CHAPTER 1
INTRODUCTION AND SCOPE OF THE WORK

1.1 INTRODUCTION

Depression is one of the most common psychological problems affecting nearly everyone either personally or through a family member. Depression can interfere with normal functioning and frequently causes problems with work, social and family adjustment. Serious depression can destroy the family life and the life of the depressed person.

The term depression is used in many different ways: to describe transient states of low mood experienced by all people at some time in their life through to severe psychiatric disorders. Depression is understood to be a condition that generally comes and goes that is more likely at certain stages of the life cycle and with some types driven by genetic, biological factors and other types being more a response to major life events.

The clinical diagnosis of depression is made on the basis of the existence of a collection of signs and symptoms also called a syndrome. Currently, the most widely used classification systems for depressive disorders are the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) and International Classification of Diseases (ICD-10) which has replaced by ICD-9. The DSM-IV system underpins much clinical practice and is both a dimensional and categorical are the sub typing of DSM-IV system. It allows a continuum of severity but also includes three major depression subtypes:

1. Mild, moderate or severe major depression without psychotic symptoms.
2. Severe major depression with psychotic symptoms and
The ICD-10 system forms the basis of much research and international comparisons. It subdivides depression along a severity continuum into:

a. Mild.

b. Moderate and

c. Severe with or without psychotic features.

Depressive symptoms can be measured in the community and in research populations by a number of self-report inventories and checklists. Depression is nearly twice as common in women as in men. Many women (particularly in this cohort of older adults) may have experienced post-partum or “empty nest” depression that was not recognized or treated. Because of the stigma associated with mental illness in this cohort, the depression may have been labeled as having a “nervous breakdown” or “bed sick” after some traumatic life experience. As a result, there may be no record of depression in the medical or psychiatric history [Rogerio, 2007].

**Common Behavioral Challenges:** The depressed persons may easily become so apathetic, lethargic and uncaring about personal hygiene, eating, activity etc., that the patients require an increased amount of staff time to execute their daily chores [Stice, 2001]. Many depressed elderly are mistaken for persons with dementia because of their concentration is so impaired that it seems their memory has failed. The person may become psychotic, hearing voices or believing things that aren't real leading staff to think them as schizophrenic [Migliore, 1994]. Agitated depression with increased irritability, brooding, pacing, and worry can create many problems for the staff and other residents. The person may become either verbally or physically threatening.
1.2 TYPES OF DEPRESSION

1.2.1 Major Depression: Major depression is a serious illness that affects a person's family personal relationships, work or school life, sleeping eating habits and general health. It’s impact on functioning and well-being has been equated to that of chronic medical conditions such as diabetes.

These observable changes occur nearly every day over at least a two week period of time and represent a change from the person’s previous level of functioning. A Major Depressive Disorder (MDD) is characterized by episodes of more persistent and pervasive disturbances in mood and accompanying features. It is formally diagnosed by the presence of at least five out of the nine symptoms including depressed mood and loss of interest. Over time, the person may also withdraw from social contact and show impairment in performing usual social roles. MDD is generally categorized into bipolar and unipolar subtypes. A distinction is made based on the different courses of the disorders and indicating different approaches to treatment [John, 2006].

1.2.2 Minor Depression: It is also called as “subclinical” or “subsyndromal” depression because it does not meet the full criteria for major depression. For example, the person has 4 of 5 symptoms. Like major depression, minor depression is associated with disability, reduced quality of life and responds well to the same treatments that are used with major depression.

1.2.3 Dysthymic Disorder: It is a chronic but less severe form of depression that includes depressed mood and at least two additional symptoms that persist for at least two years. People with dysthymia may also develop major depression.

1.2.4 Bipolar Disorder: Bipolar disorder is characterized by episodes of depression which may alternate with mania, which is indicated by elevated mood or irritability and other symptoms. Bipolar disorder requires different
treatments from major depression; professional diagnosis and treatment is essential.

1.2.5 Unipolar disorders: Unipolar disorders represents a larger residual group of disorders where an individual experiences depressive episodes only.

1.2.5.1 Melancholic or endogenous depression: It is associated with specific clinical features, particularly disturbance of psychomotor function. Although melancholic depression is rare in the community, it is an important condition in specialist treatment settings as it responds best to chemo-physical treatments such as antidepressant drugs and electroconvulsive therapy, and

1.2.5.2 Residual: It is a quite heterogeneous group of disorders, including ‘reactive depression’, ‘adjustment disorder with depressed mood’ and depressions secondary to and personality style [Goldberg, 1988]. It also includes DSM-IV disorders such as dysthymia and cyclothymia. Both of the latter are characterized by either fewer depressive symptoms or less severe expression of depressive symptoms than the MDDs, but the symptoms are persistent, lasting two or more years.

