Uav intelligent recognition and tracking method based on deep learning

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5700-202225178A-1-1-ZN Researches on Intelligent Techniques Based on Multispectral Remote Sensing for Supervising Environmental Protection and Soil and Water Conservation of Electricity Transmission Lines

Abstract. In the era of artificial intelligence, the traditional industry has undergone great changes under the guidance of modern technology theory. Enterprises or institutions in various fields have begun to develop and innovate UAV equipment with the application value of The Times with the help of technologies such as deep learning or machine vision to meet the increasing business processing needs. Since the unmanned aerial vehicle will transmit the captured images to the ground, and the encoding and decoding during transmission will affect the real-time performance of the overall system, scientific researchers have proposed an intelligent recognition and tracking method for unmanned aerial vehicles, in order to improve the work efficiency and quality of the system equipment. On the basis of understanding the current research status of UAV and target recognition technology, this paper mainly studies the UAV target recognition algorithm with deep learning as the core according to the intelligent UAV platform design scheme. The final result shows that the deep learning recognition algorithm can further improve the efficiency of UAV intelligent recognition and tracking.

Keywords: Deep learning; Drones; Target recognition; Target tracking; Object detection.

1. Introducion

Traditional UAVs are mainly used in the military field, providing basic services such as intelligence collection, long-distance flight, and military strikes. The overall design is relatively large, the application and manufacturing cost is high, and they have not been widely used for a period of time. With the continuous decline of UAV costs and the continuous development of modern science and technology, UAV technology and equipment are widely used in transportation logistics, film and television shooting, equipment inspection and so on, playing an important role in the civilian field. In the traditional UAV system, under the control of the computational performance of the flight control processor, some UAVs usually need to encode the captured images, and then transmit them to the ground for image processing, and finally transmit the processing results to the UAV for relevant operations. In this process, both coding and decoding will consume too much time, which directly affects the real-time processing of image and video, and cannot meet the basic requirements of autonomous flight and target tracking of intelligent drones. Although scholars around the world have strengthened the research of intelligent UAV technology system and simplified the transmission steps of UAV and ground terminal, the stability and accuracy of detection technology and minute technology with computer vision as the core are still very low. At the same time, the change of the scene of the target is easy to affect the target detection result, and only in the environment with little change can it show good performance. Essentially, the goal of artificial intelligence is to make computers understand and become familiar with their surroundings. Computer vision, as a theoretical technology that studies how to let computers learn to observe the world, mainly uses cameras to detect, perceive, and track the surrounding environment like humans. Nowadays, computer vision related technologies have been widely used in production and life, aerospace, service and other fields.[1-3]

Target tracking algorithm is widely used in China's security monitoring system, intelligent transportation system and other aspects, compared with the target detection algorithm can accurately distinguish different targets and track effectively, so it is one of the research hotspots in the field of computer vision and artificial intelligence in the new era. In the traditional sense, target tracking technology uses prediction and matching to complete target tracking. According to the spatial correlation and temporal continuity of the image, the position information of the current frame and the previous frames in the image sequence is used to predict and analyze the position information of the next frame. Nowadays, when studying UAV technology theory in our country, some scholars use Sanmu image acquisition system and machine vision system to quickly capture scene information and model, and truly realize the dynamic growth of UAV; Some scholars also use the barrage camera to detect the dynamic changes of the funnel in real time, and use the three-dimensional positioning technology to achieve the basic function of aerial refueling of drones. From the perspective of practical research, the current technical theories of intelligent UAV for target detection and tracking control system are mainly divided into two forms: On the one hand, the unmanned aerial vehicle will transmit the captured image or video to the ground for processing, and then transmit the control command to the unmanned aerial vehicle in reverse; On the other hand, a collaborative computer is directly mounted on the drone to process the images or information flow provided by the drone in real time and quickly return the control instructions. The former information transmission and exchange speed will affect the performance of the system, while the latter shortens the response time of the system, but requires additional collaborative computers. Therefore, this paper mainly studies the UAV intelligent recognition and tracking method with deep learning as the core, in order to provide an effective basis for the research of intelligent UAV technology in the new era.[4-6]

