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A Method for Eliminating Pig Face Recognition Errors Caused by Too Short Pig Growth Cycle

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Abstract: In the process of modern large-scale pig breeding, it is necessary to distinguish the identity of each pig and real-time detect its health status, weight change, dietary status, and other parameters. Traditional methods waste a lot of resources, while the high quality of pork cannot be effectively guaranteed. This project is based on convolutional neural networks to design and develop a pig face recognition system. This system uses an overhead camera suspended above the pig house to monitor the pig house for 24 hours and identify and track each pig. Due to the rapid growth cycle of the pig, the facial image information changes rapidly, which has a significant impact on the pig face recognition model. The acquisition camera module is designed to correct monitoring and tracking data. The acquisition camera is installed in the necessary place of the pig every day to collect real-time information and upload the collected information to the server. By comparing the data of individual pigs at different developmental stages with the server, the identification information of individual pigs is determined, and tracking data is corrected in a timely manner. At the same time, the monitoring and identification screen is displayed on the screen, and behavioral information parameters are recorded to facilitate the information management and breeding of the farm.

1. Introduction

About 8000 to 10000 years ago, in order to provide a reliable supply of meat, Humans domesticated wild boars, opening the era of pig breeding. Pigs have the advantages of high meat production rate and relatively short meat production cycle. At the same time, pig breeding requires a small area, and is easy to raise at low cost, in large batches, with high density, and mechanization. In addition, pork also has rich nutritional value. Its protein is high-quality protein, containing all essential amino acids for the human body. Pork is rich in iron, which is a necessary element for the formation and functional maintenance of red blood cells in the human body. Pork is the main dietary source of vitamins, especially in refined pork, which is rich in vitamin B1. Pork also contains more vitamin B2, which is important for fat synthesis and decomposition. Nowadays, the pig industry has developed into an important industry in agriculture, providing a reliable guarantee for the safe supply of human meat and food.

In a modern large-scale pig farm, there are about 100000 pigs. Managers need to identify each

pig in order to real-time detect their health status, weight changes, dietary status, and other parameters. In the past, there were four main methods for identifying a pig: ear deficiency method, labeling method, ear tag method, and electronic ear tag method. These traditional detection methods are limited by reading and writing methods and data storage restrictions, Unable to interface well with automated and intelligent management. At the same time, the existing pig face recognition technology, due to the rapid growth speed of pigs, leads to a large transformation of pig facial features, which has a significant impact on the recognition model, resulting in accuracy often not meeting our practical application needs.

In order to solve the problem of insufficient model accuracy due to large facial features during the pig growth cycle, we first designed two cameras, one of which is suspended above the pigsty to monitor the chase. The other is located at the place where pigs must pass every day and is responsible for collecting facial image information of pigs every day, which is used to eliminate errors in monitoring and tracking.

2. Theory Related to Pig Face Recognition

With the development of artificial intelligence, it has gradually penetrated into all walks of life of mankind[1]. Convolutional neural networks are widely used in image processing, speech recognition, and other fields because they simulate the design of the human cerebral cortex and have strong learning abilities.

2.1. Artificial Neural Network

In 1943, the American mathematician W. Pitts and others first proposed the concept of artificial neural networks. Neural network models and the concept of humans[2], just like radar is a product of human bionics, neural network models imitate the structure and working principles of the human brain, thus they are called artificial neural networks. Artificial neural networks, like the human cerebral cortex, are also composed of neurons, known as artificial neurons. Its working principle is to accept k inputs, multiply and add them with weights, and obtain an output result through activation function mapping. The artificial neuron working model is shown in Figure 1.

