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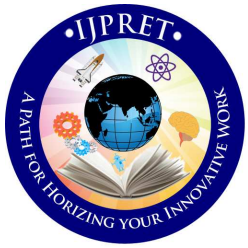

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A PATH FOR HORIZING YOUR INNOVATIVE WORK

RECOGNITION AND ANALYSIS OF BRAIN CANCER BASED ON ANN

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Abstract

A Brain Cancer is very serious disease causing deaths of many individuals. The recognition and classification system must be available so that it can be diagnosed at early stages. Cancer classification has been one of the most challenging tasks in clinical diagnosis. At present cancer classification is done mainly by looking through the cells' morphological differences, which do not always give a clear distinction of cancer subtypes. Unfortunately, this may have a significant impact on the final outcome of whether a patient could be cured effectively or not. This paper deals with such a system which uses computer based procedures to recognize tumor blocks and classify the type of tumor using Artificial Neural Network Algorithm for MRI images of different patients. 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.

INTRODUCTION

Brain cancer is a disease of the brain in which cancer cells (malignant) arise in the brain tissue. Cancer cells grow to form a mass of cancer tissue (tumor) that interferes with brain functions such as muscle control, sensation, memory, and other normal body functions. A brain tumor takes up space within the skull and can interfere with normal brain activity. It can increase pressure in the brain, shift the brain or push it against the skull, and/or invade and damage nerves and healthy brain tissue. The location of a brain tumor influences the type of symptoms that occur. Identifying the presence of a brain tumor is the first step in determining a course of treatment.

There are two main types of brain cancer. Cancer cells that develop from brain tissue are called primary brain tumors while tumors that spread from other body sites to the brain are termed metastatic brain tumors. Statistics suggest that brain cancer occurs infrequently and is likely to develop in about 22,000 new people per year with about 13,000 deaths as estimated by the National Cancer Institute. Secondary brain cancer is more common and is caused by a cancer that has begun in another part of the body, such as lung cancer or breast cancer that spreads to the brain. Another brain cancer is also called metastatic brain cancer.

Imaging is an essential tool of medical science to visualize the anatomical structures of the human body [1,2]. Several new complex medical imaging techniques, such as X-ray, magnetic resonance imaging (MRI), and ultrasound, strongly depend on computer technology to generate or display digital images. MRI is especially true to classify brain tissues whether it is the cancerous or not. The most important advantage of MR imaging is that it is non-invasive technique.

The method of detection and work carried out during this study is explained in brief in next section. The symptoms, tumor grade and types are discussed in section II. The image classification and feature extraction techniques are discussed in section III. The algorithm used for particular stage is given briefly in section IV. The training and testing of ANN is elaborated in section V. The result

and conclusions drawn are elaborated in section VI.

SYMPTOMS, TUMOR GRADES AND TYPES

Symptoms

The symptoms of brain tumors depend on tumor size, type, and location. Symptoms may be caused when a tumor presses on a nerve or damages a certain area of the brain. They also may be caused when the brain swells or fluid builds up within the skull. Brain tumors are composed of cells that exhibit unrestrained growth in the brain. These are the most common symptoms of brain tumors:

- Headaches
- Nausea and vomiting
- Changes in speech, vision, or hearing
- Problems balancing or walking
- Changes in mood, personality, or ability to concentrate
- Problems with memory
- Muscle jerking or twitching
- Numbness or tingling in the arms or legs

Most often, these symptoms are not due to a brain tumor. Another health problem could cause them. A diagnosis of brain cancer can be missed or delayed because some symptoms of brain cancer are similar to symptoms of other conditions.

Grades

Not all brain tumors are alike, even if they arise from the same type of brain tissue. Tumors are assigned a grade depending on how the cells in the tumor appear microscopically. The grade also provides insight as to the cell's growth rate. NCI lists the following grades:

- Grade I: The tissue is benign. The cells look nearly like normal brain cells, and they grow slowly.
- Grade II: The tissue is malignant. The cells look less like normal cells than do the cells in a grade I tumor.
- Grade III: The malignant tissue has cells that look very different from normal cells. The abnormal cells are actively growing and have a distinctly abnormal appearance (anaplastic).
- Grade IV: The malignant tissue has cells that look most abnormal and tend to grow quickly.

Types

When most normal cells grow old or get damaged, they die, and new cells take their place. Sometimes, this process goes wrong. New cells form when the body doesn't need them, and old or damaged cells don't die as they should. The build-up of extra cells often forms a mass of tissue called a growth or tumor. Primary brain tumors can be benign or malignant: Benign brain tumors do not contain cancer cells: Usually, benign tumors can be removed, and they seldom grow back. Benign brain tumors usually have an obvious border or edge. Cells from benign tumors rarely invade tissues around them. They don't spread to other parts of the body. However, benign tumors can press on sensitive areas of the brain and cause serious health problems. Unlike benign tumors in most other parts of the body, benign brain tumors are sometimes life threatening. Benign brain tumors may become malignant.

