Title of the Research Proposal:

Neural Network Based Brain Tumor Detection using MR Images

Choice of the Topic with Reasoning

Brain tumors are composed of cells that exhibit unrestrained growth in the brain. Brain tumor by nature is malignant since it takes up space and invades brain tissue which is required for vital body functions. Because of the invading nature of the brain tumor it affects one of the most important organs in the body. Typical treatment for brain tumors is surgical in nature, although radiation therapy can also be prescribed depending on the particular case.

The Brain Tumors can be classified as follows:

• **Benign Tumor i.e. Non Cancerous Tumor**
  It is a type of tumor, which is Noncancerous, means they do not spread or invade the surrounding tissue.

• **Malignant Tumor i.e. Cancerous Tumor**
  It is a type of tumor which is cancerous, means it spreads and invades the surrounding tissue. It is categorized as Primary and Secondary Tumor.

  • **Primary Tumor**
    They start in the brain. Benign tumors represent half of all primary brain tumors Most of them are usually successfully treated with techniques such as surgery.

  • **Secondary Tumor (Metastatic)**
    A secondary (metastatic) brain tumor occurs when cancer cells spread to the brain from a primary cancer in another part of the body. Secondary tumors are about three times more common than primary tumors of the brain.

Problems faced by Doctors in diagnosis of Brain Tumors:

One of the principal problems in surgical planning is the precise localization of critical brain structures. It is difficult and time consuming to detect and localize malignant cells using 2D images. 3D views, however, is a difficult task and is traditionally carried out in the clinicians mind. However, with image processing tools, the information in the orthogonal 2D cross-sections can be enhanced and interactively displayed using 3D models.
This image models considerably helps the surgeon in the trajectory optimization process. The spatial information helps in planning of the procedure by allowing him to test and analyze alternative navigational paths through the physical space. Pathological data is in terms of CT, MRI, MR-angiography or functional imaging presenting image information in a way that is more similar to the surgical view of the patient during the operation, thus facilitating the comprehension of the entire anatomy. The images of interest are obtained by the following techniques.

- **X-Ray**
- **Computed Tomography-CT Scan**
- **Positron Emission Tomography-PET**
- **Magneto Encephalography –MEG**
- **Biopsy**
- **Magnetic Resonance Imaging-MR**

- **X-rays**

X-Rays of the skull were once standard diagnostic tools but are now performed only when more advanced procedures are not available.

- **Computed Tomography (CT)**

  Computed tomography (CT) uses a sophisticated x-ray machine and a computer to create a detailed picture of the body's tissues and structures. It is not as accurate as MRI and does not detect about half of low-grade gliomas. It is useful in certain situations; however a CT scan helps locate the tumor and can sometimes help determine its type. It can also help detect swelling, bleeding, and associated conditions. In addition, computed tomography is used to check the effectiveness of treatments and watch for tumor recurrence.

- **Positron Emission Tomography**
Positron emission tomography (PET) provides a picture of the brain's activity rather than its structure by tracking substances that have been labeled with a radioactive tracer. PET is not routinely used for diagnosis, but it may supplement MRIs to help determine tumor grade after diagnosis. As with magnetic resonance spectroscopy (MRS), PET is also able to distinguish between recurrent tumor cells from dead cells or scar tissues, although MRS is more widely available.

- **Magneto Encephalography (MEG)**

  These scans measure the magnetic fields created by nerve cells as they produce electrical currents.

- **Biopsy**

  A biopsy is a surgical procedure in which a small sample of tissue is taken from the suspected tumor and examined under a microscope for malignancy. The results of the biopsy also provide information on the cancer cell type. In some cases, such as brain stem gliomas, a biopsy might be too hazardous because removing any healthy tissue from this area can affect vital functions. In such case diagnosis must rely on less invasive and possibly less accurate measures.

- **Magnetic Resonance Imaging (MRI)**

  MRI is an imaging technique based on the measurement of magnetic field vectors generated after an appropriate excitation with strong magnetic fields and radio-frequency pulses in the nuclei of hydrogen atoms present in water molecules of a patient's tissues. Given that the content of water differs for each tissue, it is possible to quantify the differences of radiated magnetic energy, and have elements to identify each tissue. When specific magnetic vector components are measured under controlled conditions, different images can be acquired and information related to tissue contrast may be obtained, revealing details that can be missed in other measurements.

In MRI, one of the principle regions of interests is the brain. Currently in clinical applications, the boundary of tumor in a head image is usually traced by hand.
Thus this manual approach becomes infeasible when used with large data sets. Hence the automatic system for the detection of tumor is necessary. Recently several attempts have also been made to apply neural network architectures to brain tumor analysis.