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**Ranjita Chowdhury**  
Department of Computer  
Science and Engineering, St.  
Thomas College of Engineering  
and Technology, Kolkata,  
India

**Samir Kumar Bandyopadhyay**  
Professor Department of  
Computer Sc. & Engineering,  
University of Calcutta,  
Kolkata, India

## Analyze of some common brain diseases

**Ranjita Chowdhury and Samir Kumar Bandyopadhyay**

### Abstract

In this paper some common brain diseases are discussed. It concluded with the segmentation of brain for finding brain tumor is presented. It helps researchers to get an idea about brain diseases with symptoms and recovery process.

**Keywords:** Common types of brain diseases, dementia, Parkinson, Alzheimer and brain tumor

### Introduction

Brain is part of the nervous system, which also includes the spinal cord and a large network of nerves and neurons. Together, the nervous system controls everything from five senses to the muscles throughout our body.

When your brain is damaged, it affects many different parts, including our memory, your sensation, and even your personality. Brain disorders include any conditions or disabilities that affect our brain.

Brain injuries are often caused by blunt trauma. Trauma can damage brain tissue, neurons, and nerves. This damage affects your brain's ability to communicate with the rest of your body. Examples of brain injuries include:

- hematomas
- blood clots
- contusions, or bruising of brain tissue
- cerebral edema, or swelling inside the skull
- concussions
- strokes

Examples of the symptoms of a brain injury include:

- vomiting
- nausea
- speech difficulty
- bleeding from the ear
- numbness
- paralysis
- memory loss
- problems with concentration

Sometimes, tumors form in the brain and can be very dangerous. These are called primary brain tumors. In other cases, cancer somewhere else in your body spreads to your brain. These are called secondary or metastatic brain tumors.

Brain tumors can be either malignant (cancerous) or benign (noncancerous). Doctors classify brain tumors as grades 1, 2, 3, or 4. Higher numbers indicate more aggressive tumors. The cause of brain tumors is largely unknown. They can occur in people of any age.

Symptoms of brain tumors depend on the size and location of the tumor. The most common symptoms of brain tumors are:

- headaches
- seizures
- numbness or tingling in your arms or legs

**Correspondence**  
**Ranjita Chowdhury**  
Department of Computer  
Science and Engineering, St.  
Thomas College of Engineering  
and Technology, Kolkata,  
India

- nausea
- vomiting
- changes in personality
- difficulty with movement or balance
- changes in your hearing, speech, or vision

Some brain diseases, such as Alzheimer's disease, may develop in later stage of age. They can slowly impair your memory and thought processes. Other common neurodegenerative diseases include:

- Huntington's disease
- amyotrophic lateral sclerosis
- Parkinson's disease
- all forms of dementia

Some of the more common symptoms of neurodegenerative diseases include:

- memory loss
- forgetfulness
- apathy
- anxiety
- agitation
- a loss of inhibition
- mood changes

Mental disorders, or mental illnesses, are a large and diverse group of conditions that affect your behavior patterns. Some of the most frequently diagnosed mental disorders are:

- depression
- anxiety
- bipolar disorder
- post-traumatic stress disorder
- schizophrenia

The symptoms of mental disorders vary based on the condition. Different people can experience the same mental disorders very differently.

Parkinson's disease (PD) is a chronic and progressive movement disorder, meaning that symptoms continue and worsen over time. Parkinson's involves the malfunction and death of vital nerve cells in the brain, called neurons. Parkinson's primarily affects neurons in an area of the brain called the substantia nigra. Some of these dying neurons produce dopamine, a chemical that sends messages to the part of the brain that controls movement and coordination. As PD progresses, the amount of dopamine produced in the brain decreases, leaving a person unable to control movement normally.

The specific group of symptoms that an individual experiences varies from person to person. Primary motor signs of Parkinson's disease include the following.

- tremor of the hands, arms, legs, jaw and face
- bradykinesia or slowness of movement
- rigidity or stiffness of the limbs and trunk
- postural instability or impaired balance and coordination

Symptoms of Parkinson's disease differ from person to person. They also change as the disease progresses. Symptoms that one person gets in the early stages of the disease, another person may not get until later-or not at all.

Symptoms typically begin appearing between the ages of 50 and 60. They develop slowly and often go unnoticed by family, friends, and even the person who has them.

Most common type of dementia; accounts for an estimated 60 to 80 percent of cases.