Malignant brain tumors (also called brain cancer) contain cancer cells: Malignant brain tumors are generally more serious and often are a threat to life [3]. They are likely to grow rapidly and crowd or invade the nearby healthy brain tissue. Cancer cells may break away from malignant brain tumors and spread to other parts of the brain or to the spinal cord.

There are many types of primary brain tumors. Primary brain tumors are named according to the type of cells or the part of the brain in which they begin. For example, most primary brain tumors begin in glial cells. This type of tumor is called a*glioma*. Among adults, the most common types are:

- *Astrocytoma*: The tumor arises from star-shaped glial cells called *astrocytes*. It can be any grade. In adults, an astrocytoma most often arises in the cerebrum. Grade I or II astrocytoma: It may be called a low-grade glioma. Grade III astrocytoma: It's sometimes called a high-grade or an anaplastic astrocytoma. Grade IV astrocytoma: It may be called a *glioblastoma* or malignant astrocyticglioma [4].
- *Meningioma*: The tumor arises in the meninges. It can be grade I, II, or III. It's usually benign (grade I) and grows slowly.
- *Oligodendroglioma*: The tumor arises from cells that make the fatty substance that covers and protects nerves.

It usually occurs in the cerebrum. It's most common in middle-aged adults. It can be grade II or III.

Among children, the most common types are:

- *Medulloblastoma*: The tumor usually arises in the cerebellum. It's sometimes called a *primitive neuroectodermaltumor.* It is grade IV.
- Grade I or II astrocytoma: In children, this low-grade tumor occurs anywhere in the brain. The most common astrocytoma among children is *juvenile pilocytic astrocytoma*. It's grade I.
- *Ependymoma*: The tumor arises from cells that line the ventricles or the central canal of the spinal cord. It's most commonly found in children and young adults. It can be grade I, II, or III.
- *Brain stem glioma*: The tumor occurs in the lowest part of the brain. It can be a low-grade or high-grade tumor. The most common type is *diffuse intrinsic pontineglioma*.

The most common primary brain tumors are usually named for the brain tissue type from which they originally developed. These are gliomas, meningiomas, pituitary adenomas, vestibular schwannomas, and primitive neuroectodermaltumors (medulloblastomas). When the grades are coupled with the tumor name, it gives doctors a better understanding about the severity of the brain cancer. For example, a grade III (anaplastic) glioma is an aggressive tumor, while an acoustic neuroma is a grade I benign tumor. However, even benign tumors can cause serious problems if they grow big enough to cause increased intracranial pressure or obstruct vascular structures or cerebrospinal fluid flow.

Brain cancers are staged according to their cell type and grade because they seldom spread to other organs. In general, these cancer stages range from 0 to 4, with stage 4 indicating the cancer has spread to another organ (highest stage).

METHODOLOGY

The work carried out involves processing of MRI images of brain cancer affected patients from the local CANCER Research Hospital, for detection and Classification on different types of brain tumors. The image processing techniques like histogram equalization, image segmentation, image

enhancement and then extracting the features for Detection of tumor. Extracted feature are stored in the knowledge base of ANN [5]. A suitable Nero Fuzzy classifier is developed to recognize the different types of brain cancers. The system is designed to be user friendly by creating proper Graphical User Interface (GUI).

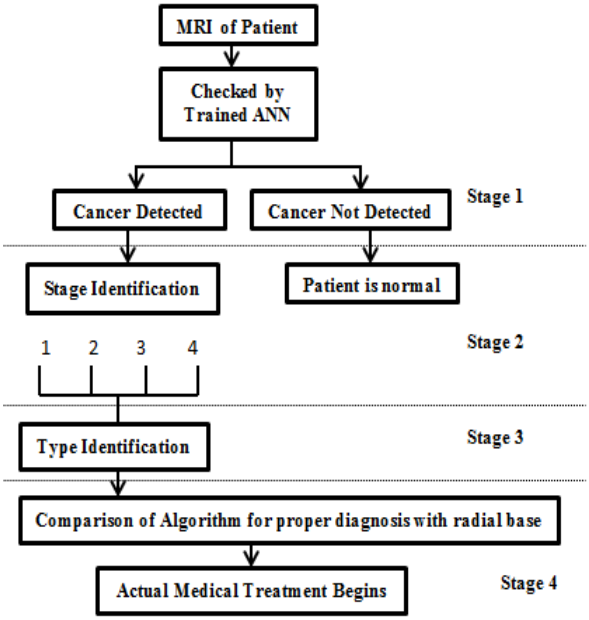

Figure 1: Stages for ANN algorithm to train

The data of around 38 patients is collected from local CANCER Research Centre and the MRI images are scanned and processed by various methods.

