APPENDIX 1

BRAIN AND BRAIN TUMOR

A1.1 HUMAN BRAIN

The brain is a stable place for patterns to enter and stabilize among each other. It is the source of all human behavior, thoughts, feelings and experience. It also integrates and controls allostatic balance and autonomic functions in the body. The brain produces many hormones and regulates its processing, recognition, cognition and integration related to emotion. It is supported and protected by the surrounding skin, bones of the skull and the meanings. It also contains watery fluid called cerebrospinal fluid. This fluid flows through spaces between the meanings and within the brain spaces called ventricles. The skin make up a protective barrier against physical damage of underlying tissues, invasion of chemical, bacterial substances, activity of its sweat glands and blood vessels. It also helps to maintain the body at a constant temperature. The skull is another important protector of brain. It is a highly complex structure and has compact and spongy types of bones. It provides the framework of the face and protects the brain.

The brain is a soft, spongy mass of tissue. It is covered by the bones of the skull and three thin lamina called meninges. Watery fluid called cerebrospinal fluid fender the brain. This aqueous outflow through gap between the meninges and through gap within the brain called ventricles. A interconnection of nerves carries messages back and forth between the brain and the reboot of the body. Some nerves go exactly from the brain to the eyes, ears, and another parts of the head. another nerves run through the spinal cord
to connect the brain with the another parts of the body. Within the brain and spinal cord, glial cells circumvent nerve cells and control them in place. The brain guide the things we accept to do (like walking and talking) and the stuff our body does leftout thinking (like breathing). The brain is also in charge of our sensibility (sight, hearing, touch, taste, and smell), memory, feeling, and personality.

### A1.2 PARTS OF BRAIN

The human brain is divided into three parts such as Forebrain, Midbrain and Hindbrain. The forebrain is made up of cerebrum, thalamus and hypothalamus. The midbrain has tectum and tegmentum. The hindbrain is made of cerebellum, pons and medulla.

#### A1.2.1 Forebrain

The forebrain is the biggest part of the brain, most of which is shaped up of the cerebrum. Other important architecture found in the forebrain include the thalamus the hypothalamus and the limbic organization. The cerebrum is split into two cerebral hemispheres joined by a mass of white substantiality known as the corpus callosum. Several hemisphere is split into four lobes frontal, parietal occipital and temporal. The exterior of each hemisphere is invent of grey matter known as the cerebral cortex and is deeply folded to increase the cortical exterior area accessible within the confines of the skull.

The cortex controls sensation, memory, and all higher emotional task, including the ability to concentrate reason and think in abstract form. The cerebral hemispheres are occupying on the most superior part of the brain. It makes up comparatively 83% of total brain mass. This area contains two levels: the cerebral cortex and the basal ganglia. They are generally
known as the cerebrum. This is involved in perceptual, cognitive, and higher motor functions.

A1.2.2 Midbrain

The midbrain sits halfway the forebrain and the hindbrain and is approximately 2 cm long. It forms a major part of the brain brainstem. It helps to attach the spinal cord and the forebrain. It includes tectum and tegmentum. These architecture form important associate between the cerebral cortex and the brainstem and the spinal cord to authority sensory transaction such as vision, movement and auditory reflexes. Brainstem gliomas occur almost entirely in children. The average age of development is about 6 years old. The tumor may grow very large before provoke symptoms.

A1.2.3 Hindbrain

The hindbrain combine the cerebellum, the pons and the medulla oblongata, which behavior collectively to device vital bodily processes. The medulla is affixed to the spinal cord and authority unconscious, body functions such as breathing, swallowing, blood transmission and muscle tone. Medulla is injured by Medulloblastomas tumor. These are the most accepted type of adolescence brain tumor. They occur more often in boys than girls, usually all over age 5. Most medulloblastomas occur before the age of 10.

A1.2.4 Nervous System

The nervous system is your body's agreement and delivery center. The basic nervous system (CNS) built of the intellect and the spinal cord and the exterior nervous system (PNS) is built of nerves. Together they manage each one item of your everyday life, from breathing and flicker to helping you recall facts for a analysis. straun capacity from your brain to your nose,
eyes, ears, face, spinal cord and from the spinal cord to the comfort of your body.

