Target Recognition and Body Length Measurement of Small Tailed Han Sheep

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Abstract. The problem and disadvantage of modern sheep farming lies in the fact that the existing production models cannot meet the existing needs. There is an urgent need for new technologies to modernize equipment and digital management of breeding farms, in order to enhance the mechanization and automation of the breeding industry. This article proposes an intelligent software for recognizing the length and size of sheep in order to address the difficulty of precision in sheep breeding. In order to complete this software, this article uses YOLOv7 for design, using Small Tailed Han Sheep as the main test target, and describes how to train YOLOv7 to achieve real-time body length detection and image recognition of Small Tailed Han Sheep. Just need to know the distance between the Small Tailed Han Sheep and the photo point to complete the approximate detection of the body length of the Small Tailed Han Sheep. This article has also successfully completed the design of this software. However, due to the issue of distance measurement, the software needs to know the distance between the measured object and the camera before measuring the body length. This design can assist farmers in more convenient measurement of the body length of raised sheep.

Keywords: YOLOv7, Target Recognition, Small Tailed Han Sheep

1 Introduction

The main purpose of this article is to design a software that can intelligently recognize the length of sheep, with the ultimate goal of laying a solid foundation for designing intelligent sheep feeding. The research on intelligent sheep feeding in foreign countries started earlier, including real-time monitoring of necessary needs such as sheep entry, feed mixing, and detection of sheep behavior. In recent years, scholars from various countries have also conducted many related studies, promoting the refinement of feeding. In fact, these sheep intelligent feeding systems are mostly studied using STM32 and PLC related systems, and can be referred to each other when conducting related research. As it is not significantly different from domestic design, the following text only lists relevant research on computer vision in foreign countries.

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In 2015, Christian Szegedy et al. optimized the convolutional network and benchmark the optimization method on the ILSVRC 2012 classification challenge validation set [1]. In 2018, Ben G. Weinstein pointed out that compared to human censorship, computer vision provides a more consistent method of scoring animal appearances in images by using non RBG color spaces (such as HSV or YChCr) that are less sensitive to changes in lighting and other image artifacts. To determine the size, position, and spectral features of ecological objects in an image, computer vision tools use image features to locate important pixels within and between images [2].

Yolov7 has a wide range of applications in various industries, including optimizing feature extraction by introducing an efficient vehicle detection long-range aggregation network (ELAN-VD) and improving the YOLOv7 micro model structure to enhance the detection accuracy of small vehicles in aerial images [3]. Due to the excellent performance of YOLOv7 over a wide speed range (5 FPS to 120 FPS), it surpasses all known object detectors. There are also key developments in real-time object detection [4]. YOLOv7 is widely used in the planting industry. There is a method for detecting Camellia oleifera fruits based on YOLOv7 network and multi data augmentation, which is used for detecting Camellia oleifera fruits in complex field scenes [5]. It can be used to significantly improve the recognition rate of fruit targets in high-density fruits [6], and improve the recognition accuracy and sensitivity of apple inflorescences [7], and also contribute to the development of dragon fruit collection robots [8-10]. In the breeding industry, yoloV7 can be used for intelligent duck counting. In social research, yoloV7 can also be used to recognize traffic signs and provide assistance for the development of intelligent transportation systems, autonomous driving, and traffic safety.

The following text will focus on how to design software for intelligent recognition of sheep body length. This article mainly introduces the recognition of targets, methods, processes, and how to train YOLOv7 to recognize Small Tailed Han Sheep.

