DEVELOPMENT OF A SUITABLE ALGORITHM USING ARTIFICIAL NEURAL NETWORKS FOR SORTING OF PISTACHIO NUTS WITH CLOSED SHELLS USING IMPACT ACOUSTICS

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SUMMARY

In this research, a hybrid separation system, based on acoustic and artificial neural networks (ANNs) techniques, was developed to separate pistachio nuts with closed shells from those with open shells in real-time. This intelligent system includes a feeding part, an acoustical recognition part, and a pneumatic air rejection mechanism. Features of pistachio nut shell types were extracted from analysis of sound signal in both time and frequency domains by means of fast Fourier transform (FFT), power spectral density (PSD) and principal component analysis (PCA) methods. Altogether seven features were extracted by PCA of amplitude and PSD features. With these features, we could successfully perform the separation task. In developing the ANN models, different ANN architectures, each having different numbers of neurons in hidden layer, were evaluated. The optimal model was selected after several evaluations based on minimizing of mean square error (MSE), correct separation rate (CSR) and coefficient of correlation (r). The optimal ANN model for the sorter was of 7-12-2 configuration. CSR of proposed optimal ANN model for three pistachio split types, closed shell, open shell and thin split were 96.7%, 97.3% and 93.1%, respectively. The developed system because of none destructivity, does not cause damage to kernels in open shell pistachios, and does not cause rejection by the consumer. Hence it can boost the exports. Classifying four different varieties of Iranian pistachio nuts, namely, Kaleghouchi (Ka), Akbari (Ak), Badami (Ba) and Ahmadagaee (Ah) was also performed by the proposed system. Features of pistachio nut varieties were extracted from analysis of sound signal in both time and frequency domains by means of FFT, PSD and PSD methods. Altogether forty features were selected as input vector to ANN models. Selected optimal ANN for classification was of 40-12-4 configuration. CSR of proposed optimal ANN model for four pistachio varieties, Ka, Ak, Ba and Ah were 96.97%, 97.64%, 96.36% and 99.10%, respectively. Net weight average of system accuracy was found to be 97.51%.