The brain is the center of the human nervous system and is a highly complex organ. It receives, analyzes and stores the information and thereby controls the physical activity of human body. Neuronal communication is established between neurons through axons or nerve fibers. White matter that surrounds the axons acts as an insulator to the channel which carries the information in terms of electrical signals, and hence this coating helps in increasing the speed of transmission of nerve signals. Brain white matter (BWM) undergoes various generative/degenerative changes with normal ageing, including alterations in myelin structure and its density. Alterations in these microstructural tissues lead to many functional changes in human system.

Such microstructural characterisation of BWM can be done through an imaging modality called Diffusion tensor magnetic resonance imaging (DTMRI). This method uses the movement of water molecules along white matter tracts to map out the brain's pathways. It reveals the integrity of white matter tracts that link regions of the brain to each other. The goal of this research work is to analyse the morphological changes happening in BWM from 8 years to 80 years under normal ageing process and on pathological
DTMR images are acquired from 112 normal subjects and from 9 participants with neurological problems. Normally, the BWM exhibits a repeated pattern, which can be dubbed as a ‘texture’ property. Such textures are fundamental in identifying, characterising and comparing objects and regions with similar properties; and, the underlying image differentiation.

Intensity properties of textures may be described by many statistical methods. Adopted here are three methods namely grey-level co-occurrence matrix (GLCM), Gray level run-length matrix (GRLM) and eigen-decomposition techniques. Image features that are representatives of tissue characteristics of BWM are extracted from these three methods. The textural features of normal brain show either evolutionary/devolutionary behavior on ageing revealing the changes in structural aspects of BWM. The result of this study demonstrates the changes occurring in BWM during the fifth and first half of the sixth decade of life (that is approximately between 40 and 55 years) is comparatively insignificant. Hence the observed morphs are correlated with the age of the subject under normal and pathogenic states.

Back propagation neural network (BPNN) is constructed which takes the textural parameters as input and classifies the image based on age. The network is trained with the collected data set and tested using data derived from the sample image data that was not used during training phase. The BPNN classifies the image data with an accuracy of approximately 92 to
97%. Whereas, the network could not recognise when it is fed with the features extracted from HIV with Progressive Multifocal Leucoencephalopathy (PML) cases but, it wrongly classifies cerebral infarction and HIV (thrombosis) cases. This is due to the fact that PML leads to high amount of demyelination when compared to other two cases. Hence the constructed BPNN could understand the structural morphology of BWM of normal cases and categorize on the basis of age. It could also differentiate normal and abnormal cases indicating gross abnormality and may not be region specific.

These findings provided new information in describing BWM structural complexity, which might in the future serve as an objective diagnostic index or as a predictive parameter for neurological diseases. This method might be used for longitudinal studies to evaluate the effect of disease or ageing on BWM.