Sensory nerves assemble knowledge from the environment; send that info to the spinal cord, which then acceleration the information to the brain. The brain then makes sense of that knowledge and fires off a reply. Motor neurons hand over the instructions from the brain to the comfort of your body. The spinal cord, made of a batch of nerves working up and down the spine, is related to a expressway, speeding knowledge to and from the brain at every second.

### A1.3 BRAIN TUMOR

A brain tumor is an atypical improvement of cells within the brain, which can be cancerous or non-cancerous (benign). It is defined as any intracranial tumor build by atypical and undisciplined cell division, normally either in the brain itself, lymphatic, in the cranial nerves (myelin-producing Schwann cells), in the brain container skull, pituitary and pineal gland, or expanse from cancers primarily occupying in another organs.

Primary brain tumors are generally located in the posterior cranial fossa in children and in the anterior two-thirds of the cerebral hemispheres in gentileperson, whereas they can involve any part of the brain.

Tumor is a one type of cancer. Cancer begins in cells, the building section that makes up tissues. Tissues make up the organs of the mortal part. Normally, cells grow and split to form new cells as the body stipulation them. When cells produce old, they die, and new cells take their area. Sometimes this orderly action goes false. New cells form when the mortal part does not demand them, and old cells do not expire when they grant. These extra cells can form a batch of tissue called a production or tumor.
Many tumor or cancer structures can transmit to the brain, the most confirmed being lung cancer, breast cancer, melanoma, kidney cancer, bladder cancer, certain sarcomas, testicular and disease cell tumors, and a count of another. Some division of cancers only transmit to the brain infrequently, such as colon cancer, or very hardly, such as prostate cancer. Brain tumors can precisely damage brain cells, or they may indirectly damage cells by generating inflammation, shrink another factor of the brain as the tumor expand, inducing brain swelling, and causing increased pressure within the skull.

A1.4 CLASSIFICATION OF BRAIN TUMOR

Brain tumors do confidential depending on the perfect spot of the tumor, the group of tissue elaborate, whether they are noncancerous (benign) or cancerous (malignant), and another factors. Constantly, tumors that dawn out being lower invasive can become also nosy. Tumors may appear at any life, but many types of tumors are most accepted in a convinced age group. In adults, gliomas and meningiomas are most accepted. Gliomas enter from glial cells such as astrocytes, oligodendrocytes, and ependymal cells.

A1.4.1 Benign Tumor

The term "benign" assign to a action, tumor, or rise that is NOT cancerous. This means that it does not transmission to other parts of the body or kill nearby tissue. Benign tumors usually expand slowly. In general, a mild tumor or condition is not disastrous. However, this is not regularly the case. If a benign tumor is big abundant, it can press on nearby blood vessels, nerves, or organs, or differently cause complication. This is specially accurate for benign brain tumors.
A1.4.2 Malignant Tumor

The differing of benign is deadly. The term "malignancy" assign to cancerous cells that usually have the ability to transmission, invade, and kill tissue. Malignant cells tend to have speed, uncontrolled production due to changes in their genetic makeup. Malignant cells that are resistant to treatment may recovery after all appreciable traces of them have been detached or destroyed. It contains cancer cells, Malignant brain tumors are commonly more deliberate and often are life aggressive.

A1.4.3 Primary Brain Tumor

Tumors that begin in brain tissue are known as dominant tumors of the brain. Dominant brain tumors are named give to the type of cells or the sector of the brain in which they begin. A dominant brain tumor is a faction (mass) of abnormal cells that dawn in the brain. Dominant brain tumors combine any tumor that starts in the brain. Dominant brain tumors can appear from the brain cells, the membranes everywhere the brain (meninges), nerves, or glands. Tumors can precisely kill brain cells. They can also kill cells by generating inflammation, placing pressure on other parts of the brain, and increasing pressure within the skull.

A1.4.3.1 Types of Primary brain tumors

The most common Dominant brain tumors are gliomas. They begin in glial cells. There are many types of gliomas:

- **Astrocytoma** - The tumor arises from star-carve glial cells called astrocytes. In man, astrocytomas most often appear in the cerebrum. In children, they appear in the brain stem, the cerebrum, and the cerebellum. A grade III
astrocytoma is consistently called an anaplastic astrocytoma. A grade IV astrocytoma is usually called a glioblastoma multiforme.

