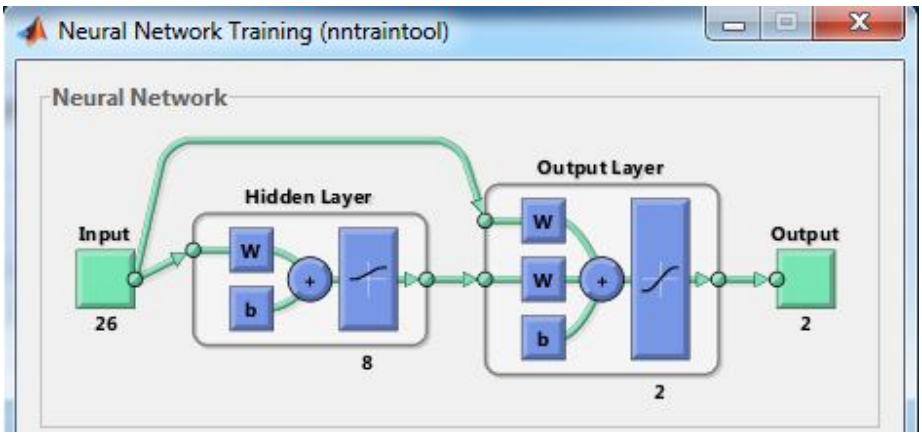


Figure (5.14) the best Cascade NN architecture

5.3Test and Result Discussions

After training stage finished; two networks was tests by MRI sample (normal and abnormal image). After training and testing we found the best architecture of ANN can be used in this study is FFBP NN because we get the best performance from it to classify the sample to normal and abnormal.

5.4Performance and evaluation of ANNS

Table 5.15 described the comparative result study between tow neural networks

Table (5.15) comparative between FFBPNN and Cascade NN

	FFBPNN	Cascade NN
Sensitivity	94.44%	87.03%
Specificity	88.24%	86.27%
Accuracy	91.42%	86.6%

In Table 5.15 the classification accuracies obtained by two neural network techniques are compared for brain cancer database. The results show that the accuracies obtained by each neural network technique are quite compatible. The highest accuracy is given by FFBPNN(91.44%).

Sensitivity = TruePositive / True Positive + False Negative…… (2)

Specificity = True Negative/ True Negative + FalsePositive…..….. (3)

Accuracy = (True Positive +True Negative)/ (True Positive+ FalsePositive + True Negative + False Negative……... (4)

1-True positive: Sick people correctly diagnosed as sick.

2-False positive: Healthy people incorrectly identified as sick.

3-True negative: Healthy people correctly identified as healthy.

4-False negative: Sick people incorrectly identified as health..

Chapter six

Conclusion and Recommendations

6.1 Conclusion

This study presents an automated recognition system for the MRI image using the Artificial Neural network. Artificial Neural Network is an advanced and powerful technique, it's also distinguished by their simplification in use, but it need much work in design and train stages. If ANN was well designed and trained; it will give very reliable results for the application was designed for it.

Computer aided diagnosis systems for detecting malignant texture in biological study have been investigated using several techniques.

The thesis explains an effective manner for ANN design for any application according to trial and error record with special methodology.

Also the thesis interested to increase generalization for designed ANNs to make it more effective when it handles with new samples.

Thesis involve design of two type of ANNs which are Feed Forward back propagation Network and Cascade-forward back propagation Network to decide which one has the best performance for study of brain tumor detection; result obtained in chapter five explained that the best one is FFBPNN with performance 91.44% also thesis proved that the best activation function for this application is TRAINSCG.

6.2 Recommendations

The recommendations are to:

1- Increase number of training samples.
2- Develop processing stages of code for it also will increase from recognizer performance.

3- For having acceptable results it may use Neuro-Fuzzy system and GUI system.
4- Use for coming researches the wavelet feature extraction like.

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