Chapter 4
Problem Statement Formulation

4.1 Barriers to Dementia Diagnosis

- Patients and their caregivers do not typically report cognitive difficulties.
- Cognitive difficulties may be masked by a continued ability to act in a socially acceptable manner.
- Physicians fail to recognize early signs.
- The mental status tests currently available are time-consuming, and the time required to administer them is unlikely to be reimbursed.
- Some of the most commonly used mental status tests lack the sensitivity and/or specificity required for an accurate diagnosis.
- In a small number of cases, co-morbid conditions (especially depression and delirium) can make differential diagnosis problematic. [9]

In developing country like India, population is more. The numbers of suffering people are also more but, comparatively very less number of experts are available. It’s not possible for them to give treatment to all and it take lot of time to become any doctor an expert doctor. The CAD systems will help them to become expert. As the disease is reversible if diagnosed at the early stage, the patients may have to suffer for the rest of their life. CAD systems could be used to reduce the number of mortality and reduce the waiting time to see the specialist. Computer program or software developed by emulating human intelligence could be used to assist the doctors in making decision without consulting the specialists directly. The software was not meant to replace the specialist or doctor, yet it was developed to assist general practitioner and specialist in diagnosing and predicting patient’s condition from certain rules or "experience". Patient with high-risk factors or symptoms or predicted to be highly effected with certain diseases or illness, could be short listed to see the specialist for further treatment. Employing the technology especially Artificial Intelligence (AI) techniques in medical applications could reduce the cost, time, human expertise and medical error.

4.2 Computational Representation of brain

The complexity of human brain structure mandates the use of engineering approaches drawn from computer vision, image analysis, computer graphics and artificial intelligence research fields to manipulate, analyze and communicate brain
data. The rapid growth in brain imaging technologies has also been matched by an extraordinary increase in the number of investigations analyzing brain structure and function in clinical and research settings. [100]

4.3 Problem Statement

Mild cognitive impairment can represent a transitional state between normal ageing and Alzheimer’s disease. Non-invasive diagnostic methods are needed to identify these three categories for early therapeutic interventions. Objective was, to determine whether automated magnetic resonance imaging based measures could do this classification with a high degree of accuracy.

4.4 Work Plan

Phase I: Experiment using data from OASIS database
Phase II: Experiments using 3D MR images from ADNI database
Phase III: Experiments using Whole brain atlas 2D MR images
4.5 Aims and Objectives

The primary objective of this research is to develop methods and algorithms to identify or classify types of neurodegenerative diseases. The main research activities specifically focus on investigating and improving feature extraction of information on the neurodegeneration of brain. These features are then used as the inputs to the Artificial neural networks to obtain the type of Dementia of the brain. Some of the issues this research aims to address are summarised as follows:

1. Identifying and using proper database with sufficient number of diseased and normal cases, of neurodegenerative diseases.
2. Development of ANN algorithm capable of classifying based on extracted features.
3. Making use of voxel based morphometry for normalization of brain images and finding brain tissue volumes.
4. Using brain tissue volumes as features carrying out subsequent ANN classification.
5. As Alzheimer's disease affects the hippocampus (part inside brain) first and severely, feature extraction from hippocampus and subsequent ANN classification.
6. Extraction of texture features from brain image and design of ANN classifier.
7. Applying frequency filter to brain image and then obtaining features; feature reduction and ANN classification.
8. Applying discrete wavelet transform to brain image and obtaining coefficients; feature reduction and ANN classification.
9. Optimizing and modifying the methods in order to reach maximum classification accuracy.