- **Brain stem glioma** - The tumor appear in the lowest chunk of the brain. Brain stem gliomas most generally are diagnosed in youthful children and middle-aged man.

- **Ependymoma** - The tumor emerge from cells that edge the ventricles or the central canal of the spinal cord. They are most generally found in adolescent and youthful man.

- **Oligodendroglioma** - This rare tumor emerges from cells that make the fatty item that covers and care for nerves. These tumors usually appear in the cerebrum. They expand slowly and usually do not transmission into surrounding brain tissue. They are most accepted in middle-aged man.

### A1.4.3.2 Secondary brain tumors

When cancer transmission from its authentic place to another item of the body, the new tumor has the same kind of abnormal cells and the same name as the primary tumor. Cancer that transmission to the brain from another item of the body is different from a dominant brain tumor. When cancer cells transmission to the brain from another organ (such as the lung or breast), doctors may call the tumor in the brain a inferior tumor or metastatic tumor. Inferior tumors in the brain are far more common than dominant brain tumors.
A1.5  VARIOUS TYPES OF BRAIN TUMORS

- glioblastoma multiforme
- medulloblastoma
- astrocytoma
- CNS lymphoma
- brainstem glioma
- germinoma
- meningioma
- oligodendroglioma
- shawannoma
- craniopharyngioma
- ependymoma
- mixed gliomas
- brain metastases

A1.6  SYMPTOMS OF BRAIN TUMOR

The symptoms of brain tumors depend on tumor size, type, and region. Syndrome may be generate when a tumor presses on a courage or kill a certain area of the brain. They also may be caused when the brain surge or fluid builds up within the skull.

- Changes in sensation of a body area
- Decreased coordination, clumsiness, falls
- Emotional instability, rapid emotional changes
- Fever (sometimes)
- General ill feeling
- Headache -- recent, persistent, and a new type for the person
- Lethargy
- Memory loss, impaired judgment, calculating deficiencies
- Personality changes
- Pupils of eyes are a different size
- Seizures -- new for the person
- Speech difficulties
- Vision changes -- double vision, decreased vision
- Vomiting -- with or without nausea
- Weakness of a body area

These Syndromes are not sure signs of a brain tumor. Another condition also could cause this complication. Anyone with this Syndrome should see a doctor as soon as achievable. Only a doctor can diagnose and treat the problem.

**Diagnosation of brain tumors**

If a person has Syndromes that recommend a brain tumor, the doctor may function one or more of the following procedures:

- **Physical exam** - The doctor checks general signs of health.
- **Neurologic exam** - The physician inquiry for alertness, muscle strength, coordination, reflexes, and return to cramp. The physician also inspects the eyes to look for swelling generated by a tumor pressing on the nerve that attach the eye and brain.

- **CT scan** - An x-ray appliance related to a computer takes a series of accurate image of the head. The gentle may accept an needle of a special dye so the brain shows up clearly in the image. The image can show tumors in the brain.

- **MRI** - A powerful magnet related to a computer makes detailed images of areas inside the body. These images are consider on a monitor and can also be printed. Occasionally a special dye is needle to help show characterizes in the tissues of the brain. The images can show a tumor or another issue in the brain.

### A1.7 RISKS FOR BRAIN TUMORS

No one knows the correct causes of brain tumors. Doctors can seldom analyses why one person advances a brain tumor and another does not. However, it is clear that brain tumors are not deadly. No one can "catch" the disease from another person. Analysis has shown that people with convinced risk aspect are more likely than others to advance a brain tumor. A risk aspect is anything that increases a person's chance of expands a disease. The following risk aspect are combine with an increased chance of expand a dominant brain tumor:
- **Being male** - In general, brain tumors are more accepted in males than females. However, meningiomas are more accepted in females.

- **Race** - Brain tumors appear more regularly among white people than among people of another race.

- **Age** - Most brain tumors are disclose in public who are 70 years old or older. However, brain tumors are the alternative most accepted cancer in children. (Leukemia is the most accepted childhood cancer.) Brain tumors are more accepted in adolescent younger than 8 years old than in older children.

- **Family history** - People with house representative who have gliomas may be more expected to expand this disease. Being disclosed to radiation or convinced chemicals at work.

