Acknowledgements

The work presented in this thesis would not have been possible without the priceless guidance, encouragement and patience of my guide Prof. Anil R. Yardi. My sincere thanks for his valuable ideas and generous support. It has been my great fortune and honor to undertake the Ph.D. study under his supervision.

I would like to express my sincere gratitude towards my Institute, SVERI’s College of Engg. Pandharpur, especially honorable secretary, Dr. B. P. Ronge, because of whose kindness I was relieved to devote for this work and also for being a source of encouragement during the research. My special thanks to my elder sister Dr. Sangita R. Patil and Dr. Nathniel Sase (Neurologist) for helping me in understanding medical aspects of Neurodegenerative Diseases.

I would like to thank everyone at Department of Electronics Engg., Walchand College of Engg. Sangli and Department of Electronics and Telecommunication Engg., SVERI’s College of Engg., Pandharpur, who provided support for my research activities.

Many thanks to the Alzheimer's disease Neuroimaging Initiative (ADNI) database (http://www.loni.ucla.edu/ADNI), for approving the research rational and providing access to the MR image database. Also I thank to OASIS and Whole brain atlas databases for data and images.

My sincere thanks to my departed Father, my loving Mother and brother Ajit. I also thank other friends for their cordial support during the research. Finally, I would like to express my gratitude to my husband, Madan and son, Satyam who tolerated my ignorance without any complaint throughout this work.
Abstract

Neurodegenerative diseases, especially Alzheimer’s disease, affect a growing population of elderly people today. The predictions about the course of the disease are a key component of health care decision making for patients with Alzheimer’s. The physician’s prognosis and predicted trajectory of cognitive decline often form the basis of treatment and health care decisions taken by patients and their families. These predictions are difficult to make because of the high variability and non-linearity exhibited by individual patterns of cognitive decline.

Magnetic resonance imaging (MRI) is well recognized as an instrument for research and diagnosis in many fields of medicine, and research in 2008 showed that it may be useful in Alzheimer’s as well. For example, scientists found that an automated system for measuring the volume of the hippocampus using MRI can help doctors more accurately diagnose Alzheimer’s at an earlier stage. The hippocampus is a region of the brain that plays a key role in memory and learning. MRI also helped researchers identify abnormal structural changes in the brains of seemingly normal elderly individuals that aided detection of mild cognitive impairment, a potential precursor to Alzheimer’s disease. In addition, researchers found that MRI scans that detect shrinkage in specific regions of the mid-brain accurately diagnosed neurodegenerative disease such as Alzheimer’s even before symptoms interfere with memory. The role of artificial neural networks in medical diagnosis, prognosis, treatment and clinical decision support has been well established since the earliest days of computing. Neural networks have been applied across a wide variety of medical disciplines including oncology, cardiology, intensive care, radiology, neurology and many others. Fields of application have ranged from modelling the learning process of the brain and signal processing to classification, prediction and survival analysis.

In summary, the research conducted for this thesis improves the current Dementia classification techniques in which the task is to extract patterns from brain MR images and build accurate and transparent classifiers using artificial neural networks.