ALGORITHM

The stage 1 identifies the patient is affected by cancerous growth of tumor or not by checking the MRI images of patient. The algorithm used to check whether the patient is having cancer or not is designed by pre-data available at the research centre. Assuming 4 patients to train the Algorithm we have designed the following algorithm.

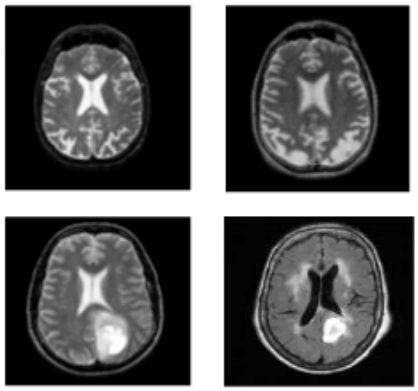

Figure 2: Sample MRI images of patients

```
No. of inputs=4;
  I= [ ];
  For j=1:no_inputs
        Path= ['train\'num2str (j)'.jpg']
        im= imread (path);
        im= rgb2gray(im);
        [a h v d ]= dwt 2(im, 'haar');
        [aa h v d ]= dwt 2(a, 'haar');
        m = mean (aa, 2);
        n = size (aa, 2);
        A = [ ];
        For ii = 1: n
              Temp = double (aa(:, ii)) - m;
```

```
        A = [A temp];
    end
    L= A'*A;
    [Vec D]= eig (L);
    L_eig_vec = Vec (: , end);
    Eigenfaces = A * L_eig_vec;
    I (: , j) = Eigenfaces;
end
Figure;
Subplot (2, 2, 1)
Plot (I (:, 1))
Subplot (2, 2, 2)
Plot (I (:, 2))
Subplot (2, 2,3)
Plot (I (:, 3))
Subplot (2, 2, 4)
Plot (I (:, 4))
```

TRAINING AND TESTING OF ANN

ANN always works on Training Phase and Testing Phase. In Training Phase the ANN is trained for recognition of different types of brain cancer. The known MRI images of cancer affected patients are first processed through various image processing steps and then textural features are extracted using Gray Level Co-occurrence Matrix. The features extracted are used in the Knowledge Base for algorithm which helps in successful classification of unknown Images. These features are normalized in the range -1 to 1 and given as an input to Artificial Neural Network Based Classifier. The unknown MRI images affected by cancer are used for testing in Testing Phase of ANN.

ANN'S are networks are usually having nodes. The input of a specific node is the weighted sum of the output of all the nodes to which it is connected. The output value of a node is, a non-linear function of its input provided. The multiplying weighing factor between the input node j and the output node i is called the weight w_{ji}. ANN is a system whose parameters are changed during operation, normally during Training phase. After the training phase the Artificial Neural Network parameters are fixed and then Testing phase is done. Presentation of output of the neural network is compared to the desired output and an error is computed [6, 7]. This error is then fed back as feedback input) to the Artificial Neural Network

and used to adjust the weights such that the error must be decreased at each iteration and the neural model gets closer and closer to producing the desired output. This process is known as Training.

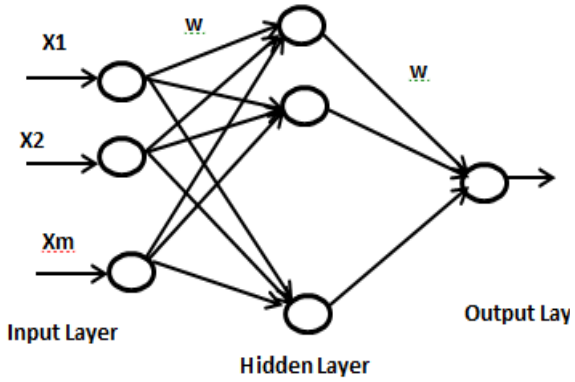

Figure 3: Architecture of used ANN

The Training of these networks consists in finding a mapping between a set of input values and a set of output values. The mapping is adjusting the value of the weights w_{ji}; using a learning algorithm, the most popular of which is the generalized delta rule [8]. After the weights are adjusted on the training set, their value is fixed and the ANN's are used to classify unknown input images.

$$Ep = \frac{1}{2}\sum_j \ (t_{pj} - o_{pj})^2$$

where,

p - One input vector

t_p - target output vector

o_p - observed output vectors

RESULT AND CONCLUSION

ANN system can be train and tested by providing various sample data (MRI images of patients) and a rigid system is under developing phase for the actual use. The classification, identification and type of tumor can also be done with the help of same ANN system. The scope of the system can further be improved by using other types of Images. It is essential to use large numberof patient's data which will improve the accuracy of the system.

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