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Deep convolutional neural network for chronic kidney disease prediction using ultrasound imaging

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Abstract

Objectives: Chronic kidney disease (CKD) is a commondisease and it is related to a higher risk of cardiovasculardisease and end-stage renal disease that can be pre-vented by the earlier recognition and diagnosis of in-dividuals at risk. Even though risk factors for CKD havebeen recognized, the effectiveness of CKD risk classifi-cation via prediction models remains uncertain. Thispaper intends to introduce a new predictive model forCKD using US image.

Methods: The proposed model includes three main pha-ses"(1) preprocessing, (2) feature extraction, (3) and clas-sification."In the first phase, the input image is subjectedto preprocessing, which deploys image inpainting andmedian filtering processes. After preprocessing, featureextraction takes place under four cases; (a) texture analysisto detect the characteristics of texture, (b) proposed high-level feature enabled local binary pattern (LBP) extraction,(c) area based feature extraction, and (d) mean intensitybased feature extraction. These extracted features are thensubjected for classification, where"optimized deep con-volutional neural network (DCNN)"is used. In order tomake the prediction more accurate, the weight and theactivation function of DCNN are optimally chosen by a newhybrid model termed as diversity maintained hybrid whalemoth flame optimization (DM-HWM) model.

Results: The accuracy of adopted model at 40th trainingpercentagewas44.72,11.02,5.59,3.92,3.92,3.57,2.59,1.71,1.68, and 0.42% superior to traditional artificial neural net-works (ANN), support vector machine (SVM), NB, J48, NB-tree, LR, composite hypercube on iterated random projection CHIRP), CNN, moth flame optimization (MFO), and whaleoptimization algorithm (WOA) models.

Conclusions: Finally, the superiority of the adopted schemeis validated over other conventional models in terms ofvarious measures.

Keywords:

Chronic kidney disease; DCNN; DM-HWMalgorithm; LBP features; Moth flame optimization.

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