Difficulty remembering recent conversations, names or events is often an early clinical symptom; apathy and depression are also often early symptoms. Later symptoms include impaired communication, poor judgment, disorientation, confusion, behavior changes and difficulty speaking, swallowing and walking.

Revised guidelines for diagnosing Alzheimer's were published in 2011 recommending that Alzheimer's be considered a slowly progressive brain disease that begins well before symptoms emerge.

Hallmark abnormalities are deposits of the protein fragment beta-amyloid (plaques) and twisted strands of the protein tau (tangles) as well as evidence of nerve cell damage and death in the brain.

### Review Works

Alzheimer described the case of a 51-year-old woman with a 'peculiar disease of the cerebral cortex,' who had presented with progressive memory and language impairment, disorientation, behavioral symptoms (hallucinations, delusions, paranoia), and psychosocial impairment [1-3]. Remarkably, many of the clinical observations and pathological findings that Alzheimer described more than a century ago continue to remain central to our understanding of AD today.

Alzheimer's disease is often confused with normal aging and dementia. Severe memory loss, characteristic of AD, is not a symptom of normal aging. Healthy aging may involve the gradual loss of hair, weight, height and muscle mass. Skin may become more fragile and bone density can be lost. A decrease in hearing and vision may occur, as well as a decrease in metabolic rate. It is common to have a slight decline in memory, such as slower recall of information, however cognitive decline that impacts daily life is not a normal part of the aging process.

Dementia is defined as the significant loss of cognitive abilities severe enough to interfere with social functioning [5-6]. It can result from various diseases that cause damage to brain cells. There are many different types of dementia, each with its own cause and symptoms. For example, vascular dementia is caused by decreased blood flow to a part of the brain, as caused by a stroke. Dementia may also be present in patients with Parkinson's disease and hydrocephalus. AD is the most common form of dementia, caused by the build-up of beta amyloid plaques in the brain. Dementia is a clinical syndrome (a group of cooccurring signs and symptoms) that involves progressive deterioration of intellectual function [4]. Various cognitive abilities can be impaired with dementia, including memory, language, reasoning, decision making, visuospatial function, attention, and orientation. In individuals with dementia, cognitive impairments are often accompanied by changes in personality, emotional regulation, and social behaviors. Importantly, the cognitive and behavioral changes that occur with dementia interfere with work, social activities, and relationships and impair a person's ability to perform routine daily activities (e.g., driving, shopping, housekeeping, cooking, managing finances, and personal care). AD is a critical public health issue in many countries

around the world, with a significant health, social, and financial burden on society. Worldwide, it is estimated that 35 million people have AD or other types of dementia, and about 65 million people are expected to have dementia by 2030 (115 million by 2050). AD is a multifactorial disease, with no single cause known, and several modifiable and non-modifiable risk factors are associated with its development and progression. Age is the greatest risk factor for the development of AD. The likelihood of developing AD increases exponentially with age, approximately doubling every 5 years after age 65.<sup>10, 11</sup> The vast majority of individuals suffering from AD are aged 65 or older and have 'late-onset' or 'sporadic' AD (95% of all cases). Rare genetic mutations are associated with the development of AD before age 65, which is known as 'early-onset' or 'familial' AD (5% of all cases). The gold standard for the diagnosis of AD is an autopsy-based (post-mortem) pathological evaluation. The presence and distribution of amyloid plaques and NFT in the brain is used to establish the diagnosis of 'definitive' AD and stage the disease. In clinical settings, the diagnosis of AD is largely based on medical history, physical and neurological examinations, and neuropsychological evaluation, as well as the exclusion of other etiologies using selective ancillary testing. The clinical diagnosis of AD has an accuracy of 70-90% relative to the pathological diagnosis, with greater accuracies being achieved in specialty settings such as memory disorder clinics. There is no cure for AD, and drug therapy for the disease is still in its infancy. Approved medications for the treatment of probable AD help control the symptoms of AD but do not slow down the progression or reverse the course of the disease itself. Positron emission tomography utilizing 18F-fluorodeoxyglucose (FDG-PET) as a radioactive tracer is a nuclear imaging technique which measures regional brain metabolism. The earliest sign of AD detectable on an FDG-PET scan is the hypometabolism of the posterior cingulate cortex and precuneus.

