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QUANTIFYING SPEECH CHARACTERISTICS FOR DETECTING AUTISM

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Abstract

The presence of prosodic anomalies in autistic children is recognized by experienced clinicians but their quantitative analysis is a cumbersome task beyond the scope of typical pen and pencil assessment. Quantifiable speech measurements, i.e., loudness and pitch, are correlated to prosody making them potential references for assisting the analysis. However, their importance is underestimated in the application of autism diagnosis. These measurements are largely ignored in mainstream autism diagnosis batteries and commonly replaced with few vague assessments. This research work emphasizes the potential of speech measurements on autism diagnosis through creating and evaluating a fully automatic speech-oriented autism detecting system. We propose an automatic approach allowing to tease apart various aspects of prosodic abnormalities and to translate them into fine-grained, automated, and quantifiable measurements. Using a harmonic model of voiced signal, we isolated the harmonic content of speech and computed a set of quantities related to harmonic content. Employing these measures, along with standard speech measures such as loudness, we successfully trained machine learning models for distinguishing children with autism from those with typical development. We evaluated our models empirically on a task of detecting autism on a sample of 118 children (90 diagnosed with autism and 28 controls) and demonstrated that these models perform significantly better than a chance model. The classification results obtained by using prosodic measurements from "Friends and Marriage Conversation" are the best, with 74.52% accuracy (ACC), 70.02% sensitivity (SEN), 79.17% specificity (SPE), and the area under receiver operating characteristic curve (AUC) of 83.04%. The experiment result indicates that voice and speech analysis could be incorporated as novel outcome measures for treatment research and used for early detection of autism in preverbal infants or toddlers at risk of autism.