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Improved Performance of C4.5 Algorithm with Chi-Square Method on Pure Tea Classification Using Electronic Nose

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Abstract
Tea is one of the plantation products within the Ministry of Agriculture of the Republic of Indonesia, which plays an important role as a mainstay commodity that boosts the Indonesian economy. Each type of tea has different properties, and the quality of tea can be measured by the aroma of each type of tea. The human sense of smell is still very limited in classifying pure tea types. Therefore, a device is needed to assist in measuring the aroma of tea in the form of an electronic nose. Devices that are installed with several gas sensors assist humans in taking data from the aroma of pure tea and measuring the value of each type of tea for testing datasets with data mining algorithms. Testing the pure tea dataset with four intact attributes using the C4.5 algorithm resulted in an accuracy of 93.65% and an increase in the performance of the C4.5 algorithm by 94.27% by testing the dataset using Chi-Square feature selection with two attributes with the highest value.

Keywords: *Electronic Nose, E-nose, C4.5 Algorithm, Chi-Square, Tea Plantation Commodities, Pure Indonesian Tea.*

1. Introduction
Tea is one of the plantation products within the Ministry of Agriculture of the Republic of Indonesia, which plays an essential role as a mainstay commodity that boosts the Indonesian economy [1]. In 2018, the Central Statistics Agency noted that tea could increase foreign export exchange by 1.5% of the Gross Domestic Product of the agricultural sector or by 108.5 million USD [2]. Each type of tea has different properties, and the aroma of each type of tea can measure the quality of the tea. Nowadays, some business people modify many types of tea by adding fragrance to the tea, which reduces the purity of the tea and the properties contained. The human sense of smell is still very limited in classifying pure tea types, so it isn't easy to distinguish which types of black, green, oolong or white tea [3]. Therefore, a method is needed to help retrieve data and distinguish tea's aroma with an instrumentation tool in the form of an electronic nose. Research on the application of the electronic nose by Jan Wang et al. in the evaluation of tea quality combined with chemometric methods this study concluded that the electronic nose shows the feasibility of its application in carrying out its classification with several methods used [4]. Further research on the application of electronic nose in the classification of civet coffee and not civet Indonesia based on a comparison of statistical analysis by Sulaiman Wakid this study resulted in an accuracy of 97% of the Decision Tree algorithm testing and standard deviation statistical parameters [5]. Classification is one of the data mining algorithms that have the concept of grouping data into specific criteria by reading previously existing data [6]. The C4.5 algorithm is the embodiment of the development of the ID3 algorithm, which is tested to group datasets with specific criteria by forming decision trees and has advantages over data noise, missing values, and handling variables with discrete and continuous types [7]. According to Barak F. Tanyu, his research proved in classifying pure tea types, so it isn't easy to distinguish which types of black, green, oolong or white tea [3]. Therefore, a method is needed to help retrieve data and distinguish tea's aroma with an instrumentation tool in the form of an electronic nose. Research on the application of the electronic nose by Jan Wang et al. in the evaluation of tea quality combined with chemometric methods this study concluded that the electronic nose shows the feasibility of its application in carrying out its classification with several methods used [4]. Further research on the application of

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