A Ship Classification Method Based on Pytorch

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Abstract

The maritime economy plays a pivotal role in the economy development, but the current VTS and AIS systems are insufficient for maritime supervision. Computer vision perception technology uses surveillance video as input, combined with artificial intelligence, pattern recognition, image processing and other technologies to achieve ship classification information, which will help strengthen maritime management. PyTorch is an open source Python machine learning library that can be used for natural language processing and deep learning. This paper is based on PyTorch to extract ship feature information, classify different types of ships, and achieve better and faster ship classification.

Keywords

Machine vision, Ship classification, PyTorch, Deep learning.

1. Introduction

The maritime economy plays a pivotal role in the development of the country's economy. From the strategic conception of the *Maritime Silk Road* proposed by the general secretary Jinping Xi in 2013 [1]. The development of marine resources is obtained more and more attention with the opening and expansion of new trade routes. In order to improve the safety and efficiency of marine traffic, the maritime administration department has introduced the VTS (vessel traffic service) and AIS (Automatic Identification System) systems to monitor whether the ship's route is separated or not, the direction of travel, speed, and the mutual transit of ships, etc. These systems provide the safe navigation information when ships enter and leave the port. The radar system has ship tracking capabilities, but the information provided is limited and cannot identify ship types. AIS is a new type of ship collision avoidance equipment. Compared with radar target tracking, this technology improves the means for ships to obtain collision avoidance information [2]. The reality is that although it is now mandatory for ships of a certain tonnage to install related equipment, many ships will not be equipped the equipment, for leading to departure from supervision. In many cases, the reason the equipment is shut down is precisely to avoid supervision. In this case, other perceptual recognition technologies need to be used to provide information support for maritime regulatory authorities.

Askari et al. further studied the relationship between ship length and width, and used the aspect ratio as the identification standard to successfully classify ships [3]. Nilufen et al. increased the characteristics of the ship's profile strength and other characteristics, and successfully distinguished three types of ships: tanker, speedboat and ferry using a multi-feature classifier [4]. Yin Xiong et al. identified two categories of oil tankers and cargo ships based on different characteristics of ship structures [5]. These methods have achieved good recognition results, which not only show that the contour is an important feature to distinguish ship types, but also verify the necessity of multi-feature representation of images. This paper provides a new entry point for the research of maritime supervision perception and recognition through the application research of machine vision and related technologies in maritime supervision.

2. Ship perception and recognition technology

In the face of critical areas such as wharfs and bridges, where the existing VTS and AIS maritime systems cannot effectively monitor the situation, the application research of information support can be provided through perception technology and related technologies.

2.1 Computer vision technology

In the case of high visibility, computer vision technology is a very effective monitoring method. Computer vision perception technology uses surveillance video as input, combined with artificial intelligence, pattern recognition, image processing and other technologies to achieve the purpose of obtaining specific information. This topic intends to use computer vision to determine vessel identity information and its application scenarios in maritime supervision Research is carried out, but computer vision is greatly restricted in the case of poor visual conditions at night or during the day.

2.2 Infrared sensing technology

In the case of poor visual conditions at night or during the day, infrared sensing technology has greater advantages. Infrared vision is to detect temperature and ignore the visual conditions of visible light, making it easier to detect targets at night. This subject intends to study the application methods of infrared technology in ship identification, and to study the application scenarios of maritime supervision.

2.3 Multi-spectral sensing technology

Perceive the material of the detected object, multi-spectral remote sensing technology is worth studying. Remote sensing refers to the use of modern technology and advanced tools to directly receive the electromagnetic spectrum information of the target object from a long distance without contacting the target, and to analyze and interpret the information through transmission, storage and processing. It is a fast and effective technology for acquiring large-scale information; with the development of multispectral technology and the successful development of imaging spectrometers, remote sensing has realized the development from multispectral to hyperspectral and even ultra-hyperspectral. The evolution of technology and intelligence. Remote sensing data has the advantages of high timeliness, wide coverage, rich and objective information, and has been widely used in various fields. This subject intends to study the application method of multispectral technology in ship identification.

2.4 Location and Tracking technology

Location and target tracking are the key to the research of sensor perception technology. A wireless sensor network is composed of a series of sensor nodes with certain computing and communication capabilities. Through wireless communication, these nodes form a network system that can cooperatively sense, collect and process the information of the sensing object, and send the information to the observer. With the help of various sensors, information of specific dimensions can be obtained, such as the position, length, and width of the ship, which can be used for the identification of the ship. This subject intends to study the application of sensor sensing technology in maritime supervision.

3. Ship classification based on pytorch

3.1 Preprocessing module

The image function checks the distribution of all classes, and adopts the method of deleting unreasonable classes to improve accuracy. Analyze the image, and transform the image in a variety of custom image enhancement methods to see if there is a subjective feature enhancement. The main model chosen in this article is Resnet, which is the latest development of convolutional neural networks [6]. The effect of only a single model is definitely not as good as the effect of multi-model synthesis. This article combines three models of Alexnet, Densenet, and Squeezenet, and performs a weighted average according to their weights to obtain the final prediction result. Through operations such as random flipping, cutting, and rotation of the image, data enhancement processing is realized to meet the input requirements of the model.