  **Radiation** - Employee in the nuclear industry have an expanded risk of establish a brain tumor.

- **Formaldehyde** - Pathologists and embalmers who effort with formaldehyde have an expanded risk of advance brain cancer. Scientists have not found an increased risk of brain cancer among other category of labours disclosed to formaldehyde.

- **Vinyl chloride** - Labours who make plastics may be disclosed to vinyl chloride. This chemical may increase the risk of brain tumors.

- **Acrylonitrile** - People who make textiles and plastics may be disclosed to acrylonitrile. This exposure may increase the risk of brain cancer.
A1.8 TREATMENT OF BRAIN TUMOR

Treatment can suggest surgery, radiation therapy, and chemotherapy. Brain tumors are excellent handle by an organization involving a neurosurgeon, radiation oncologist, oncologist, or neuro-oncologist, and another health care providers, such as neurologists and social employee. Early treatment often enhance the chance of a good outcome. Treatment, however, depends on the capacity and category of tumor and the general health of the tolerant. The ambition of medication may be to antidote the tumor, relieve symptoms, and increase brain activity or the person's comfort. Surgery is often necessary for most dominant brain tumors. Some tumors may be fully removed. Those that are wide inside the brain or that arrive brain tissue may be debulked instead of fully removed. Debulking is a step to reduce the tumor's size. Tumors can be ambitious to remove finally by surgery alone, because the tumor invades surrounding brain tissue much like roots from a plant transmission through soil. When the tumor cannot be evacuated, surgery may still help curtail pressure and relieve symptoms.

A1.8.1 Other tests for Brain Tumor Detection

- **Angiogram** - Dye injected into the bloodstream tide into the blood vessels in the intellect to make them show up on an x-ray. If a tumor is present, the physician may be able to see it on the x-ray.

- **Skull x-ray** - Some category of brain tumors cause calcium deposits in the intellect or changes in the bones of the skull. With an x-ray, the physician can check for these changes.

- **Spinal tap** - The physician may discard a sample of cerebrospinal fluid (the fluid that fills the field in and over the
brain and spinal cord). This procedure is function with local anesthesia. The physician uses a long, thin needle to discard fluid from the spinal column. A spinal tap takes about 30 minutes. The gentle must dishonesty flat for a few hours afterward to keep from assimilating a headache. A laboratory analysis the floeing for cancer cells or other signs of obstacle.

- **Myelogram** - This is an x-ray of the spine. A spinal tap is function to inject a appropriated dye into the cerebrospinal flowing. The gentle is tilted to allow the dye to mix with the flowing. This test helps the physician encounter a tumor in the spinal cord.

- **Biopsy** - The removal of tissue to view for tumor cells is called a biopsy. A pathologist view at the cells under a microscope to analysis for abnormal cells. A biopsy can appearance cancer, tissue changes that may start to cancer, and another conditions. A biopsy is the only confident way to diagnose a brain tumor.

- **Needle biopsy** - The surgeon makes a small laceration in the scalp and drills a small gap into the skull. This is called a burr hole. The physician passes a needle through the burr gap and discard a sample of tissue from the brain tumor.

- **Stereotactic biopsy** - An imaging device, such as CT or MRI, counselor the needle through the burr hole to the point of the tumor. The surgeon withdraws a sample of tissue with the needle.

- **Biopsy at the same time as treatment** - Sometimes the surgeon takes a tissue fragment when the gentle has surgery to remove the tumor.
A1.9 SURVEY OF NATIONAL CANCER INSTITUTE STATISTICS

The incidence of brain tumors is developing rapidly, especially in the older population than related with younger population. Brain tumor is a group of abnormal cells that grows indoors of the brain or over the brain. Over the last 20 years, the overall extent of cancer, including brain cancer, has expanded by more than 10%, as reported in the National Cancer Institute statistics (NCIS). Death rate calculation for USA for Brain tumour: 12,764 for every year, 1,063 for every month, 245 for every week, 34 for every day, 1 for every hour, 0 for every minute, 0 for every second. Nowdays, MRI is the noninvasive and very much emotional imaging test of the brain in routine clinical process. Magnetic resources imaging (MRI) is a noninvasive medical analysis that helps physicians diagnose and treat medical conditions. MR imaging uses a energetic magnetic field, radio recurrence pulses and a computer to production detailed pictures of organs, soft tissues, bone and virtually all other internal body structures. It does not use ionizing radiation (x-rays) and MRI provides detailed pictures of brain and nerve tissues in multiple planes without interference by exceptional bones. Brain MRI is the action of choice for most brain disorders. It provides clear pictures of the brainstem and posterior brain, which are ambitious to view on a CT scan.
MATLAB 7.0

