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Summary of Pig Behavior Recognition Based on Computer Vision Technology

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Abstract

Micro changes need to be observed manually for a long time, which is impractical in the large-scale breeding model.As an effective auxiliary technology for information processing, computer vision technology provides an automated, non-contact, low-cost, high-yield, and non-injury and stress-free behavior recognition method for animals. It can be used to consider the health status of pigs and to prevent and prevent them in time. Discover the disease.In recent years, computer vision technology has been used more and more in the pig industry. Pig behavior recognition has always been an important content of pig industry research. It is related to the capacity and output of pig farms, so it is necessary to accurately treat pigs. Only behavior is recognized.Traditional pig behavior identification mainly uses RFID technology, but it interferes with the normal growth of pigs and is not easy to operate.At present, computer vision technology is more and more used in the pig industry, effectively solving the problems of traditional methods.This article describes the recognition methods of pig behaviors, analyzes the advantages and disadvantages of different recognition methods, and summarizes the application of deep learning in pig behavior recognition.

Keywords

Computer vision,Pig, Behavior Recognition, Deep learning .

1. Introduction

The scale and quantity of China's pig industry are constantly expanding, and breeding informatization is an important model for pig breeding supervision in the future. At present, the most commonly used method of pig farm supervision is manual monitoring. However, due to the unstable factors of manual monitoring, the labor consumption is large and the behavior is finer than the outline to identify the drinking behavior of pigs. Machine vision is a non-invasive method. It can monitor the daily behavior of animals in real time. Because of its low price and easy installation, it has been widely used in pig farm production management. Many pig farms have obtained a large amount of surveillance video data, but use animal video surveillance data for information extraction , There are not many studies on obtaining useful information for production management. The application on pigs is mainly about crawling, attacking, eating, drinking and other behaviors. Scholars such as Li Jian proposed the Yolo algorithm combined with individual segmentation algorithm, centroid detection algorithm and angle detection algorithm to identify pig drinking behavior; Li Dan, Zhang Kaifeng [2] and other scholars proposed a mask R-CNNde-based pig crawling behavior recognition ; Li Juxia[1]et al. proposed a pig eating behavior detection algorithm based on YOLOv4; computer vision technology and deep learning are used more and more in pig behavior recognition, which is also the inevitable trend of the future development of the pig industry.Organization of the Text

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1.1. Pig target acquisition and identification

1.1.1. Segmentation and extraction of pig targets

The behavior recognition of pigs first needs to extract the foreground target from the acquired video sequence frames. The commonly used extraction algorithms mainly include static single frame and dynamic multi-frame. Among them, the principle of the static single-frame extraction algorithm is to split the video sequence into many single-frame images, and then extract the target through feature analysis in the single-frame image. The advantage is accurate extraction, but the disadvantage is low efficiency; dynamic multi-frame extraction algorithm The principle is to use the processing algorithm between adjacent frames to extract the target in the video sequence. The advantage is that it is fast, but it is difficult to extract the target when the target is slow or in a static state.

1.2. Individual identification

Ear tag identification is the most commonly used pig identification method, but this method is affected by the signal and receiving distance and is easily damaged. Although traditional manual marking is easy to identify, it is no longer conducive to operation when the breeding scale is large. The use of computer vision methods to identify individual pigs can minimize the cost and reduce the cost. Tan Huilei[3] extracts color information entropy, shape parameters and texture features from the pig's buttocks and back to construct feature vectors, and calculates feature similarity to identify For individual pigs, the accuracy rate is 86.7%; Yang Qiumei[4] and others use traditional threshold segmentation methods to obtain binarized images to extract pigs from the background, and then introduce the image occupation index to predict the behavior of pigs, with an accuracy rate of 96.22 %; (Porcupine) Yang Wei[5] et al. used the Gaussian model background modeling method to model the background of pigs and breeding environment, mark the outline of the pig, and the recognition accuracy rate reached 86.34%.

2. Pig behavior recognition analysis

At present, pig behavior recognition mainly includes grounding behavior, aggressive behavior, drinking behavior, eating behavior, and excretion behavior recognition. This article mainly introduces pig's diet and drinking behavior recognition; push-down behavior recognition; crawling behavior recognition; breathing behavior recognition; aggressive behavior recognition.

2.1. Pig eating and drinking behavior recognition

The dietary status of pigs is an important basis for judging their health. Unscientific dietary management of pigs will affect the health of pigs. Real-time, continuous and accurate detection of the eating and drinking status of pigs is of great significance for preventing pig diseases and improving breeding welfare. Tan Huilei[6] et al. proposed a contour-based recognition method for pig drinking behavior. First, the drinking area is separated from the original image, and the effective image processing method is used to obtain the target contour, establish the training sample, and then perform the contour of the individual pig in the area. The polygon is approximated, the feature quantity is extracted, and the similarity is finally calculated for contour matching. This method has made breakthroughs in recognition speed and recognition quality. However, due to the large interference in the background of the pig house, the deformation of the pig contour leads to inaccurate extraction, so the recognition rate is not high, and the recognition rate needs to be further improved in the future. Yang Qiumei[4] and others introduced the image occupation index to predict the drinking behavior of pigs. This method will cause misjudgment and missed judgment, so on this basis, a PDR method based on deep learning was added to improve the accuracy rate, reaching 92.11%. It can also be used to identify other related behaviors of pigs, such as the recognition of excretion behavior. Li Juxia[1]

