CHAPTER 3

PROPOSED CAD METHODOLOGY

3.1 GENERAL

CAD systems play a key role in the early detection of liver cancer and help to reduce the death rate. A CAD system acts as a diagnostic tool of a radiologist indicating abnormalities that would have been missed otherwise. This chapter briefly describes the proposed CAD system and the materials and methods used. The methodology framed for implementing the system is explained using a flow chart in section 3.3. The materials used in this research are also given in this chapter.

3.2 CAD SYSTEM FOR TUMOUR CHARACTERIZATION

An automatic and effective CAD system that overcomes the limitations of manual ROI segmentation, texture feature analysis at single scale and with minimum directionality is proposed in this thesis. The proposed system automatically segments the tumour ROI and employs a novel multiresolution, multidirectional feature extraction technique based on Contourlet Coefficient Co-occurrence Matrix (CCCM) for classifying liver tumours into Benign and Malignant using a probabilistic neural network classifier. The performance of the system is analyzed by employing several performance measures.
3.3 MATERIALS AND METHODOLOGY

3.3.1 Materials

A dataset of 300 abdominal CT images (150 benign and 150 malignant) collected from different patients scanned by CT of the abdomen at the Cancer Institute, Chennai is used in this work. Each tumour in the dataset is associated with a multi-slice CT volume with in-plane resolution range of 0.5–0.8 mm and slice thickness of 5 mm. The DICOM images have been exported, into a set of 2D axial slices in JPEG format of size $512 \times 512$ pixels. The clinical information and ‘‘ground truth’’ diagnosis were established from either biopsy results or from an observed tumour characterization. The clinical information for each patient includes age, gender as well as the morphological characteristics of the tumours, as determined by a radiologist trained in abdominal imaging. The input datasets are grouped into two; a training set and a testing set with 150 datasets each (75 benign and 75 malignant). The malignancy considered in this work is HCC or Hepatoma and the benign tumour considered is Hemangioma.

3.3.2 Methodology

The CAD system developed consists of three stages carried out in succession: (i) Tumour segmentation to automatically select ROI, (ii) Feature extraction to perform texture feature analysis and (iii) ANN to provide tumour characterization. The methodology of the proposed CAD system is shown in Figure 3.1.

Figure 3.1 CAD methodology for tumour characterization
Figure 3.2 Flow chart of the proposed CAD system for tumour characterization

The flow chart of the proposed CAD system is depicted in Figure 3.2. The tumour segmentation stage involves automatic liver segmentation and tumour ROI segmentation. The liver is segmented from the abdominal CT image using pre-processing, region growing and post processing. Tumour
ROI is cropped from the segmented liver by segmenting the tumour employing AFCM algorithm. CCCM based texture features are extracted from the ROI in the feature extraction stage. The dimensionality of the extracted features is reduced using Principal Component Analysis (PCA). The dimensional reduced features are trained and tested using a PNN classifier into Benign and Malignant liver tumours. The performance of the proposed CAD system is evaluated using several performance measures.

3.4 SUMMARY

The materials used and the methodology followed in implementing the proposed CAD system has been described in this chapter. The various stages of the proposed CAD system are indicated by a flow chart. The following Chapters describe the three stages of the proposed CAD system in detail: Chapter 4 describes the tumour ROI segmentation stage, Chapter 5 describes the feature extraction stage and Chapter 6 describes the classification stage in detail.