A2.1 MATLAB

Matlab is an abbreviation of Matrix Laboratory. It is a promoted Mathematical Programming Environment used broadly in Education as well as in Industry. The trick behind Matlab is that whole is represented in the form of arrays or matrices. Mathematical Operations starting from simple algebra to complex calculus may be efficiently carried out using this environment. The main cause of Matlab in Software Development is Algorithm Design and Development. Code advanced in Matlab can be converted into C, C++ or Visual C++. Additionally Matlab may be called as ActiveX entity from still higher level languages like Visual Basic, etc. Images can be conveniently represented as matrices in Matlab. One can open a figure as a matrix using imread command.

The matrix may quietly be m x n form or it may be 3 dimensional array or it may be an indexed matrix, depending simultaneously image type. The image processing may be done common by matrix calculation or matrix manipulation. Image may be displayed with imshow command. Changes image may then be saved with imwrite command. In RGB Images there exist three indexed images. First image encloses all the red part of the picture, second green and third contains the blue portion. So for a 640 x 480 sized copy the matrix will be 640 x 480 x 3. An equivalent approach of dyed image illustration is catalogue Image. It actually occurs in two matrices that is image matrix and map matrix. Each color in the image is inclined an index number
and in image matrix each color is described as an index number. Map matrix enclose the database of which index number belongs to which color.

Picture Processing Toolbox software in MATLAB 7.0 produce a general set of reference-standard algorithms and graphical tools for picture processing, analysis, visualization, and algorithm development. User can restore boisterous or degraded images, enhance images for upgraded intelligibility, extract features, analyze shapes and textures, and register two images. Most toolbox functions are written in the open MATLAB® language, giving the capability to inspect the algorithms, modify the source code, and construct your own custom functions. MATLAB 7.0 is a good tool for handling medical images. Especially for MRI.

A2.2 IMPORTING AND EXPORTING IMAGES

- Image Processing Toolbox guides images set up by a wide range of devices, including frame grabbers, satellite, digital cameras and airborne sensors, medical imaging devices, microscopes and other scientific instruments and can visualize, analyze, and process these images in several data types, along with single- and double-precision floating-point and signed or unsigned 8-, 16-, and 32-bit integers.

- There are different ways to import or export pictures into and out of the MAT-LAB environment for processing. You can use Image Acquisition Toolbox (available independently) to collect live images from frame grabbers, DCAM-compatible cameras, Web cameras and other equipment. Using Database Toolbox (also available independently), can access images stored in ODBC/JDBC-compliant databases.
MATLAB guide standard data and picture formats, along with HDF-EOS, FITS, TIFF, PNG, JPEG, HDF, ASCII, Microsoft Excel and binary files. It also guide multiband image formats, such as LANDSAT. Low-level I/O functions approve you to advance custom routines for working with any data format.

Picture Processing Toolbox guides a number of specialized image file formats. For medical images, it guides the DICOM file format, along with associated metadata, as well as the Analyze 7.5 and Interfile formats. The toolbox additionally can read geospatial picture in the NITF format and high dynamic range pictures in HDR format.

![Sample MRT Images in DICOM Format](image.png)

**Figure A2.1 Sample MRT Images in DICOM Format**

### A2.2.1 Image Processing Toolbox

Picture Processing Toolbox in MAT LAB 7.0 serves a global set of reference-standard algorithms and graphical tools for picture processing, visualization, analysis and algorithm development. Picture Processing Toolbox guides scientists and engineers in areas such as remote sensing, biometrics, surveillance, microscopy, gene expression, semiconductor testing,
color science, image sensor design and material. It also promotes the learning and teaching of image processing techniques.

A medical picture is poised of pixels which can be thought of as small dots on the mask. A digital picture is an direction of how to dye each pixel. We will see in article later on how this is done in practice. A typical size of an image is 512-by-512 pixels. Later on in the course you will see that it is beneficial to let the dimensions of the picture to be a power of 2.