2 Methods and Materials

In this experiment, YOLOv7 was selected to complete the object detection system. The YOLO series has witnessed the evolution of object detection in the era of deep learning. The YOLOv7 network mainly includes four parts: Input, Backbone, Neck, and Head. Firstly, the image is preprocessed through a series of operations such as data augmentation in the input section, and then sent to the backbone network. The backbone network extracts features from the processed image; Subsequently, the extracted features are fused through the Neck module to obtain features of three sizes: large, medium, and small; Finally, the fused features are fed into the detection head and the results are output after detection. YOLOv7 has higher accuracy than YOLOv5 under the same volume, with a speed of 120% faster (FPS), 180% faster than YOLOX (FPS), 1200% faster than Dual Svin-T (FPS), 550% faster than ConvNext (FPS), and 500% faster than SWIN-L. In the range of 5FPS to 160FPS, YOLOv7 surpasses currently known detectors in both speed and accuracy. Tested on GPU V100, a model with an accuracy of 56.8% AP can achieve a detection rate of over 30 FPS (batch=1).

At the same time, this is currently the only detector that can still exceed 30 FPS at such high precision.

The target recognition object for this experiment is the Small Tailed Han Sheep . The Small Tailed Han Sheep is a mammal belonging to the family Bovidae in the order Artiodactyla. Strong physique, tall, with long limbs, sturdy hooves, and drooping ears; The ram has a large head and a thick neck, with spiral horns; Ewes have a small head and a long neck, with most having horns and a very small number having no horns. Body length, straight back and waist, evenly developed front and back. The coat is white, with very few black brown patches on the head and limbs. Small Tailed Han Sheep are mainly produced in Wenshang, Jining, Shandong, China and can be raised in various parts of China. It is also one of the sheep that farmers raise in large numbers. Because most of it is white throughout, it is easy to recognize. Due to the presence or absence of sheep horns, it is easy to detect their body length. In summary, from the perspective of difficulty and wide application, the target recognition object for this experiment is the Small Tailed Han Sheep .

The main process of this experiment is as follows:

Measuring the body length of Small Tailed Han Sheep.

Measure the distance between the Little Tailed Han Sheep and the camera to ensure consistent distance.

Take side photos of the Little Tailed Han Sheep.

Build a target recognition system using YOLOv7 to identify Small Tailed Han Sheep.

Enter the distance and construct a function to calculate the body length of the Small Tailed Han Sheep.

Compare the calculated results with the actual body length to determine if the system can function properly.

From the process, it can be seen that the focus of this experiment is on how to use YOLOv7 to achieve target detection of Small Tailed Han Sheep. The follow-up of this experiment will also focus on the data construction of YOLOv7.

Firstly, list the objects used in this experiment. Fig. 1 shows the image of the Small Tailed Han Sheep that needs to be recognized in this experiment.

Fig. 1 Small Tailed Han Sheep used in the experiment (Photo credited: Original)

The data of Small Tailed Han Sheep used in this experiment are as follows: Table 1 shows the actual measurement data of small tailed Han sheep with different numbers.

Table 1. Body data of Small Tailed Han shee

Number	Body length	Distance
Sheep1	1.2m	0.8m
Sheep2	1.4m	0.8m

Because this experiment did not involve ultrasonic ranging, it is necessary to measure the distance in advance for the convenience of subsequent experiments.

After all the preparation work is completed, YOLOv7 target recognition training should be carried out.

Firstly, pretraining of the model is required to test whether the weights have been successfully downloaded. The pre trained model we used this time is yolov7_training.pt, which was trained on the MS COCO dataset. We downloaded this model to /yolov7/weights/ . We need to create a/weights/folder to store our pre trained models uniformly. After completing the testing, data preparation and model training can be carried out.

Next, we need to carry out data preparation work. Firstly, generate the/datasets/folder and put all the data into it for unified management. The training data is in YOLO data format. Then use labelImg for data annotation to obtain a YOLO format dataset. Next, it's time to generate train_list.txt and val_list.txt. Train_list.txt stores the paths of all training images, while val_list.txt stores the paths of all validation images. At this point, the dataset is ready.