### Methodology

Neuroimaging is a promising area of research for detecting AD. There are multiple brain imaging procedures that can be used to identify abnormalities in the brain, including PET, MRI, and CT scans. Each scan involves a unique technique and detects specific structures and abnormalities in the brain. Brain imaging is not currently a standard part of AD testing, however current clinical studies have shown promising results that may change the procedure used by physicians to diagnose the disease. PET Positron emission tomography (PET) uses radiation signals to create a three-dimensional color image of the human body. The patient is injected with a radiotracer, composed of a radioactive medicine bound to a naturally occurring chemical. For the study of AD, the chemical is usually glucose. The radiotracer travels to the organs that use that specific molecule for energy. As the compound is metabolized, positrons are emitted. The energy from these positrons is detected by the PET scan, which converts the input to an image. This image reflects the function of the patient's body by showing how effectively the radiotracer is broken down. The amount of positron energy emitted creates a variety of colors and intensities, which reflects the extent of brain activity. A PET scan has the capacity to detect changes in metabolism, blood flow, and cellular communication processes in the brain.

There is currently no cure for AD, however there are multiple drugs that have been proven to slow disease progression and treat symptoms. When initiating treatment for AD patients, physicians divide the symptoms into "cognitive" and "behavioral and psychiatric" categories. This enables treatment that is specific to the symptoms being experienced. Cognitive symptoms affect memory, language, judgment, and thought processes. Behavioral symptoms alter a patient's actions and emotions.

Parkinson's disease (PD) is a progressive neurodegenerative condition, affecting 1-2% of the over-65 population, causing dopamine deficiency within the nigrostriatal system. Pathologically there is loss of neurones within the substantia nigra pars compacta and other subcortical nuclei associated with the widespread occurrence of Lewy bodies. PD manifests clinically after the pathology has reached an advanced stage, with loss of approximately 50% of dopaminergic neurons. In common with other neurodegenerative conditions, it is thought that the pathogenesis of PD results from:

- The abnormal aggregation and processing of mutant or damaged protein
- The cellular response to that protein

There is no known biological marker for PD. The clinician is required to differentiate idiopathic PD from other parkinsonian syndromes. Clinical diagnostic accuracy in PD is important for therapeutic and prognostic reasons. It is also fundamental for accuracy in epidemiological studies and clinical trials. Pathological examination remains the gold standard for diagnosis of PD. Unfortunately, there are no widely accepted pathological criteria defined for this diagnosis. The usefulness of any diagnostic test can be assessed using sensitivity, specificity and positive and negative predictive values. The sensitivity of diagnostic criteria for PD is the proportion of patients with the disease who fulfil the criteria. The specificity of the criteria is the proportion of patients who do not have PD who do not fulfil the criteria. Given that sensitivity is conditional on the disease being present and specificity on the disease being absent, they should be unaffected by disease prevalence. The positive predictive value of the criteria is the probability that the patient has PD given that they meet diagnostic criteria. The negative predictive value of the criteria is the probability that the patient does not have PD, given that they do not meet diagnostic criteria. Positive and negative predictive values are dependent on the underlying prevalence of PD within the population being studied. Traditionally the diagnosis of PD required the presence of 2 out of the 3 motor cardinal features of: bradykinesia, rigidity and resting tremor. Several attempts at clinical diagnostic criteria have been proposed, but few have been applied consistently or assessed for reliability. There are no set of agreed pathological criteria for the diagnosis of PD. Many of these studies are retrospective and contain small numbers. In addition donor tissue is more likely to be received from patients who have died in hospital and in patients in whom there has been greater diagnostic uncertainty. The clinical criteria employed in these studies are often vague and in some not mentioned at all. However, these studies do suggest that a significant proportion of patients diagnosed with PD have an alternative diagnosis, and that diagnostic accuracy is greatest when patients are assessed by

movement disorder specialists and followed over a long period [7-8].

Prescription database searches of antiparkinson medications followed by case record review provide epidemiological data on PD and other parkinsonian syndromes, with greater accuracy than simply analysing data from pharmacy databases which often do not have diagnostic information. Variation in PD prevalence between geographical areas occurs, which is not explained by methodological differences. While there are differences between areas for risk factors for the development of PD, the magnitude of prevalence variation is great, and justifies more detailed research into the relative importance of several potential causes.

A brain tumor is a growth of abnormal cells inside the brain. Most brain tumors that children get are called primary brain tumors, meaning that they originated in the brain and did not spread from somewhere else. Tumors might be localized, remaining in one area, or they might be invasive, spreading into nearby tissues. Tumors are also categorized as benign (non-cancerous) or malignant (cancerous). However, it is difficult to call any brain tumor "benign", because all can cause serious problems.