et al. established an image database of pig eating behavior based on different perspectives, different degrees of occlusion, and different light intensities, and used the YOLOv4 model to detect the eating behavior of pigs. In the deep learning network, the in-depth feature extraction and high-precision detection and classification characteristics of the YOLOv4 network are used to accurately detect the eating behavior of pigs.Chen Zicheng[6] uses a behavior description method based on spatio-temporal interest points and a bag-of-words model to describe video frames, and then uses SVM classifier to build a pig behavior model to classify and detect pig diet and other behaviors with an accuracy rate of 92.31%.

2.2. Recognition of pigs on the ground

Studies have shown that the higher the temperature, the higher the humidity, and the slower air flow, the shorter the residence time of pigs. The lower the temperature, the denser the distribution of pigs in places with low humidity and fast air flow. At the same time, the behavior of pigs on the ground can also show the health of the pigs. Therefore, detecting the density of pigs on the ground can better control the environmental temperature, maintain the health of the pigs, and increase the welfare of pigs. Nasirahmadi[7] et al. used the Delaunay triangulation algorithm to connect the pig herd into a triangular network, analyzed the relationship between the pig's ground behavior and temperature, and input the Delaunay parameters obtained in the study into the artificial neural network. The current temperature is higher and lower than the appropriate temperature. , And moderate as the output, the accuracy rate is 95.6%.

2.3. Pig crawling behavior recognition

Climbing behavior is a kind of dangerous action, which is mainly manifested as climbing the front hoof of the pig to climb the back of the pig being crawled, especially when the pig is in estrus. This behavior often causes skin trauma and even fractures, which will affect the health of pigs, reduce breeding welfare, affect the quality of pork, and cause economic losses.

Li Dan[2,14] and other scholars proposed a weight-based pig crawling behavior detection method based on deep learning. The Mask R-CNN network is used to segment the pigs in the image to obtain the mask, and then the mask pixel area of each pig is calculated, and the defined threshold is calculated according to Threshold recognition of crawling across rows, this method is better than the traditional method in the classification effect of diverse background illumination changes, pig sports background color close and pig body light adhesion.

2.4. Recognition of pig breathing behavior

Swine diseases are often accompanied by symptoms of shortness of breath. Pig diseases can be detected in time by detecting the respiratory frequency of pigs, and it can also be used to detect the relationship between biological genes and animal behavior [16]. The traditional method uses manual observation to monitor. This method is not only labor intensive and subjective, but the algorithm based on computer technology can save manpower and make up for the shortcomings of excessive subjectivity.

According to the characteristic that the abdomen and spine of pigs breathe periodically, Ji Bin[8] and other scholars proposed to use the parameters of the spine line to construct the intercept descriptor and wave descriptor of the spine line, which can reflect the spine line The periodic change of contraction during breathing requires only the calculation of the descriptor value to get the pig breathing frequency; Xie Haiyuan[9] and other scholars proposed a recognition algorithm based on the envelope analysis algorithm to identify the boundary between the contour of the pig's leg and the trunk to extract the spine. The maximum radius of curvature of the contour segment is constructed, and a descriptor of the maximum radius of curvature of the contour of the ridge is constructed, and a waveform diagram model of the pig belly breathing motion is established with an accuracy of 94.3%.

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2.5. Pig aggressive behavior recognition

In large-scale group breeding of pigs, aggressive behaviors often occur in the pig herd. The aggressive behaviors of pigs are not only easy to cause damage to the pig's body, but also easy to cause pig infections, and in severe cases, it may lead to pig deaths. Cause losses to the pig farm. At present, pig farms mainly rely on manual observation to monitor the aggressive behavior of pigs, which not only consumes a lot of manpower, but also cannot guarantee the real-time and accuracy of aggressive behavior detection. Therefore, automated monitoring of the aggressive behavior of group pigs is an important part of ensuring the efficiency of the pig farm.

Aiming at the aggressive behavior of group pigs, Gao Yun[10] and other scholars proposed a method based on deep learning, using 3D CONV's group pig aggressive behavior recognition algorithm (3DConvNet), which can still accurately identify aggressive behaviors under poor lighting conditions. It breaks through the shortcomings of the previous algorithms on the harsh lighting conditions. Chen[11] et al. extracted the overall motion acceleration characteristics of pigs with aggressive behavior between adjacent image frames, and used hierarchical clustering to calculate the acceleration threshold to identify the aggressive behavior. The accuracy was 95.82%. This method has high recognition accuracy and is less restricted by scene conditions.