Then start configuring the relevant files for training. Firstly, there are two files that need to be configured, one is/yolov7/cfg/training/yolov7. yaml, which is a configuration file related to the model; One is/yolov7/data/coco.yaml, which is the configuration file for the dataset. Then start configuring the model files. The first step is to copy the yolov7.yaml file to the same path, then rename it to yolov7-Helmet.yaml. Step 2, open the yolov7-Helmet.yaml file and modify nc to a target total of 2 for the dataset. Finally, configure the dataset file. The first step is to copy the coco.yaml file to the same path, then rename it, and we will name it Helmet.yaml. Step 2, open the Helmet.yaml file and make the modifications as shown below. There are five areas that need to be modified. The first step is to comment out the command for automatically downloading COCO datasets from the code to prevent it from occupying memory; The second step is to modify the position of the train to the path of train_list.txt; Thirdly, modify the location of val to the path of val_list.txt; Fourth: Modify nc to the total number of targets in the dataset; Fifth point: Modify names to the names of all targets in the dataset. Then save. At this point, the relevant files have been configured.

Finally, the model can be trained to obtain the training and inference results. The training uses the three files mentioned earlier: the pre trained models yolov7_training.pt, yolov7 Helmet.yaml, and Helmet.yaml, as well as some other hyperparameters. The specific commands are as follows: python train.py --weights weights/yolov7_training.pt --cfg cfg/training/yolov7-Helmet.yaml --data data/Helmet.yaml --device 0,1 --batch-size 64 --epoch 10

Then two cache files will be generated under yolov7/datasets/Helmet/, which are convenient for the model to read and generate data. Do not delete them during the training process. After scanning, the model will start training. After the training is completed, the terminal will print out the best model and save the model results of the last epoch in/runs/train/exp/.

At this point, we have completed the YOLOv7 dataset on Small Tailed Han Sheep . Using this dataset, we can identify the Small Tailed Han Sheep through a camera. Next, simply obtain the body length of the Little Tailed Han Sheep in the camera and convert it to the actual body length. The calculated body length of the Small Tailed Han Sheep can be obtained at a certain distance. After the program is completed, multiple experiments can be conducted to compare the calculated body length with the actual body length. If the error is very small, the experiment can be completed.

3 Results

The focus of this experiment is on how to construct a dataset for YOLOv7 on Small Tailed Han Sheep. And use Python to complete the target recognition of the Small Tailed Han Sheep. In addition, due to the fixed recognition distance and angle of the target in this experiment, there was not much innovation in calculating the body length.

The recognition effect of this experiment is as follows: Fig. 2 shows the body length recognition of Small Tailed Han Sheep.

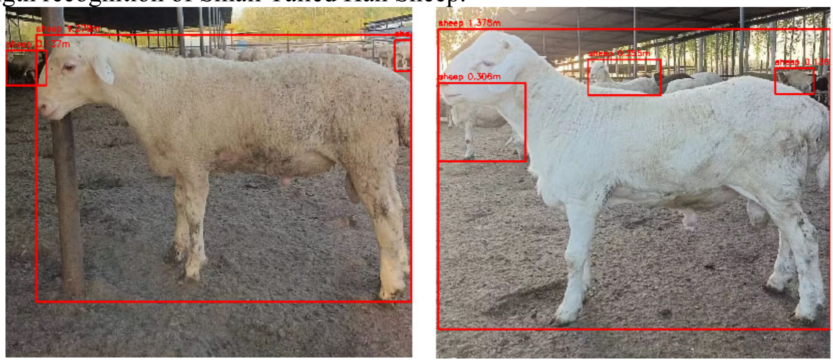

Fig. 2 Recognition results and calculation of body length for Small Tailed Han Sheep (Photo credited: Original)

According to the picture, it is evident that the task of identifying the Small Tailed Han Sheep has been fully completed in this experiment. Not only can it identify the main target, but it can also recognize Small Tailed Han Sheep with different postures. The body length recognition of the main target is also quite precise, and the relevant data is as follows. Table 2 shows the actual data and identification data of Small Tailed Han Sheep with different numbers.

