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INFORMATION OF THE DISSERTATION

PhD candidate: **TRAN THI KIM NGA**

Title: **ENHANCING THE CLASSIFICATION ACCURACY OF RICE VARIETIES WITH RICE IMAGES**

Major: **Electronics Engineering**

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Scientific advisor: **Assoc. Prof. ĐỖ HỒNG TUẤN; Dr. VLADIMIR Y. MARIANO**

Institution: **Ho Chi Minh City University of Technology – Vietnam National University-Ho Chi Minh City.**

Dissertation's objectives

Each rice variety is usually suitable for its own cultivation conditions of climate, soil, and water, etc. So selecting of suitable variety for the growing conditions is an important part to enhance crop yields and the quality of the harvested rice. Moreover, many new rice varieties are generated nowadays, and they become more and more diversified to deal with new challenges such as climate change, pests and diseases, etc. Besides varieties with different external observations, many varieties are quite similar so that it is easy to confuse one variety with others. This leads to wrong selections of rice varieties, affecting crop yields and the quality of the harvested rice. Therefore, enhancing the accuracy of classification for rice varieties with similar external appearance becomes more important.

For that reason, the aim of this study is to enhance the classification accuracy of 17 rice varieties that are popularly planted in Vietnam. For classification of rice varieties, image processing is applied to extract the features of each one and combined them with machine learning methods. The feature sets including color, morphological, and texture were combined with binary particle swarm optimization (BPSO) and the support vector machine (SVM), called BPSO+SVM, to select features and to improve the classification accuracy. Besides texture features computed from gray level co-occurrence matrix (GLCM), texture analysis based on local ternary pattern (LTP) methods was proposed to combine with SVM and artificial neural network (ANN). For enhancing the classification accuracy, two convolutional neural network (CNN) models, namely modified VGG16 and modified ResNet50, were combined with image dataset for classification these rice varieties.

Contributions of the dissertation

The main contributions were summarized as follows.

- In this research, there were three datasets built for classification of the 17 rice varieties. The first dataset, namely total datatset, includes five feature subsets: basic color, clustering color, morphological, statistical, and texture features computed from gray level co-occurrence matrix (GLCM). The second dataset, namely extended improved local ternary pattern (extended ILTP), was based on local binary pattern (LBP) and local ternary pattern (LTP) methods. And the third image dataset was generated to combine with CNN. This dataset contains 7 image sets with different number of training images.

- To decrease the number of used features and to improve the classification accuracy, the proposed BPSO+SVM method, was applied to first dataset. The obtained result shows the proposed method achieves higher classification accuracy than the SVM alone, and the required number of features was only 39% of the total dataset. In addition, the proposed BPSO+SVM can be extended to other classifiers such as Naïve Bayes and Random Forest.

- The second dataset, extended ILTP, was combined with SVM and ANN, respectively, for classification the 17 rive varieties. To improve classification accuracy, the radius of neighborhood and threshold value of local pattern were considered in the pattern coding procedure of the proposed method. The experiment results show that the proposed method can enhance classification accuracy of rice varieties when combined with SVM.

- The third dataset was combined with convolutional neural networks for classification the 17 rice varieties. The two proposed CNN models, namely modified VGG16 and modified ResNet50, were based on VGG16 and ResNet50 models. Experiments were conducted to evaluate and compare the performances when changing dimensions of image sets; and compare the accuracy of these models before and after modified. From the results, it shows that the modified VGG16 and modified ResNet50 models can significantly improve the classification accuracy of the 17 rice varieties.

- Finally, to evaluate the robustness of the proposed classification methods, several experiments was carried out (1) for long-term stored rice varieties, (2) for rice varieties with changed color due to storage conditions, (3) for other 17 rice varieties, and (4) for more rice varieties. The results show that these models can be applied effectively for classification of long-term stored rice varieties, rice varieties with changed color due to storage conditions, other rice varieties as well as more rice varieties.

Scientific Advisor **PhD Candidate**

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