

Identification of Grouper Fish Types using Convolutional Neural Network Resnet-50 Algorithm

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Abstract

Grouper is a type of fish that is popular within the population. This article deals with the identification method of the type of grouper fish using deep learning CNN type Resnet-50 algorithm with a relatively small amount of dataset. The identification is conducted based on color patterns with increasing the epoch value to improve the accuracy. The accuracy of identification is 75 % and the more the epoch value is increased, the better accuracy value is obtained. Epoch is a factor that affects the time of training an AI model and affects the accuracy value of the AI model.

Keywords: Grouper Fish; CNN Resnet-50; epoch value; identification method; deep learning.

1. Introduction

Grouper is a type of fish that is popular with the public. It is necessary to identify the type of grouper fish based on color patterns with increase the epoch value to get the best accuracy.

We can identify the diversity of grouper fish using a computer science approach, namely data mining methods. Data mining is a method of processing data. This method can be used to explore information. One of the data processing methods in data mining is classification. Classification is a process that involves finding functions or models to explain various categories of data or distinguish between different concepts.

The goal of the research is to predict the classes of objects whose labels are unknown. Numerous algorithms in data mining can be employed for classification tasks, such as convolution neural network (CNN).

In this study, the author uses CNN with Resnet-50 model architecture to predict the type of grouper. What type of grouper is the fish in this picture?. Grouper is a high fish commodity. his is like research said by pramesti et all (S. H. Liao, 2020) where the research said that Grouper (Serranidae) is one of the high-economic marine fish commodities and It is challenging to identify grouper species because groupers have a high degree of morphological

similarity and colour variation. Apart from that, this grouper is also a target for fishermen and has high economic value. This wasmprevealed in research by (R. Bshary, 2011).

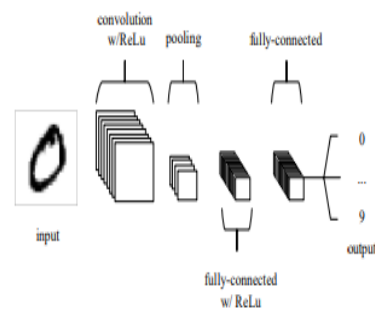


Figure 1. Simple CNN architecture

Based on the literature review above, researchers tried to predict identify images of grouper fish by using data mining methods with machine learning algorithms.

The algorithmic approach taken is the convolution neural network algorithm with resnet-50 model architecture.

2. Literature Review

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2.1. Grouper Fish

Groupers are large fish of the perch type (S. B. Kotsiantis, 2006). They are genera in the subfamily Epinephelinae. Groupers and the sea basses are in the family Serranidae. Most groupers are in one of two large genera: Epinephelus and Mycteroperca. Also, species in the small genera Anyperidon, Cromileptes, Dermatolepis, Gracila, Saloptia, and Triso are also called groupers. Fish in the genus Plectropomus are referred to as coral groupers. These genera are all in the subfamily Epiphelinae. Sometimes other fish have common names with the word "grouper".

Table 2. Classification 3 name type of groupers

No	Type
1	Cantang
2	Mouse
3	Tiger

Source: Data defined by researchers (2024)

Nonetheless, "grouper" on its own is usually taken to mean the subfamily Epinephelinae. Groupers and octopuses often work together to catch prey on coral reefs (D. Attenborough, 2017).

Table 1. Confusion Matrix Concept

		Reality	
		Positive	Negative
Prediction	Positive	TP	FP
	Negative	FN	TN

This table is often called a confusion matrix because the terms used can create confusion for people who read it. Briefly, it can be remembered by:

1. TP: the model successfully predicts positive (yes), because it is positive (yes)
2. TN: the model successfully predicted negative (no), because it was negative (no)
3. FP: the model predicts positive (yes), but is wrong because the reality is negative (no)
4. FN: the model predicts negative (yes), but is wrong because the reality is positive (yes)

Groupers are teleost, typically having a stout body and a large mouth. They are not built for long-distance, fast swimming. They can be quite large: in length, over a meter. The largest is the Atlantic goliath grouper (*Epinephelus itajara*) which weighed 399 kilograms (880 pounds) and a length of 2.43 m (7 ft 11+1/2 inch) (A. B. J. Malyan, 2023) Though in such a large group, species vary considerably. They

swallow prey rather than biting pieces off of them. They do not have many teeth on the edges of their jaws, but they have heavy crushing tooth plates inside the pharynx. They habitually eat fish, octopuses, and crustaceans. Some species prefer to ambush their prey, while others are active predators. Reports of fatal attacks on humans by the largest species, such as the giant grouper (*Epinephelus lanceolatus*), are unconfirmed (T. A. Santosa, 2021).