2. Method

2.1 Design scheme of intelligent UAV platform

In this paper, the UAV is equipped with a cooperative processor and uses the robot operating system and deep learning algorithm to process the video information of the camera in real time, so as to truly realize the real-time recognition, effective detection and tracking algorithm of the UAV for the target. The specific process is shown in Figure 1 below:[7-9]

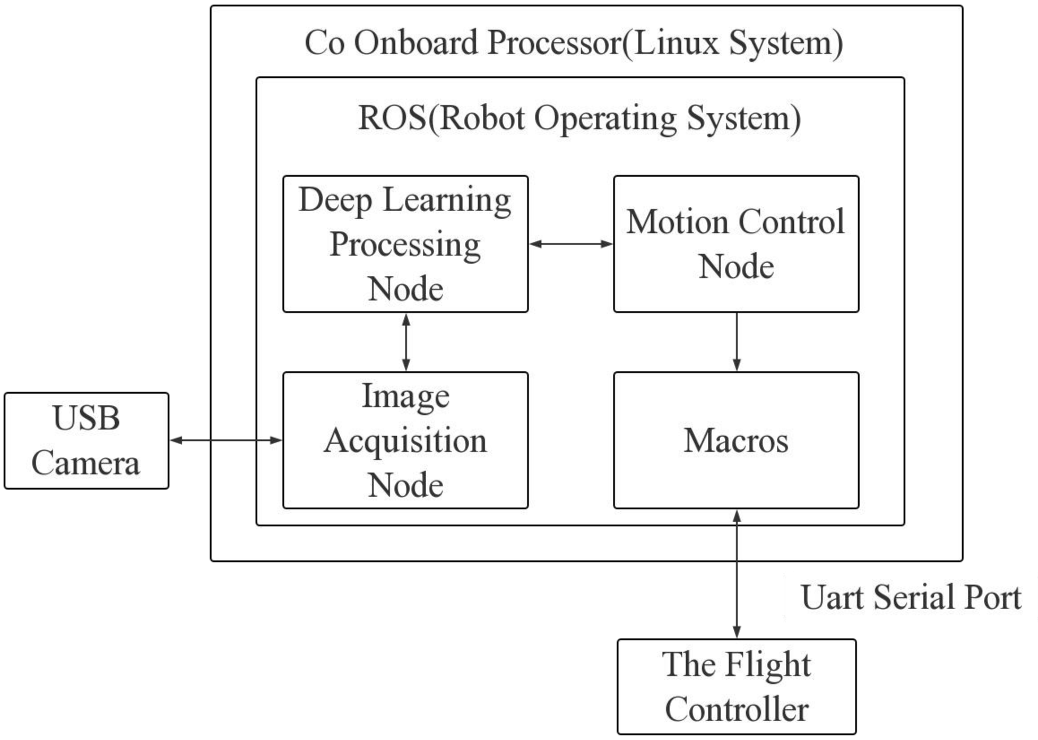

Figure 1 Operation flow chart of the intelligent UAV platform

Based on the above analysis, it can be seen that the overall scheme design uses Linux and ROS operating systems to build an application platform, which includes image acquisition, deep learning processing, motion control and other contents. From the perspective of practical application, the image acquisition node is mainly used to obtain pictures, videos and other information of the camera, which will be directly transmitted to the deep learning control node; Deep learning processing nodes are mainly used to implement algorithms such as target recognition, target detection and target tracking. The motion control node will quickly issue control commands about flight based on the final result of the deep learning processing node. The camera will use the universal serial bus interface to effectively connect with the airborne co-processor, and the airborne co-processor will be effectively connected to the flight control center through the asynchronous transceiver interface.