A2.2.2 Intensity Image

This is the comparable to a "gray scale image" and this is the picture we will largely work with in this course. It describes an image as a matrix where each element has a value is parallel to how bright/dark the pixel at the parallel position should be colored. There are two ways to described the number that represents the gloss of the pixel: The double class or data type. This nominates a floating number ("a number with decimals") between 0 and 1 to each pixel.

The value 0 corresponds to black and the value 1 corresponds to white. The other class is called uint8 which nominate an integer between 0 and 255 to describe the gloss of a pixel. The value 0 parallel to black and 255 to white. The class uint8 only desire roughly 1/8 of the storage compared to the class double. On the other hand, many mathematical functions can only be adapted to the double class. We will see later how to novitiate between double and uint8.
APPENDIX 3

MAGNETIC RESONANCE IMAGE

A3.1 MAGNETIC RESONANCE IMAGE

Magnetic resonance imaging (MRI) is basically a medical imaging technique most generally used in radiology to visualize accurate internal structure and limited function of the body. MRI produces much greater variation between the various soft tissues of the body than computed tomography (CT) does, making it peculiarly useful in neurological (brain), oncological, musculoskeletal, cardiovascular and (cancer) imaging. It’s not like a CT scan. It benefits no ionizing radiation, but uses a powerful magnetic field to adjust the nuclear magnetization of (usually) hydrogen atoms in water in the body. Radio frequency (RF) fields are used to consistently alter the alignment of this magnetization, causing the hydrogen nuclei to provide a rotating magnetic field appreciable by the scanner. This signal can be manipulated by additional magnetic fields to compose enough information to design an image of the body.

A3.2 MRI Basics

An MRI change the magnetic field of the body portion being viewed. Normal tissue and gross tissues don’t provide the same images when this process of magnetic radio waves crosses the magnetic field of the body portion being viewed, aiding medical personnel in detecting abnormalities.
A3.2.1 Normal MRI Brain Images

Normal brain images provided by an MRI will have any basic properties—they will arrive equal in ratio on both the left and the right sides of the picture on the page, as well as same in size and coloration dimension for every section of the brain imaged. For example, the brain axial picture (a view from above the head) is similar in arrival to a walnut when it has been completely halved with no destruction resulting to the nut involved on the inside of the shell. This brain image in an MRI would mirror a normal functioning brain.

A3.2.2 Abnormal MRI Brain Images

Abnormal brain picture will vary build upon the medical sickness or disease that is present in the patient. This is due to the basis that illnesses upset different parts of the brain and will only be described in that particular portion of the brain during the visualize process. One observable difference that will be present in every stage, however, is the obvious disparity between the two sides or portions of the brain being notice. If the picture shows a huge-sized segment of the brain on the left side in contrast to the right, then there is evidence of an irregularity. Another abnormal brain image could be imitated in color variation. For example, commonly an MRI produces an picture with muted gray dye. If the MRI picture has a segment of the brain that appears as white, then this can express an abnormal brain MRI image, and also, abnormal brain MRI images can look much darker in certain areas alternative of the general hush shade of gray.

A3.3 WORKING PROCEDURE

The body is poised of water molecules which each encloses two hydrogen nuclei or protons. When a person tucks inward the powerful
magnetic range of the scanner, the magnetic occasion of these protons align with the direction of the field.

A radio density electromagnetic range is then shortly turned on, induce the protons to alter their sequence relative to the range. When this range is turned off the protons return to the primary magnetization sequence. These sequence revolution create a signal which can be expose by the scanner. The density at which the protons oscillate depends on the energy of the magnetic range. The geography of protons in the body can be determined by practice additional magnetic range during the scan which allows an picture of the body to be boost.

