Diagnosing Manifestations of Cardiovascular, Renal, and Liver Disease in the Fingernail Through a Convolutional Neural Network in a Smartphone Application

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Many cardiovascular, liver, and kidney diseases, including lung cancer, cirrhosis, and kidney failure, are undetectable in their early stages, and as these diseases progress into their later stages, survival rate declines. These diseases often have small or unnoticeable manifestations in the fingernail that allow for the early detection of these conditions. These fingernail conditions often go ignored or misdiagnosed. Current diagnostic methods require a careful clinical examination, a detailed medical history of the patient, and an MRI scan, making such diagnoses unaffordable or inaccessible to those living in rural or underserved communities. Using a convolutional neural network, an iOS application was built with the capability to diagnose five nail conditions that are caused by or associated with cardiovascular, liver, or kidney conditions by uploading images to the application with a smartphone. Using a dataset of 1768 images (collected from online image encyclopedias) to train and test the neural network, stratified 8-fold cross validation was performed against the neural network. The results demonstrate that the proposed application has a high average sensitivity rate of 89.5% and average specificity rate of 90.4%. On an ROC curve, it displayed an AUC of 94.4%. Therefore, the application is a viable screening device for these undetectable conditions and can be used to increase early detection of these conditions, increasing survival rates and providing peace of mind for patients at risk. It can also be used as a diagnostic tool and overall health monitor in homes and in rural areas without easy access to medical facilities.

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