1.2.6 Postnatal depression: It describes the expression of depression associated with childbirth and post-partum mood disorder. These include brief episodes of depressed mood, MDD and post-partum psychosis in which psychotic symptoms are also present.

1.2.7 Adjustment Disorder with Depressed Mood: It has signs and symptoms of depression that occur in response to a significant psychosocial stressor but do not meet the full criteria for major depression. Symptoms occur within 3 months of the stressor and subside within six months after the stressor or its consequences have resolved.

1.2.8 Bereavement: It is signs and symptoms of depression that occur following the loss of a loved one. It is considered as bereavement unless the patients “persist for more than two months or include marked functional
impairment, morbid preoccupation with worthlessness, suicidal ideation, psychotic symptoms or psychomotor retardation.”

Affective disorders or mood disorders are terms that can be used to describe all those disorders that are characterized by mood disturbance. Disturbances can be in the direction of elevated expansive emotional state or in the opposite direction, i.e., in a depressed emotional state. Seasonal affective disorder is a subtype of mood disorder where there is a seasonal pattern of mood variation. There is a regular pattern of onset and remission of depressive symptoms and episodes, which usually have onset in autumn / winter and remission in spring / summer. The symptoms of seasonal affective disorder are a typical of depression, often comprising hypersomnia, carbohydrate craving as well as increased appetite and weight gain [David, 1989].

Anxiety is an unpleasant feeling of fear and apprehension accompanied by increased physiological arousal. Anxiety disorders are those in which fear or tension is the primary disturbance, include phobic disorders, panic disorder, generalized anxiety disorder, obsessive disorder and post-traumatic stress disorder [Ahlberg, 2002].

1.3 CAUSES OF DEPRESSION
1.3.1 Stress and Loss Associated with Ageing: Physical illness or disability decreased sensory capacities, changes in social status and responsibilities to others. It decreased self esteem due to role loss or change, loss of friends and family, relocation, loss of financial resources, social isolation and diminished capacity to adapt to change.
1.3.2 Biological Depression: Comes "out of no where", tends to be more severe than the "reactive" type and person more likely to have other episodes earlier in life.
1.3.3 Physical Illness: Physical illness can directly cause the symptoms of depression, physical illness can cause a reaction of depression by causing chronic pain, or fear of pain, disability, loss of function, loss of self esteem, increased dependence, fear of death, depressed elderly may present with physical complaints and medications can cause the symptoms of depression. The environment in which physical illnesses are treated may contribute to isolation, sensory deprivation and enforced dependency.

1.4 PHYSICAL ILLNESSES THAT IS ASSOCIATED WITH DEPRESSION

1.4.1 Metabolic Disturbances: Acid-base disturbance, azotemia, uremia, dehydration, hypo and hypocalcaemia, hypo and hyperglycemia, hypo and hyperglycemia, hypo and hypernatremia and hypoxia.

1.4.2 Endocrine: Addison's disease, Cushing's disease, Diabetes mellitus, Hyper and hyperparathyroidism Hypo and hyperthyroid [Alberti, 1998].

1.4.3 Neurological Disease: Aneurysms, brain tumors, cerebral arteriosclerosis, cerebral infarct, cerebrovascular disease, dementia: all types, intracranial tumors, meningitis, neurosyphilis, Parkinson’s disease, subarachnoid hemorrhage and temporal lobe epilepsy [David, 2002].

1.4.4 Respiratory Infections: Brucellosis, hepatitis, influenza, pneumonia and tuberculosis

1.4.5 Cancer: Occult carcinomas and pancreatic cancer.

1.4.6 Cardiovascular Disorders: Congestive heart failure, endocarditis and myocardial infarction.

1.4.7 Pulmonary Disorders: Chronic obstructive lung disease and malignancy.

1.4.8 Gastrointestinal Disorders: Hepatitis, irritable bowel, malignancy, other organic causes of chronic and abdominal pain, ulcer, and diverticulosis.

1.4.9 Genitourinary: Urinary incontinence and urinary tract infections.
1.4.10 Musculoskeletal Disorders: Degenerative arthritis, osteoporosis with vertebral compression or hip fracture, paget’s disease, polymalgia rheumatic, and rheumatoid arthritis.