2.2 Deep learning algorithm

Compared with neural networks in the traditional sense, deep learning includes more than two layers of hidden nodes in the network model construction, and pays more attention to layer by layer training in the model training process, which can avoid the phenomenon of gradient diffusion in multi-layer structures. According to the analysis of the UAV target recognition frame diagram shown in Figure 2 below, it is mainly to identify the UAV through the image in the monitoring system, in essence, it is the target recognition of the UAV. Nowadays, convolutional neural network is the longest used in image recognition, but because this algorithm is limited by the hidden layer structure, it is not easy to converge if the training sample is too large during training, and it is difficult to improve if the training sample set is too small. With the continuous increase of UAV types and flight attitude, it is difficult for traditional recognition methods to accurately identify targets. Therefore, some scholars proposed to use deep learning algorithm in their research to improve the UAV target recognition rate after improving the hidden layer structure. The overall framework design will first obtain the UAV image sample set through the image acquisition network, divide the image into training set and test set after image preprocessing, then adjust the weight value of the model in the input deep learning model, and finally use the test set to test the trained model.[10-13]

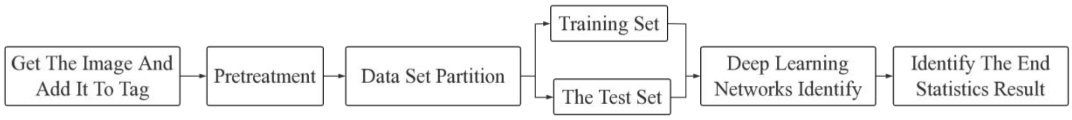

Figure 2 Frame diagram of UAV target recognition

2.3 Model Construction

In this study, the combination of UAV and non-UAV image data is mainly mastered. The former is obtained by using eight monitoring points and four omnidirectional HD cameras, while the latter is a collection of various civil and military aircraft images. Each of the two sets contains 1,500 images with an average resolution of 300×200, and each training sample is 1000. The test sample is 500. Since the size and resolution of the input sample directly affect the selection of the convolution sum of the deep learning model, it is necessary to ensure that the data size is the same after preprocessing the sample image set, so as to facilitate the subsequent UAV target recognition and tracking training.

In deep learning, the convolutional neural network is used to identify two-dimensional images. This network has a high degree of image scaling and translation without deformation. The training speed of the network can be improved by adjusting the weight value and calculating the undersampling layer. According to the analysis of the UAV target recognition and tracking flow chart with deep learning as the core as shown in Figure 3 below, after effectively processing image sample data, it is necessary to build a deep learning model and scientifically process parameters, and train the deep learning model by using the acquired picture sample set. In the training process, the classical reverse error propagation method should be used to accurately calculate the error between the output data and the label data, and finally the neural network algorithm should be used to adjust the weight value of each level.

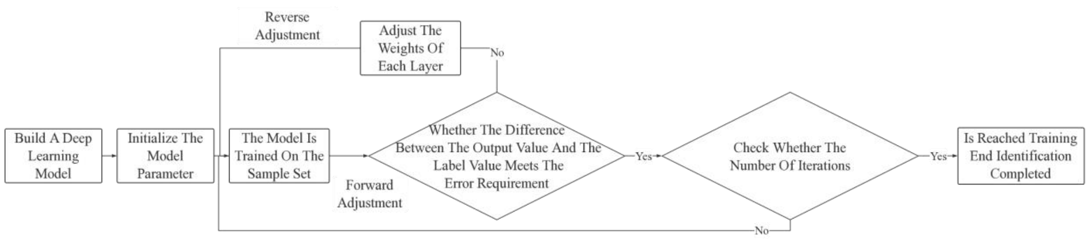

Figure 3 UAV target recognition and tracking flow chart with deep learning as the core Figure

3. Results Analysis

Combined with the UAV target recognition framework and target recognition and tracking flow mastered in this paper, experimental analysis is carried out in MATLAB programming environment. Because the characteristic parameters of UAV are complex, the Caffe program framework shown in Figure 4 is used to identify the target in the experiment. As a modular deep learning framework, it can improve the speed of algorithm training and the accuracy of target identification by using the unique CPU interface.