These are produced by turning gradient coils on and off which generate the knocking sounds heard along an MR scan. Diseased tissue, such as tumors, can be catch because the protons in other tissues return to their equilibrium state at various rates. By altering the parameters on the scanner this issue is used to create contrast between various types of body tissue. Contrast deputy may be injected intravenously to enhance the arrival of blood vessels, tumors or inflammation. Contrast agents may also be directly infused into a joint in the case of arthrograms, MR picture of joints. Unlike CT, MRI uses no ionizing radiation and is commonly a very safe proceeding. Patients with some metal implants, cochlear implants, and cardiac pacemakers are interrupt from having an MRI scan due to stuff of the capable field and powerful radio density pulses. MRI is used to image every part of the body, and is especially useful for neurological circumstance, for disarray of the muscles and joints, for evaluating tumors, and for display abnormalities in the heart and blood vessels.
A3.3.1 \( T_1 \)-weighted

MRI equipment is costly. 1.5 tesla scanners regularly price between $1 million and $1.5 million USD. 3.0 tesla scanners regularly price between $2 million and $2.3 million USD. manufacture of MRI suites can price up to $500,000 USD, or more, depending on deal scope.

A3.3.2 \( T_2 \)-weighted

\( T_2 \)-weighted flash use a spin echo (SE) sequence, with high TE and high TR. They have long been the clinical factotum as the spin echo arrangement is less affected to inhomogeneities in the magnetic range. They are especially well suited to edema as they are touchy to water fulfilled.

A3.4 Benefits of MRI

- MRI is a noninvasive imaging technique that does not involve exposure to ionizing radiation.

- MR images of the soft-tissue structures of the body—such as the heart, liver and many other organs— is more likely in some instances to identify and characterize abnormalities and
focal lesions than other imaging methods. This detail makes MRI an invaluable tool in early diagnosis and evaluation of many focal lesions and tumors.

- MRI has confirmed valuable in diagnosing a large range of conditions, along with cancer, heart and vascular disease, and muscular and bone abnormalities.

- MRI approves the discovery of abnormalities that might be obscured by bone with another imaging method.

- MRI allows physicians to assess the biliary system noninvasively and without distinction injection.

The contrast material used in MRI exams is less likely to make an allergic attitude than the iodine-based materials used for conventional x-rays and CT scanning.

MRI produces a fast, noninvasive alternative to x-ray angiography for diagnosing trouble of the heart and blood vessels.

## A3.4 RISKS OF MRI

- The MRI examination acts almost no danger to the average patient when proper safety guidelines are followed.

- If sedation is used there is danger of excessive sedation. The technologist or nurse monitors your vital signs to minimize this danger.

- Even if the strong magnetic field is not bad in itself, implanted medical devices that have metal may malfunction or cause problems at the time of an MRI exam.
• There is a very minor danger of an allergic reaction if contrast material is injected. Such attitude commonly are mild and easily controlled by medication. If you practice allergic symptoms, a radiologist or another physician will be vacant for immediate assistance.

• Nephrogenic systemic fibrosis is presently a recognized, but rare, confusion of MRI believed to be used by the injection of high doses of MRI contrast material in sufferer with very poor kidney function.

A3.4.1 Limitations of MRI of the Body

High-quality pictures are guaranteed only if you are capable to remain perfectly still or hold your breath, if needed to do so, while the pictures are being recorded. If you are anxious, perplexed or in severe pain, you may determine it crucial to lie still at the time of imaging. A person who is very huge may not fit into the opening of a conventional MRI machine. The existence of an implant or other metallic object at times makes it crucial to obtain clear pictures and patient movement can have the same effect.. Breathing may uses artifacts, or image distortions, at the time of MRIs of the chest, abdomen and pelvis. Bowel motion is other source of motion artifacts in abdomen and pelvic MRI studies. This is less of a trouble with state-of-the art scanners and techniques. Although there is no induction to trust that magnetic resonance imaging harms the fetus, pregnant women commonly are advised not to have an MRI exam unless medically significant. MRI may not always differentiate between cancer tissue and edema fluid.MRI typically costs more and may take more time to implement than other imaging modalities.
APPENDIX 4

GRAPHICAL USER INTERFACES FOR AUTOMATIC SYSTEM

Figure A4.1 Registration process for automatic system

Figure A4.2 Contrast difference between normal MRI and douted MRI
Figure A4.3 Sum of square difference between normal MRI and doubted MRI

Figure A4.4 White cells difference between normal and abnormal MRI
Figure A4.5 Segmented image from original MRI

Figure A4.6 Classification report
Figure A4.7 Segmentation using genetic algorithm
Table A4.1 Time Complexity when number of cluster varying

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Figure A4.8 Time complexity between segmentation methods