1.4.11 Collagen Vascular Disease: Systemic lupus erythematosis.

1.4.12 Anemias: Folate & iron deficiencies, megaloblastic anemia and pernicious anemia.

1.4.13 Metal Intoxications: Toxicity due to the metal like Thallium, and mercury.

1.5 SIGNS AND SYMPTOMS OF DEPRESSION

1.5.1 Disturbed Mood: Sadness, discouragement, crying, anxiety, panic attacks, brooding, irritability and the patients feel sad, blue, depressed moods.

1.5.2 Disturbed Perception: Loss of ability to experience pleasure, withdrawal from usual activities often related to fatigue, loss of concentration, or inability to feel pleasure, feelings of worthlessness, unreasonable fears, which are often associated with anxiety, excessive worry, feelings of guilt, including self-reproach for minor failings, delusions, and hallucinations.

1.5.3 Behavioral Changes:

- Increased or decreased body movements: (e.g., psychomotor agitation or retardation); pacing, wringing hands, pulling or rubbing hair, body, or clothing;

- Sleep disturbance: difficult to get sleep, staying asleep or especially waking up early;

- Changes in appetite: usually loss of appetite but sometimes increased appetite; weight loss, but occasionally weight gain; fatigue, decreased energy;
Preoccupation with physical health: imagining as suffering from cancer or some other serious illness when the patients don't have;

Difficulty in concentrating, thinking or making decisions: slowed speech, slowed responses with pauses before answering, decreased amounts of speech, low or monotonous tones of voice; thoughts of death or suicide or suicide attempts; constipation and unusually fast heartbeat.

1.5.4 Study Indication Groups: Major depressive disorder, other depressive disorders, other psychiatric disorders, behavioral disorders and other disorders.

1.5.5 Other Depressive Disorders: Bipolar disorder, premenstrual dysphoric disorder, posts natal depression, seasonal affective disorder, typical depression, bipolar disorder, and dysthymia.

1.5.6 Other Psychiatric Disorders: Adjustment disorder, anxiety disorders, alzheimer’s disease, bulimia, generalized anxiety disorder, generalized social phobia, negative symptoms of schizophrenia, neurasthenia, non-depressed Obsessive Compulsive Disorder (OCD), pain disorder, panic disorder, post-traumatic stress disorder and social anxiety disorder.

1.5.7 Other Behavioral Disorders: Alcoholism, insomnia, anxiety preceding surgery, obesity and hypertension, and diabetes, or glucose intolerance, smoking cessation, weight loss and weight maintenance [Mokdad, 1995; Roberts, 2003; Seidel, 1999; Simon, 2006].

1.5.8 Other Disorders: Diabetic neuropathy, fibromyalgia, mixed urinary incontinence, migraine prophylaxis, neuropathic pain, non-ulcer dyspepsia, premature ejaculation, stress urinary incontinence, sexual dysfunction, sleep in healthy volunteers and urge urinary incontinence.

1.5.9 Depression and Related Disorders: Depression and anxiety disorders, depression and health-related risk behavior, depression and
physical illness, depression and other natural health priority areas, cardiovascular health, diabetes, cancer and injury [Han, 1995].

1.5.10 The Course of Depression across the Lifespan: Childhood, adolescence, adulthood, postnatal depression and depression in the older years [Aro, 1987; Hayward, 1989; Kaltiala, 2006].

1.5.11 Impact of Depression: Depression causes a substantial burden of morbidity, disability and mortality.

1.5.12 Disability Outcomes Associated With Depressive Disorder: High levels of disability are reflected in impairment in work productivity, days lost from work, educational failure, poor family functioning, poor social functioning, diminished sense of wellbeing, utilization of medical services, and visits to medical clinics.

1.6 SCHEMATIC DIAGRAM FOR DEPRESSION CLASSIFICATION

Collect depression data

Categorize the data

Normalize the data

Separate the data into training set

Separate the data into testing set

Fig.1.1 Flow chart for separating the depression data

Figure 1.1 presents a schematic flow chart for separation of depression data. Depression data is collected from the patients. The data is categorized based on the experts suggestions (no
depression, mild depression etc.). The data is normalized. The data is separated into training and testing data.

1.6.1 Training the ANN algorithms

Figure 1.2 presents training sequence for ANN using depression data. The artificial neural network topology is initialized with nodes in the input layer, node sin the hidden layer and nodes in the output layer. Random weights are assigned between layers except in RBF. The network is presented with all the training patterns and the final weights of the network are stored separately in different files for further use in testing the ANN.

