ABSTRACT

“The medical imaging studies” brings out new discoveries in the understanding of normal physiological function and persistent prognosis of diseases. The computer based Medical Image Processing (MIP) methodologies are commonly used in different biomedical applications. These methodologies necessitate the significant innovations for effective diagnosis and treatment.

The proposed research work is carried out for investigations of various screening techniques to identify the severity stages of diseases. The antenatal screenings based on Ultrasound Scanning Systems (USS) are used to reveal ailments relevant to uterus and the Fetal Anatomy (FA) changes. The premature newborn must be screened more carefully in order to provide the early treatment of congenital disorders. The RetCam is used for screening ophthalmic disorders in premature infants to perceive the stages of severity. The genetic Brain Disorders (BD), especially the neurodegenerative issues and its acute phase, are screened by the Magnetic Resonance Images (MRI).

The proposed research established the efficient MIP schemes for various medical images to reveal severity stages of different diseases which are more suitable for physicians who make decisions based on images. The different medical imaging systems such as USS, RetCam and MRI are utilized to diagnose the diseases of antenatal, neonatal and pediatric issues. The antenatal investigations consist of the Uterine Fibroid (UF), Fetal Anatomies
(FA) and Fetal Cardiac Structure (FCS) utilized ultrasound scan to acquire images which have myriad challenges due to poor quality of the images. The Retinopathy of Prematurity (ROP) is one of the major problems occurred in neonates which can cause blindness and the diagnosis procedure develops repetitive stress injury for the physicians. The accurate diagnosis of Brain Disorder from pediatric MRI is a time consuming and tedious task for neurologists.

The diversified anomalies such as UF, FA, FCS, ROP and BD are diagnosed through the USS, RetCam and MR imaging systems that are hypothesized in the proposed research work. The morphological operations, Probabilistic Boosting Tree (PBT) with Neural Networks (NN), Hybrid Active Appearance Model (AAM), Isotropic Undecimated Wavelet Transform (IUWT) with Adaptive Neuro Fuzzy Inference System (ANFIS) and K-means, Seeded Region Growing (SRG), N-D filtering with volume rendering techniques are proposed for analyzing the various diseases. The proposed MIP schemes may provide optimum solutions on certain chaotic clinical images for better diagnosis.

The proposed research work presented the MIC algorithm using MATLAB and the Improved Morphological Image Cleaning (IMIC) algorithm and Undecimated Wavelet Transform (UWT) are realized using the Machine Vision Graphical Design (MVGD) tool. The most significant parameters such as area, diameter and perimeter are estimated from the segmented fibroid images. The proposed work contains 39 different individual’s 351 US images that cover various types of UFs. The results of the
proposed methods are validated by the physicians and found that the manual interventions are reduced on the diagnosis.

The proposed Fetal Anatomy parameter measurement system utilizes 312 US image sequences to calculate the Biparietal Diameter, Head Circumference, Abdominal Circumference, Femur Length, Humerus Length and Crown Rump Length. The Probabilistic Boosting Tree classifier method is proposed for FA parameters detection and classification. The Back Propagation Neural Network is utilized to assess the FA parameters based gestational age abnormality within a short time.

The Fetal Cardiac Structure detection from ultrasound image is a time consuming and important process in fetus diagnosis. The ultrasound video sequences have 3600 images to 7200 images per patient and the samples of 216 images are considered for the proposed research. The enhanced US images are used to segment the fetal cardiac Region of Interest using K-means clustering. The Active Appearance fetal cardiac model is developed which has the combination of an active shape and a texture model. The results obtained are validated by physicians through the clinical findings.

The Retinopathy of Prematurity is one of the major problems that should be treated carefully in premature infants. In the proposed research work, the database consists of 1100 images for various ROP stages. The Histogram equalization methods, 2-D Gaussian Matched Filter and Morphological approach are proposed to detect the presence of ROP based on the retinal vessel, optic disk and statistical feature analysis. The contrast stretching method and the 2-D IUWT is designed to segment and measure the
ROP vessel and ridge parameters. The retinal vessel and ridge parameters are considered for the ANFIS classifier to identify the severity stages of ROP. The new ROP screening system provides accuracy and a substantial time reduction in diagnosis.

The estimation of Corpus Callosum (CC) size and Brain Volume (BV) plays a vital role in the Brain Disorder diagnostic procedure. The proposed method utilized 10 sagittal view images for CC estimation. The BV is estimated by 1600 axial and coronal view images. The N-D multidimensional filter, K-means and SRG methods are used to measure CC size. The 3-D visualization, volume rendering methodology and voxel size are utilized to estimate BV. The results revealed the atrophy of CC area and the BV reduction in the BD patients which also confirmed the pathology characteristics.

The new medical image processing schemes are proposed to investigate the UF, FA, FCS, ROP and BD. The anomaly features are extracted and measured from the large number of US, RetCam and MR images, which are evaluated and validated by radiologists and physicians. The proposed research work would save a significant amount of time for physicians, allowing them to concentrate on surgery and treatment. The developed schemes can also be implemented in hospitals with Graphical User Interface as a user friendly tool to increase the diagnostic efficiency.