1. Introduction

Ornamental betta fish have a lot of enthusiasts because keeping betta fish is one way to overcome boredom and reduce stress. Ornamental betta fish come from many countries and even almost all countries. Based on [1], there are 91 species of ornamental betta fish. The special characteristics that can distinguish the types of ornamental betta fish are the shape of the fins and tails and the varying colors [2]. However, it will still be difficult to distinguish the types for ordinary people who have never studied at all about this ornamental betta fish.

The technology that is currently developing is very sophisticated. Using a classification system that applies image processing and machine learning can help ordinary people to recognize the types of ornamental betta fish. Convolutional Neural Network (CNN) is one of the most effective and efficient classification methods in many pattern recognition and image identification systems capable of producing good performance [3]. CNN is a deep learning method which is composed of layers.

Many studies have been conducted on image classification with fish objects. Some of them, Rekha et al. [4] classifying fish images using VGG-16 with the Adam optimization algorithm. Dhruv et al. [5] tried to apply three different activation functions to the model and got the maximum accuracy with ReLU activation function. Guoqing et al. [6] by applying several different CNN architectures, model 2 achieves the highest accuracy. The three studies classify fish images without considering the color of the fish. Mookdarsanit et al. [7] with the R-CNN research method in detecting object and VGG for classifying betta fish. In line with Mookdasanit's research, in this study we employ betta fish as the object of research by using the ResNet-50 architecture and comparing 3 different color spaces, where color is one of the important aspects in classifying betta fish images.

Theoretically, the more number of layers the CNN has, the better the modeling capability of the neural network is. Therefore, the deeper the network should result in lower errors during the training process [8]. However, in reality the deeper the network, the vanishing gradient problem will arise which can cause high errors during the training process [8]. One aspect that is quite important for the training process on a neural network is the selection of an optimization algorithm. The selection of the right optimization algorithm can affect the performance that will be generated by the model because the optimization algorithm is able to reduce errors caused by the training process and also in the neural network model during training [9]. The choice of color space also affects the image classification system [10].

In this study, the images will be segmented first to separate foreground from the background using the Grabcut method and ResNet-50 will be applied as a CNN architecture to reduce the vanishing gradient problem [11]. Three color spaces will be applied in this study to find out which color space is the right one to apply to the model. In this connection, we employ three color spaces, namely RGB, HSV, and CMYK. In addition, Adam is implemented as an optimization algorithm.

The paper is structured as follows: Section II explains the relevant literature review; Section III describes the system model; Section IV presents experimental result and discussions; and the conclusion is drawn in Section V.