1.6.2 Testing the ANN algorithms/ Diagonising the Depression Patients

Figure 1.3 presents flow chart for testing the ANN. Data from a patient who feels discomfort is collected using questionnaire. The data is collected based on Hamiltonian rating scale. The data is normalized to fix the values in the range 0 to 1.
Collect data from the patients through oral discussion

As the information from the patients will not be precise, present the information into the input layer of the ANN algorithms and process with the stored weights

The outputs from the output layer of the ANN are used to retrieve the information from the database which will be a complete information in addition to the information provided by the patients

Based on the retrieved information, doctors can suggest remedies

Fig.1.3 Testing the ANN for identifying the type of depression present in a patient

Figure 1.4 presents the overall schematic flow for the implementation of ANN in identifying the depression in a patient. Data is collected from patients using Hamiltonian rating scale. The data is categorized into different levels. Features are extracted from the data. These features are presented to the input layer of ANN algorithms along with target values assigned for each training pattern. At the end of training of the ANN algorithms, final weights are stored in the database.

During testing of ANN algorithms, the number of depression data categorized correctly is compared for the ANN algorithms using receiver operating characteristics curve, accuracy and sensitivity.
Fig. 1.4 Schematic Flow for Classification of Depression
1.7 PROBLEM SPECIFICATION

The problem is to implement an intelligent data mining concept for the huge amount of depression data. As the number of patients are growing rapidly due to stress and loss associated with aging, biological depression, physical illnesses, and different signs and symptoms of depression; quick diagnosis and telemedicine requires immediate automated diagnosis and solution for a patient. This can be achieved properly only from the knowledge gained from the experts with regard to diagnosing methods.

Depression data such as depressed mood, feelings of guilt, suicide, insomnia early, insomnia middle, insomnia late, work and activities, retardation, Psychomotor, agitation, anxiety, anxiety somatic, somatic symptoms, somatic symptoms general, genital symptoms, genital symptoms, insight, diurnal variations, depersonalization and derealization, paranoid symptoms, obsessionals and compulsive symptoms have been collected for 1800 patients based on the Hamilton rating scale for depression [Hedlun, 1979; Williams, 1992]. These data are used for training the proposed ANN algorithms for classification of the depression data.

1.8 OBJECTIVES OF THE RESEARCH

The objective of this research work is to propose improved intelligent networks for depression data.

1. To design neural network algorithm for faster learning of psychological depression data.

2. To find out the best neural network algorithm that involves less computational effort in learning psychological depression data.
1.9 SCOPE OF THE RESEARCH

The scope of the research work includes the following:

1. To find out how to make different patterns of depression data to be learned by the ANN through analysis.
2. A procedure has to be decided the required topology of the ANN.
3. Different values of depression data will be analyzed.
4. As the dimension of the data increases for patient, conventional methods takes more time to retrieve the relevant information or the complexity of the algorithm increases. ANN concepts have to be explored with combination of efficient data processing algorithm to provide an improved approach for the ANN to mine the depression information.

1.10 CONTRIBUTION OF THE THESIS

In this research work, a systematic approach has been developed to train different ANN topology with different algorithm for depression data mining and diagnosis. The major algorithms implemented are the following:

1) Back Propagation Algorithm (BPA).
2) Radial Basis Function (RBF).
3) Echo State Neural Network.(ESNN)
4) Back Propagation Algorithm in combination with Radial Basis Function (BPARBF).
5) Back Propagation Algorithm in combination with Echo State Neural Network (BPAESNN).
6) Radial Basis Function in combination with Echo State Neural Network (RBFESNN).
1.11 ORGANIZATION OF THE THESIS

The second chapter presents review of literature on depression.

The third chapter deals with depression data collection.

The fourth chapter presents implementation of proposed algorithms for depression data mining.

The fifth chapter explains the results and discussion with comparisons of the performance and computational efforts of the algorithms implemented in this research work.

The sixth chapter concludes the dissertation with conclusions and future scope of the work.

1.12 SUMMARY

An overview of data mining has been discussed in this chapter. Psychological depression system, methods adopted for psychological depression data mining have also been discussed; highlighting the problems in a detailed manner. The objectives and scope of the thesis have been explained elaborately. Contribution of the thesis and organization of the thesis have been presented. Chapter 2 presents review of literature.