Tumors can destroy brain cells directly, or they can indirectly cause damage, through these mechanisms:

- causing inflammation
- compressing (squeezing) other parts of the brain as the tumor grows
- causing generalized swelling of the brain, called cerebral edema
- causing increased intracranial pressure (the pressure inside the skull)

Brain tumors are classified by where they are in the brain, what kind of tissue they are composed of, whether they are benign or malignant, and many other factors. Some tumors tend to be hereditary, running in families. Other types, such as craniopharyngioma (KRAYN'-ee-oh-far-in-jee-oh'-mah), seem to be congenital, developing before birth. Ultimately, the cause of most brain tumors is not known.

Brain tumors can occur at any age. Tumors of the central nervous system (brain and spinal cord) make up about 20 percent of all childhood cancer cases, which makes it second in number only to leukemias. The annual incidence of brain tumors in children under the age of 15 is about 3 per 100,000. More than 1,200 new cases of brain tumor occur each year.

The incidence of many tumors varies with the age of the patient. For example, gliomas account for 75 percent of brain tumors diagnosed in children, but only 45 percent in adults. Retinoblastoma is the only form of brain tumor that is commonly seen in the first year of life.

### Symptoms

The symptoms of a brain tumor depend upon several factors, including the specific site of the tumor, the type of tumor, and the age and health of the patient. Symptoms might include the following:

- headache
- vomiting
- personality or behavior changes
- emotional instability or rapid emotional changes
- intellectual decline
- seizures

- facial paralysis
- eye abnormalities or double vision
- reduced level of consciousness or decreased alertness
- weakness or lethargy
- Visit in hospital.
- general ill feeling or malaise
- swallowing difficulty
- impaired sense of smell
- uncontrollable movement
- hand tremor
- confusion
- Like the symptoms, the treatment for a brain tumor depends upon its site, type and size. Tumors should all be treated promptly to increase the chance of a good outcome.
- The goals of treatment might be cure of the disorder, relief of symptoms or improvement of function. There are three main types of treatment: surgery, radiation therapy and chemotherapy.
- Most brain tumors require some sort of surgery. If a tumor is completely removed, it is said to be excised. If the tumor is deep within the brain or if it has infiltrated the surrounding brain tissue, the neurosurgeon might elect to remove as much of the tumor as possible, a process called "debulking". Sometimes the tumor is biopsied, where a piece of tissue is removed so it can be examined and tested in the laboratory. This will help the oncologist determine the type of tumor involved and how best to treat it. Sometimes a special technique called stereotactic (ster-ee-oh-TAK'-tihk) surgery, often guided by computer-assisted tomography (a CAT scan), can be helpful in removing tumors located very deep within the brain. Even if a tumor cannot be removed, surgery can reduce the intracranial pressure (the pressure on the brain) and relieve symptoms.

Radiation therapy uses radiation or high-energy particles, such as x-rays, gamma rays and neutrons, to kill cancer cells and shrink tumors. Radiation comes from a machine that emits what is called external beam radiation therapy. Radiation therapy is only used with certain types of tumors that are sensitive to this treatment. There are sometimes side effects from radiation therapy, including fatigue, burns and possible damage to surrounding tissue.

Chemotherapy refers to many types of anticancer medications. These strong medicines are used for some brain tumors that are sensitive to chemotherapy drugs. They may be taken by mouth (orally), in a shot in the muscle (IM), or through a vein (IV). Some chemotherapy drugs have strong side effects, which are discussed in the next section.

Other medications that might be used are: corticosteroids and osmotic diuretics to reduce brain swelling; anticonvulsants to reduce seizures; analgesics to control pain; and antacids or histamine blockers to control stomach ulcers.

Treatment for a brain tumor might include other supportive or therapeutic services. Physical therapy, occupational therapy and speech therapy might be needed to address the effects of the tumor itself or of the surgery. Support from a psychologist or social worker might be helpful with adjustment issues, because a brain tumor can result in changes in abilities, behavior and many other aspects of life.

### Possible treatment side effects

In addition to symptoms from brain swelling, increased pressure inside the skull, and surgery, a person with a brain tumor might also experience significant side effects of radiation therapy and chemotherapy. The degree and intensity of side effects depends on several factors, including the patient's age, the site of the tumor, the type and dosage of radiation therapy and the type and dosage of chemotherapy. Some people will experience minimal side effects, while others will encounter side effects from treatment that seem more devastating than the tumor itself.

