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Contents

I. Introduction

At present, there are 34,800 fish species present around the world [1], and many more fish species are yet to be recognized. India is bestowed with rich diversity of freshwater fish species inhabiting rivers, ponds, and lakes. A large number of people in India, consume different freshwater fish daily to meet their nutritional needs. It has been reported that fish provides chief and cheap source of animal protein for about 60 percent of Indian population [2]. Besides their nutritional role the Indian fishing industry also strengthens the Indian economy with its contribution of 1.1% of gross value added. Identification of the fish species is considered as one of the most fundamental aspects for different aquaculture research projects. It is not easy for the consumers to recognize fish species in a cluttered environment because of similarity in morphological features among some closely related species. Experts with proper knowledge of fish taxonomy can recognize the fish species easily, but they also sometime face problems to recognize them properly. Recognition of fish species and counting of fish species are vital jobs in the different fishing industries. Automatic identification of the different fish species in a cluttered environment helps the fishing industry as well as the common people and other stakeholders. Considering its importance, in this study the identification of five different fish species—Labeo catla (Catla), Labeo rohita (Rohu), Cirrhinus mrigala (Mrigal), Labeo bata (Bata), and Hypophthalmichthys molitrix (Silver carp) in a cluttered environment is considered. Images taken from the different live fish markets in an unconstrained environment were considered in this study. The problem becomes challenging due to the presence of different fish species in a frame, different lighting conditions, variations in the size of the fish, occlusions, etc. The semantic segmentation technique is applied in this study to segment the fish heads that are clearly visible in the image. The body and tail parts are not properly visible due to the presence of occlusions. Only the head portion of the fish is often visible in a cluttered environment. The head portion of different fish species is quite different in shape and size and plays a crucial role in identifying fish species at a single glance. A dataset with a ground truth semantic segmentation mask is prepared for this study. Different augmentations like rotation, flip, sigmoid correction, and logarithmic correction are applied to make a standard dataset that fits for the application of deep learning-based segmentation architecture. Two popular semantic segmentation networks named U-Net and PSPNet were used with ResNet [3] and the InceptionV3 [4] pretrained backbone network. The main contributions in this study are as follows:

Authors