3.2 Model training

First, ships of different classifications are stored in different folders. The input requirements of the model are basically the same, and then the data set is divided into training set, test set, and verification

set, which are used in the training and testing stages of the model. According to the model training process, the training set is input, the model is trained, the model is evaluated after each iteration, and the model is obtained after the entire iteration. The model training process is shown in Figure 1.

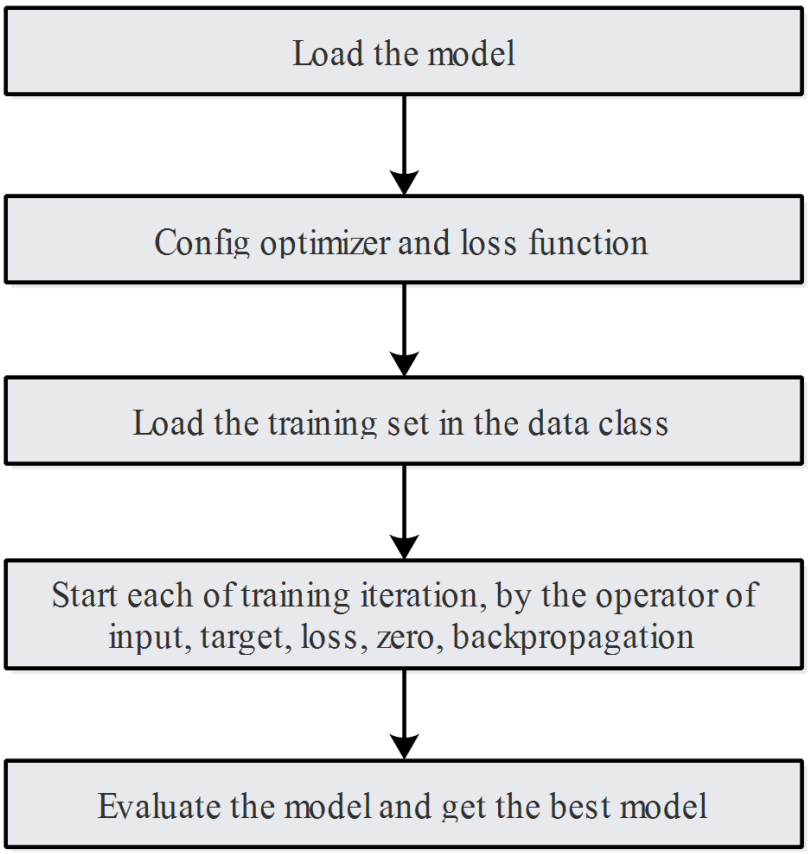

Figure 1. The flow of model training

3.3 Ship classification

After the classifier model is trained, it is not necessary to train again. After the classifier is saved, it can be loaded again when needed. Use the torch method to load the model for prediction. Among the obtained detection results, the classification effect is relatively good. For a small number of pictures that are classified incorrectly or the ship type is not recognized, the main reason is that the number of samples of some ship types in the data set is too small to be well trained. When the ship appears in the picture When the appearance of the half-length or ship is similar to other types, it is easy to cause misjudgment or unrecognition.

4. Conclusion

The introduction of intelligent technology into shipping management has played an important role in improving maritime supervision video. Ship identification has played an important role in intelligent maritime affairs. Based on the maritime video surveillance system as a platform, this paper combines the detection and tracking technology of machine vision to identify and classify the ship types in the sampled images. Ship type identification is widely used in the neighborhoods of ship registration management, maritime accident investigation, and navigation management of waterways.

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References

[1] Yan Z, He S, Shi-Bin J, et al. Strategic Thinking and Key Steps of Constructing the Intersection of the Belt and Road in Jiangsu Province during the 13th Five-Year Plan[J]. Journal of Jiangsu Normal University(Philosophy and Social ences Edition), 2016.

[2] Tu E, Zhang G, Rachmawati L, et al. Exploiting AIS data for intelligent maritime navigation: A comprehensive survey from data to methodology[J]. IEEE Transactions on Intelligent Transportation Systems, 2017, 19(5): 1559-1582.

[3] Askari F, Zerr B. An automatic approach to ship detection in spaceborne synthetic aperture radar imagery: an assessment of ship detection capability using RADARSAT[R]. SACLANT UNDERSEA RESEARCH CENTRE LA SPEZIA (ITALY), 2000.

[4] Cotuk N, Ture S, Cetin M. Application of point enhancement technique for ship target recognition by HRR[C]//Algorithms for Synthetic Aperture Radar Imagery X. International Society for Optics and Photonics, 2003, 5095: 185-193.

[5] Yin X, Wang C, Zhang H, et al. Vessel recognition with high resolution TerraSAR-X image based on structure feature[J]. Journal of Image and Graphics, 2012, 17(1): 106-113.

[6] Lu Z, Jiang X, Kot A. Deep coupled resnet for low-resolution face recognition[J]. IEEE Signal Processing Letters, 2018, 25(4): 526-530.