Table 2. Body data and calculation results of Small Tailed Han Sheep

Number	Body length	Calculation results	distance

Sheep1	1.2m	1.278m	0.8m
Sheep2	1.4m	1.378m	0.8m

According to the results, it was found that the calculated result of Sheep1 differs significantly from the actual body length. This is due to the influence of measurement accuracy. In actual measurement, it is necessary to measure two physical quantities: the actual body length and distance of the sheep. In actual testing, it can cause significant errors. This in turn affects the relevant results. This is also the main challenge that constrains the technology. Due to the absence of an ultrasonic ranging system, there may be errors between the measured distance and the actual distance. This not only causes errors in the calculation of sheep body length. This also leads to the inability of the technology to be used on a larger scale. The body length of a sheep can only be calculated when the distance between the sheep and the camera is constant.

This experiment also demonstrated the corresponding advantages of YOLOv7 in target recognition. Firstly, the detection accuracy is improved. YOLOv7 improves the accuracy of the detection algorithm, making the detected targets more accurate. Secondly, it is fast. YOLOv7 is faster than previous versions and can process a large number of images in a short period of time. Better adaptability, YOLOv7 can adapt to target detection needs in different environments, making it suitable for use in various scenarios. Finally, support for high-resolution images: YOLOv7 supports processing high-resolution images, making it suitable for higher precision object detection. In this experiment, even without the addition of Small Tailed Han Sheep with black spots, the system still recognized the Small Tailed Han Sheep . This proves the high adaptability of YOLOv7 in target recognition. Below will be Fig. 3, which shows the author's recognition of a Small Tailed Han Sheep with a black head.

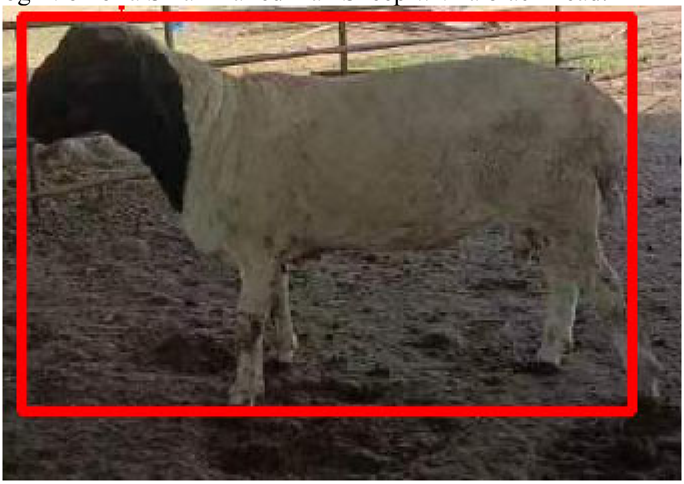

Fig. 3 Identification of Small Tailed Han Sheep with Black Spots (Photo credited: Original)

4 Conclusion

In summary, using YOLOV7 training for sheep image recognition enables AI to recognize sheep that appear on the screen. Then input the distance between the sheep and the camera to calculate the sheep's body length. And display it in the output bar below. In practical operation, due to technical limitations, only the detection of sheep body length when facing the camera from the sheep's side can be completed. This paper completes the detection of sheep body length, which can help farmers quickly measure sheep body data in actual production and also play an auxiliary role in the study of sheep growth. Unfortunately, this technology requires a fixed camera angle and distance for measuring sheep. This poses certain difficulties for sheep who have been constantly in motion. Due to the fact that some sheep have black heads, they are easily integrated with the environment during actual testing. It can cause errors and difficulties in recognition. And due to the inability to control the actual distance between the sheep and the camera, errors can also occur during recognition. This technology is influenced by a series of factors such as the type of sheep, shooting location, and surrounding environment. Further improvements and optimizations are needed for this technology.

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