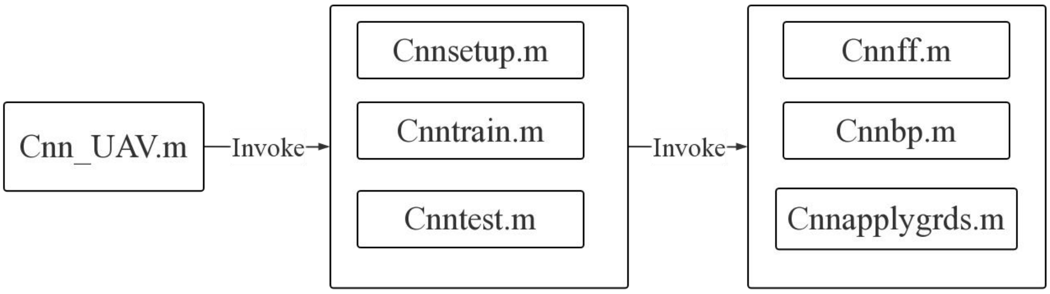

Figure 4 Flowchart of the Caffe program framework

By comparing the classical Le-Net5 network model and the improved target recognition model, it is found that under the condition of 150 iterations, the error recognition rate of the classical model is 8.82% with a learning rate of 0.1. The error recognition rate is 10.80% when the learning rate is 0.01. Comparing the two learning rate error recognition rates under different iterations, it can be found that the error rate of the experiment is low when the learning rate reaches 0.1. In the case of a certain learning rate, the error recognition rate will continue to decline with the increase of the number of iterations, so within the convergence range, the more iterations, the lower the error recognition rate. It should be noted that when the number of iterations is too large, the target tracking and recognition model is likely to be unable to converge or the convergence time is too long.

When the learning rate of the improved target recognition model reaches 0.1, the error recognition rate of 150 iterations is 3.05%, which is lower than the target recognition rate of 100 iterations and 50 iterations, and the actual convergence speed is slower. Comparing different learning rates, it can be found that with the same number of iterations, the learning rate of 0.1 is lower than the target recognition error of 0.01. According to the analysis of experimental results shown in Table 1 below, under the same conditions such as sample set, number of iterations and learning rate, the target recognition rate of the classical Le-Net5 network model studied in this paper can reach 91.18%, and the recognition rate of the improved target recognition model can reach 96.95%, an increase of 5.77%. This proves that the UAV intelligent recognition and tracking method based on deep learning is effective. Therefore, in the future, researchers should continue to explore the application direction of deep learning model in the research and development of intelligent UAV technology, so as to build a standardized and perfect target recognition and tracking model and improve the efficiency of target recognition and tracking.[14-15]

Table 1 Experimental results

network model	step length	convolution kernel	Error recognition number	Error recognition rate/%
LeNet-5 model	1	5×5	52	8.82
improved model	2	5×5	18	3.05

4. Conclusion

To sum up, although deep learning model is the focus of UAV intelligent identification and tracking method in the new era, I have mastered a lot of technical theories and practical experience in practical exploration, but the overall application still faces many problems, such as parameter differences, model migration ability and so on. Therefore, in the rapid development of social economy and science and technology, intelligent drones should rely on computer vision technology and artificial intelligence theory, continue to deeply explore the target recognition and tracking network based on deep learning and related optimization methods, combined with practical cases to verify the effectiveness and real-time performance of relevant methods, so as to improve the intelligent recognition and tracking performance of drones. Better meet the needs of image analysis and tracking recognition in different fields. At the same time, it is necessary to increase the training of professional and technical personnel, encourage and support scientific research scholars to learn from foreign research results, and then put forward more valuable technical methods according to China's basic national conditions.

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