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Classification of Digital Chest Radiographs Using Image Processing Techniques to Aid in Diagnosis of Pulmonary Tuberculosis

Authors : A. J. S. P. Nileema, S. Kulatunga , S. H. Palihawadana

Abstract : Computer aided detection (CAD) system was developed for the diagnosis of pulmonary tuberculosis using digital chest X-rays with MATLAB image processing techniques using a statistical approach. The study comprised of 200 digital chest radiographs collected from the National Hospital for Respiratory Diseases - Welisara, Sri Lanka. Pre-processing was done to remove identification details. Lung fields were segmented and then divided into four quadrants; right upper quadrant, left upper quadrant, right lower quadrant, and left lower quadrant using the image processing techniques in MATLAB. Contrast, correlation, homogeneity, energy, entropy, and maximum probability texture features were extracted using the gray level co-occurrence matrix method. Descriptive statistics and normal distribution analysis were performed using SPSS. Depending on the radiologists' interpretation, chest radiographs were classified manually into PTB - positive (PTBP) and PTB - negative (PTBN) classes. Features with standard normal distribution were analyzed using an independent sample T-test for PTBP and PTBN chest radiographs. Among the six features tested, contrast, correlation, energy, entropy, and maximum probability features showed a statistically significant difference between the two classes at 95% confidence interval; therefore, could be used in the classification of chest radiograph for PTB diagnosis. With the resulting value ranges of the five texture features with normal distribution, a classification algorithm was then defined to recognize and classify the quadrant images; if the texture feature values of the quadrant image being tested falls within the defined region, it will be identified as a PTBP – abnormal quadrant and will be labeled as 'Abnormal' in red color with its border being highlighted in red color whereas if the texture feature values of the quadrant image being tested falls outside of the defined value range, it will be identified as PTBN–normal and labeled as 'Normal' in blue color but there will be no changes to the image outline. The developed classification algorithm has shown a high sensitivity of 92% which makes it an efficient CAD system and with a modest specificity of 70%.

Keywords : chest radiographs, computer aided detection, image processing, pulmonary tuberculosis
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