Mammogram is one of the best technologies currently being used for diagnosing breast cancer. Breast cancer is diagnosed at advanced stages with the help of the mammogram image. In this thesis an intelligent system is designed to diagnose breast cancer through mammograms, using image processing techniques along with intelligent optimization tools, such as Genetic Algorithm (CGA), Ant Colony Optimization (ACO), and Artificial Neural Network. The detection of microcalcifications is performed in two phases: preprocessing and segmentation in the first phase and feature extraction, selection and classification in the second phase.

161 pairs of digitized mammograms obtained from the Mammography Image Analysis Society (MIAS) database is used to design the proposed diagnosing system. Initially, the film artifacts and X-ray labels are removed from the mammogram images and median filter is applied to remove the high frequency components from the image. Then the mammogram images are normalized. The pectoral muscle region is removed from, the breast region to increase the reliability of the segmentation.

The suspicious region or microcalcifications is segmented using bilateral subtraction for a pair of images and Markov Random Field (M.RF) hybrid with ACO algorithm for single mammogram images. In the bilateral subtraction, the asymmetries between the corresponding region in the left and the right breast images are considered for
segmentation. The breast border and the nipple position are used as reference points for alignment of mammograms. In this study the breast border is detected using GA and the nipple position is identified using a novel method called ACO algorithm.

The MRF and ACO based image segmentation method is a process seeking the optimal labeling of the pixels. The optimum label is that which minimizes the Maximizing a Posterior (MAP) estimate. ACO metaheuristic algorithm is implemented to compute the optimum label, which is to be treated as an optimum threshold for segmentation.

The textural features can be extracted from the segmented mammogram image to classify the microcalcifications into benign, malignant or normal. The textural analysis methods such as Surrounding Region Dependency Matrix, Spatial Gray Level Dependency Matrix, Gray Level Run-Length Matrix, and Gray Level Difference Matrix are used to extract the fourteen Haralick features from the segmented image. The reduced features are selected from the extracted set of features using rough set based reduction algorithms, GA and ACO.

The selected textural feature values are given as input to a three layer Back Propagation Neural network (BPN) classifier to classify the microcalcifications into benign, malignant or normal. The BPN classifier is validated using Jack Knife method. A Receiver Operating Characteristics (ROC) analysis is performed to evaluate the classification performance of the proposed approaches. The area under the ROC curve Az is used as a measure of the classification performance.