Most of the side effects of radiation go away soon after the treatment is over. However, some complaints might persist. Nausea, fatigue, dry mouth and skin reactions in the treatment area are usually temporary. Sometimes, radiation therapy affects blood counts, but this is unusual when treating brain tumors. Hair loss may occur, but is often temporary. Sometimes, hair is darker when it regrows. A major side effect of radiation for brain cancer is damage to normal brain tissues. The damage can mild, moderate or severe. Newer techniques of radiation therapy have limited this damage to normal tissues.

Chemotherapy, often simply called "chemo", can cause many side effects. Some drugs affect the bone marrow or blood-producing tissue. The medical provider will monitor these effects by following blood counts. White blood cells (which fight off infections), red blood cells (which contain hemoglobin to carry oxygen to other parts of the body) and platelets (which help form clots) can all be affected by chemo. The result might be increased risk of infection; increased risk of bruising or bleeding; or anemia and fatigue. Other possible side effects of chemotherapy include:

### Friends with cancer

Nausea and vomiting weight change diarrhea and constipation mouth sores fever pain temporary hair loss depression and anxiety Sometimes medications called steroids are prescribed to reduce inflammation in the brain. Common side effects of steroids include increased appetite and weight gain, swelling of the face and feet, restlessness, mood swings, burning indigestion and acne. As the doctor works to adjust the dosage of the steroids, the child may experience some fatigue and difficulty with concentration. These symptoms are usually eliminated when the dosage is adjusted to precisely fit the child's needs.

Some children with brain tumors are unable to participate fully in physical activities because of the tumor or the side effects of treatment. They might have times when they are very fatigued, or perhaps have experienced significant weight gain from the steroids. However, the child should be encouraged to participate in activities to the greatest extent possible. Depending on specific circumstances, the child might require snacks in the morning or afternoon. The child's medical team will provide advice and information on any necessary limitations or special requirements.

Brain tumor is one of the major causes for the increase in mortality among children and adults. The complex brain tumors can be separated into two general categories depending on the tumors origin, their growth pattern and malignancy. Primary brain tumors are tumors that arise from cells in the brain or from the covering of the brain. A secondary or metastatic brain tumor occurs when cancer cells spread to the brain from a primary cancer in another part of the body. Most Research in developed countries

show that the number of people who develop brain tumors and die from them has increased perhaps as much as 300 over past three decades.

The Segmentation of an image entails the division or separation of the image into regions of similar attribute. The ultimate aim in a large number of image processing applications is to extract important features from the image data, from which a description, interpretation, or understanding of the scene can be provided by the machine. The segmentation of brain tumor from magnetic resonance images is an important but time-consuming task performed by medical experts The digital image processing community has developed several segmentation methods<sup>[10]</sup>.

Four of the most common methods are:

1. Amplitude Thresholding,
2. Texture Segmentation
3. Template Matching and
4. Region Growing Segmentation (RGS).

It is very important for detecting tumors, edema and necrotic tissues. These types of algorithms are used for dividing the brain images into three categories (a) Pixel based (b) Region or Texture Based (c) Structural based. Several authors suggested various algorithms for segmentation. Some of them suggested a multi-scale image segmentation using a hierarchical self-organizing map; a high speed parallel fuzzy c-mean algorithm for brain tumor segmentation. An improved implementation of brain tumor detection using segmentation based on neuro fuzzy technique was proposed some researchers. Some designed a method on 3D variational segmentation for processes due to the high diversity in appearance of tumor tissue from various patients.

### 3. Present methods

Noise presented in the image can reduce the capacity of region growing filter to grow large regions or may result as a fault edges. When faced with noisy images, it is usually convenient to preprocess the image by using weighted median filter. The MRI image consists of film artifact or labels on the MRI such as patient name, age and marks. Film artefact is removed using general preprocessing algorithm. Here, starting from the first row and the first column, the intensity value, greater than that of the threshold value is removed from MRI. The image is given to enhancement stage for the removing high intensity component and the above noise. This part is used to enhance the smoothness towards piecewise- homogeneous region and reduce the edge blurring effects. This proposed system describes the information of enhancement using weighted median filter for removing high frequency component.

### Algorithm

It is presented in c-like code with some functions whose names indicate the operation of the functions.