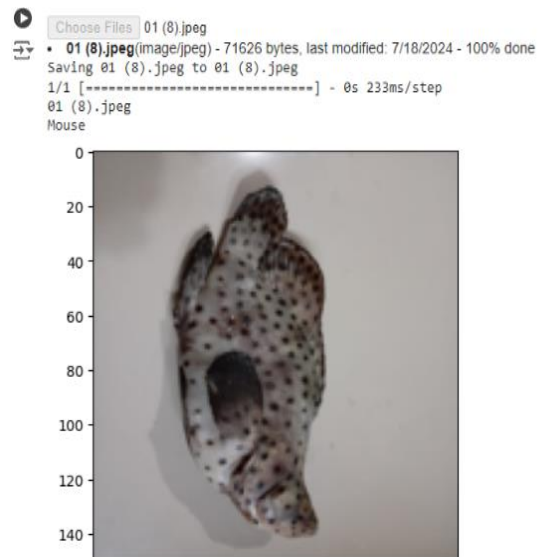


Figure 2. Mouse Groupers.

2.2. Data Mining and Machine Learning

Data mining and machine learning are two intersecting branches of artificial intelligence which uses the explosive growth in data to analyse the association between causes and effects, predict imminent problems and provide solutions (J. Gladju, 2022).

Machine learning is the ability of a computer to use complex algorithms and learn from mined datasets without being exclusively programmed (R. H. Robin, 2020). Confusion Matrix Concept and Classification 3 name type of groupers are listed in Table 1 and Table 2, respectively.

The form of knowledge induction in machine learning is especially useful for addressing ill-defined and informally stated problems that lack algorithmic solutions, such as visual recognition, material behavior and detection of interesting regularities in large data sets (M. Kubat, 1996). Machine learning techniques are either supervised learning methods based on logic (decision tree), perceptron (artificial neural networks and radial basis function networks), instance (k-nearest neighbour), Bayesian networks (probability) and support vector machines or 'knowledge oriented' unsupervised learning methods based on cognitive perspective, representational issues, inductive essence of learning, exhaustive search, heuristic search, divide and conquer learning, progressive coverage, predicate logic, concept

formation, quest for natural laws, discovery in dynamic systems, analogy providing search heuristics, close neighbourhood, genetic algorithms, perspectives, hybrid systems and multi-strategy learning (C. Liu et al., 2023).

2.3. CNN

A convolutional neural network (CNN) is a regularized type of feed-forward neural network that learns features by itself via filter (or kernel) optimization. Vanishing gradients and exploding gradients, seen during backpropagation in earlier neural networks, are prevented by using regularized weights over fewer connections (H. T. Rauf, 2019).

```
# Preprocess the images

def preprocess_images(image_directory):

    images = [ ]

    labels = [ ]

    classes = sorted(os.listdir(image_directory))

    for index, class_name in enumerate(classes):

        class_directory = os.path.join(image_directory, class_name)

        for image_name in os.listdir(class_directory):

            image = PIL.Image.open(os.path.join(class_directory, image_name))

            image = image.resize((150, 150)) # Resize the image to a consistent size

            image = np.array(image)

            images.append(image)

            labels.append(index)
```

Figure 3. Preprocess the image.



Figure 4. Cantang Groupers.

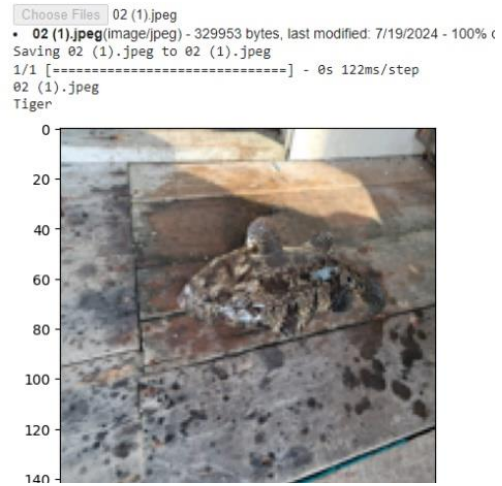


Figure 5. Tiger Groupers.