2.6. Pig excretion behavior recognition

The amount of ammonia emissions in the pig house is affected by the size of the floor area contaminated by pig manure, which depends on the pig's excretion behavior. Therefore, minimizing pig manure pollution is of great significance for reducing ammonia emissions in the pig house, and it is also very important for improving the environmental problems of pigs [15]. In addition, environmental issues will also affect the welfare level of the pigs and the working conditions of the employees.

Wu Qiong[12] proposed to construct a moving pig detection model based on the adaptive background difference method to detect pigs' excretion behavior; Li Zhenye[13] tracked moving pigs in real time and identified the time the pigs stayed in the excretion area to predict pigs' excretion behavior, but This method may cause misjudgment, because the pigs stay in the excretion area and do not exhibit excretion behavior. There is a similar misjudgment problem to the prediction of pig drinking behavior based on the image occupation index proposed by Yang Qiumei[4].

3. Behavior recognition analysis of other animals

Like other mammals, dairy cows only produce milk after conception. Finding the cows in estrus in time and ensuring smooth fertilization is the key to increasing milk production and improving the economic benefits of dairy cows. Wang Shaohua et al. proposed a non-contact automatic recognition method of cow estrus behavior. This method uses an improved Gaussian mixture model to achieve target detection of moving cows, then removes interference background based on color and texture information, and then uses deep learning network to train cow behavior classification The network model recognizes the cow's crawling behavior, and finally realizes the automatic recognition of the cow's estrus behavior. The accuracy of this method for the cow's estrus recognition is 100%. This method can also be appropriately adjusted to be suitable for identifying pigs' crawling behavior. Lao Fengdan[17] et al. used machine vision technology to identify the behavior of a single layer, and obtained the top view of the layer by analyzing the video file. The key parameters were center of mass coordinates, contour map area, contour map perimeter, contour map center of mass movement displacement, and average motion. Speed, contour long axis, contour short axis, ratio of long axis to short axis, form factor, maximum distance from top half of contour to long axis,

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maximum distance from bottom half of contour to long axis, top and bottom contour to long The maximum correlation coefficient of the axis distance, the minimum correlation coefficient of the upper and lower contour map to the long axis distance, and the maximum coordinate value of the contour map, formulate the characteristic parameter values of the laying hens when performing various behaviors, calculate the relevant parameter values to identify the drinking water of the laying hens, The behavior of feeding, grooming, resting, flapping wings, shaking, exploring, and lifting wings. Zhang Min[18] et al. used the method of camera vertical experiment platform to collect animal activities, and used image processing technology to analyze the animal's top view. The feature parameters formulated for the top view include the normalized variance value of the distance from the center of gravity to each point of the contour, and the center of gravity to each point of the contour. The ratio of the maximum distance to the minimum distance, the included angle between the maximum and minimum distances from the center of gravity to each point of the contour, and the proportion of the contour concave segment in the total contour image. The focus is on the pixel change of the top view, and the calculation of each parameter value identifies the extension of the mouse. Three behaviors: lengthening, bending and squatting.

4. Problems in pig behavior recognition

The stability of information acquisition. The environment of the breeding farm has an impact on the video capture and image processing. The breeding environment is usually fully enclosed or semi-enclosed. The light in the house is generally dark, which is not conducive to the camera to collect the target object. At the same time, the size of the house and the breeding density of the house have an impact on the outline The correct extraction of the graph has a greater impact.

The accuracy of pig behavior recognition. The accuracy of behavior recognition is not up to the standard put into use. Because most recognition methods are based on the characteristics of the pig's living space, it is easy to cause the algorithm to fail, and the running time of the algorithm is too long to achieve the effect of real-time monitoring. . Therefore, the accuracy and stability of pig behavior recognition algorithms are the focus of future research.

Effectiveness of target tracking. Keeping track of the target or tracking for a long time is a key factor in considering effectiveness and stability. Most algorithms have unsatisfactory processing effects due to occlusion and adhesion between pigs and pigs. Therefore, improving the effectiveness of target tracking is the focus of future research algorithms.

Applicability of behavior recognition. Most of the current diet and excretion behavior recognition algorithms are implemented based on specific pig pens, which leads to poor portability of the algorithm and lacks the ability to adapt to multiple pig houses. Behavior recognition algorithms all obtain a single perspective. Due to the limited information provided, it is difficult to solve multiple behavior recognition.

Applicability issues in target extraction. Due to the difference in color and background of pigs, most of the current researches on pig extraction are for a certain type of pig, and not applicable to all types of pigs. However, there are many types of live pigs in the pig factory, and the backgrounds are also different, so it is the focus of future research to make a certain algorithm suitable for various environments and pig types.

5. Outlook

This article mainly analyzes pigs' drinking and eating behaviors, crawling behaviors, breathing behaviors, aggressive behaviors, and excretion behaviors, introduces algorithms to identify them, and analyzes the advantages and disadvantages of the algorithms. At present, there are not many studies on pig behavior recognition using deep learning methods. In recent years,

deep learning has become a key research method in the research field. It can not only extract semantic information in depth, but also extract those that are difficult to obtain. The subsequent identification of pig behaviors should be widely used in deep learning methods to develop deep learning and realize intelligent pig raising.

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