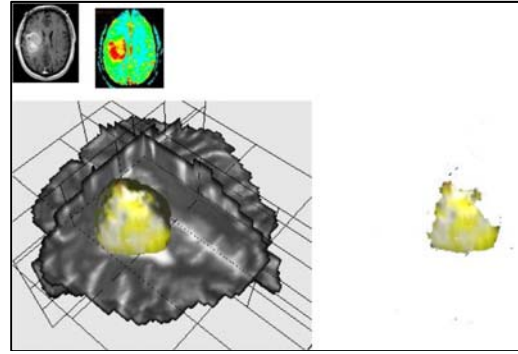
```
namespace Mri Out
{class Program
{public static Int32 qf = 16;
static void Main(string[] args)
{String imgName = "";
String pathName = @"C:\WorkFolder\";
if (args.Length != 1)
{Console.WriteLine("Error");
Console.ReadKey();}
```

```

else
imgName = args[0].ToString();
String svName = pathName +
imgName.Substring(0, imgName.Length - 4);
GauSmooth gs = new
GauSmooth(imgName);
gs.Smooth();
gs.save(svName);
MidPointQuant_Mode hq = new
MidPointQuant_Mode(svName+"_GS.bmp");
hq.perform();
hq.saveBitmap(svName + "_h");
MidPointVert_Mode vq = new
MidPointVert_Mode(svName + "_h.bmp");
vq.perform();
vq.saveBitmap(svName + "_hv");
MonoToneHorzEdge he = new
MonoToneHorzEdge(svName + "_hv.bmp");
he.getEdge();
he.saveBitmap(svName + "_hor_Ed");
MonoToneVertEdge ve = new
MonoToneVertEdge(svName + "_hv.bmp");
ve.getEdge();
ve.saveBitmap(svName + "_ver_Ed");
ImageOR io = new ImageOR(svName +
"_hor_Ed.bmp");
io.ORTo(svName + "_ver_Ed.bmp");
io.saveBitmap(svName + "_Edge");
SmoothCurveLine scl = new
SmoothCurveLine(svName + "_Edge.bmp");
scl.Perform();
scl.SaveAs(svName);
CleanEdge ce = new CleanEdge(svName + "_Edge.bmp",
svName + "_Bound.bmp");
ce.clean();
ce.save(svName);
Pectoral p = new Pectoral(svName + "_CleanEdge.bmp");
p.Perform();
ROI r = new ROI(svName + "_CleanEdge.bmp", svName +
"_Pect.bmp");
r.getRegion();
r.save(svName);
SmoothOutLine sol = new SmoothOutLine(svName +
"_Smooth.bmp", svName + "_PectSmooth.bmp");
sol.save(svName);
TrueOutLine tol = new TrueOutLine(svName +
"_Bound.bmp", svName + "_Pect.bmp");
tol.save(svName);
Anatomy an = new Anatomy(svName + "_ROI.bmp");
an.Perform();
an.save(svName);
SRG sr = new SRG(pathName + imgName, svName +
"_Ana.bmp", svName + "_Pect.bmp");
sr.perform();
sr.save(svName);}} }

```

The outputs of the algorithm are given below. The tumor is finally detected from the portion brain image.



### Conclusions

This paper describes different brain diseases with tumor detection. The proposed algorithm is given for better understanding of tumor detection.

### References

1. Alzheimer A. Uber eine eigenartige Erkrankung der Hirnrinde [About a Peculiar Disease of the Cerebral Cortex]. *Allg Z Psychiatr* 1907; 64:14648.
2. Alzheimer A. About a peculiar disease of the cerebral cortex. *Alzheimer Dis Assoc Disord* 1987; 1:38.
3. Maurer K, Volk S, Gerbaldo H, Auguste D. Alzheimer's disease. *Lancet*. 1997; 349(9064):15469.
4. Gilman S. *Oxford American handbook of neurology*. Oxford University Press: Oxford, UK, 2010.
5. Healthy Aging-Normal Aging. *WebMD - Better Information*. Better Health. Web. 12 Oct. 2010.
6. Dementia Definition - Alzheimer's disease Information on *MedicineNet.com*. Medicine Net. 21 June 2002. Web. 10 Oct. 2010.
7. Ahmad, Chappell P. Surface EMG pattern analysis of the wrist muscles at different speeds of contraction. *J. Med. Eng. Technol.* 2009; 33(5):376-385.
8. Ascherio G, Gizdulich P. Denoising of surface EMG with a modified Wiener filtering approach. *J. Electromyogr. Kinesiol.* 2010; 20(2):366-373.