In practice this would mean that for the example given earlier, the input 'volume' will have a dimensionality of $64 \times 64 \times 3$ (height, width and depth), leading to a final output layer comprised of a dimensionality of $1 \times 1 \times n$ (where n represents the possible number of classes) as we would have condensed the full input dimensionality into a smaller volume of class scores filed across the depth dimension.

```
# Load and preprocess the dataset

images, labels = preprocess_images(dataset_path)

num_classes = len(np.unique(labels))

labels = to_categorical(labels, num_classes)

# Split the dataset into training and testing sets

X_train, X_test, y_train, y_test = train_test_split(images, labels, test_size=0.2, random_state=42)
```

Figure 6. Load and preprocess the dataset.

2.4. CNN Type Resnet-50

ResNet is a classic deep neural network model mainly used for image classification and object detection tasks (F. F. Pramesti, 2022).

An important contribution of ResNet is solving the problem of gradient vanishing during the training process of deep neural networks, allowing the network to be well-trained to a deeper level. In addition, ResNet is widely used in various computer vision tasks, including object detection, image classification, and image segmentation. ResNet is often used as the base network structure and by adding some adaptive or specific layers on top of it, it can effectively extract fish feature information, thereby achieving more accurate abnormal detection (O. U. Press, 2016).

2.5. Confusion Matrix

There are several ways to measure the performance of a model that produces binary classification, such as the concept of true positive (TP), true negative (TN), false positive (FP), and false negative (FN).

3. Research Method

There are four steps in this research:

1. Preprocessing the image: resizing the image.
2. Dividing the data into training and test data.
3. Downloading the CNN Resnet-50 Module.
4. Identifying the type of Groupers.

The grouper fish dataset is comprised of 30 sample image. By using the resnet 50 type CNN deep learning algorithm, grouper fish species can be identified. Before inputting image data, the libraries that will be used are defined, namely Keras and TensorFlow. Then the data that will be used in training and testing will be called. The next step is training using the CNN model with resnet-50. Before inputting image data, the libraries that will be used are defined, namely Keras and TensorFlow. Then the data that will be used in training and testing will be called. The next step is training using the CNN with resnet-50 model architecture.

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Google collabs can be used as a tool to implement it. The libraries and functions used include Conv2D and Tensorflow Keras functions, Matplotlib, Scikit Learn,

```
dnn_model = Sequential()

imported_model=
tf.keras.applications.ResNet50(include_top=False,

    input_shape=(150,150,3),

    pooling='avg',classes=5,

    weights='imagenet')

for layer in imported_model.layers:

    layer.trainable=False

dnn_model.add(imported_model)

dnn_model.add(Flatten())

dnn_model.add(Dense(512, activation='relu'))

dnn_model.add(Dense(5, activation='softmax'))
```

Figure 7. Load and preprocess the dataset2.

Pandas, Numpy. In this study we classified 3 names type of groupers as shown in Table 2. Process of modelling in this research are shown in Figures 2 to 8.

```
for fn in uploaded.keys():
    # Predicting images
    path = io.BytesIO(uploaded[fn])
    img = Image.open(path)
    img = img.resize(IMAGE_SIZE) # Adjust the
    target size to your desired image size
    imgplot = plt.imshow(img)

    x = np.array(img)
    x = np.expand_dims(x, axis=0)

    images = np.vstack([x])
    classes = dnn_model.predict(images,
    batch_size=BATCH_SIZE)
    classes = np.argmax(classes)

    print(fn)
    if classes == 0:
        print('Cantang')
    elif classes == 1:
        print('Mouse')
    else:
        print('Tiger')
```

Figure 8. Predict type of groupers.

4. Result

The identification results that the accuracy of prediction is 75 % to predict the image groupers based on colour patterns. In the grouper prediction process, the more we increase the epoch value, the better the accuracy value. Epoch is a factor that affects the time of training an AI model and affects the accuracy value of the AI model. In this study, hyperparameter tuning of the epoch value was carried out to see the optimization of the resulting accuracy 14 value (K. He, 2016).

As in the research of Rauf et al (A. Sharma, 2018), CNN model with transfer learning resnet 50 can increase the accuracy value in predicting the type of grouper fish compared to traditional methods by increasing the epoch value.

5. Conclusion

Identification of type groupers fish based on te colour patterns has been done using deep learning CNN type with Resnet 50 algorithm. By setting the epoch to 30 the identification accuracy value is 75%. In the next research, identification of the type of grouper can be carried out based on other physical characteristics.

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