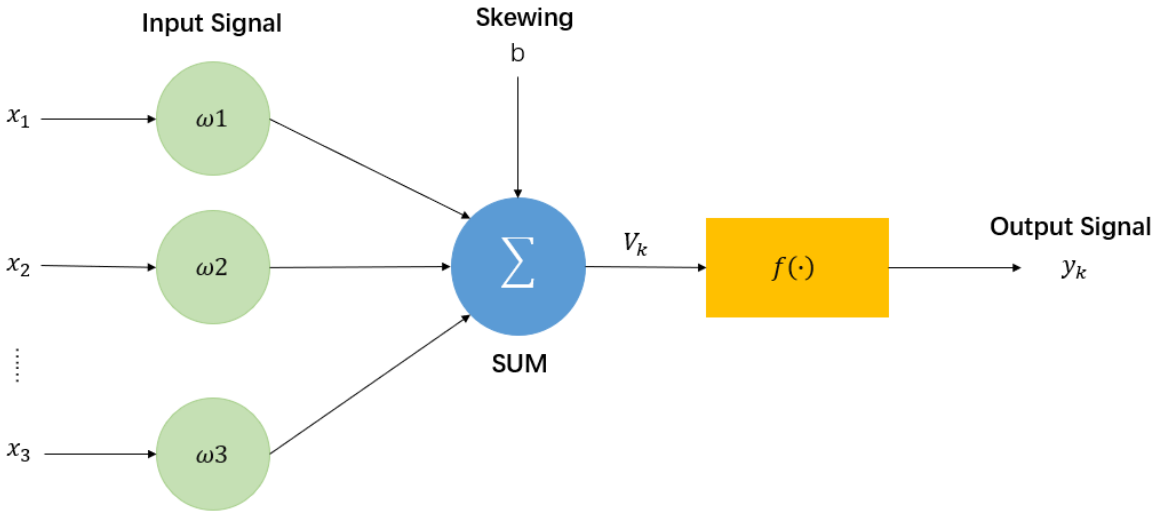

Figure 1: Artificial Neuron Working Model.

2.2. Convolutional Neural Network

Convolutional neural network[3] has excellent performance in processing large amounts of data and has achieved excellent results in areas such as computer vision. Convolutional neural network is an artificial neural network with a multi-layer structure. The difference between traditional neural networks and traditional neural networks is that traditional neural networks are composed of one neuron fully connected, while convolutional neural networks are those in which each neuron is connected to the previous neuron, and the neuron structures at the same layer share a convolutional kernel with the same weight. This change in connection mode allows convolutional neural networks to achieve higher level feature extraction. The convolutional neural network is illustrated below Figure 2.

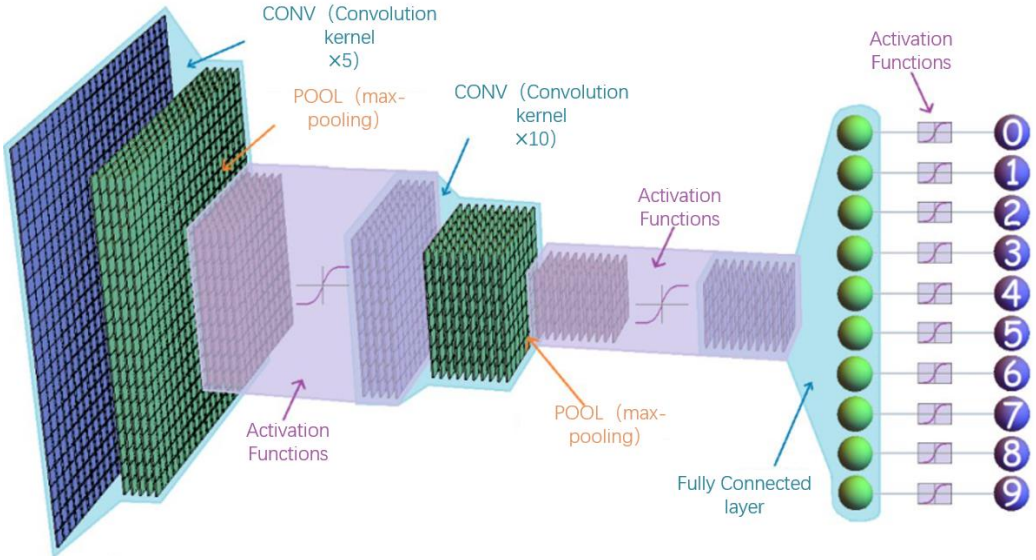

Figure 2: Convolutional neural network diagram.

2.3. Production and Data Enhancement of Pig Face Recognition Dataset

Create datas set of pig faces based on the image video of the entire pig[4]. First, obtain the coordinate information of the pig through an xml file, and use the lxml library in Python to extract information. Next, use OpenCV to clip the pig face in the video, and place the clipped image in the corresponding folder. The production of pig face recognition dataset can be completed.

There are seven methods for data enhancement of pig face images: mirroring, flipping, zooming, rotating, color dithering, noise and cropping. Using these seven methods to process images can complete data enhancement and improve the training effect of the model.

2.4. Implementation of Pig Face Recognition

For pig face recognition, the first step is to establish a recognition model. Here, the basic OpenCV algorithm and the common YOLO algorithm are introduced.

2.4.1. Pig Face Recognition Using OpenCV Algorithm

OpenCV[5] is a cross platform computer vision and machine learning software library released under the Apache 2.0 license. Composed of C functions and part of C++, it also provides interfaces for languages such as Python, Ruby, and Matlab, and can be used on operating systems such as

Linux, Windons, MacOS, and Android. The following describes the process of realizing pig face recognition through Python. Firstly, according to the dataset production method mentioned in 2.3, we create a dataset for pig face recognition. The next step is to perform data enhancement, using the built-in functions of OpenCV to crop samples and perform grayscale processing. After that, it is necessary to scan the processed sample and generate a text file of the sample image. Next, generate a Vec file through Createsmple. After that, we started training the model. Here, the classifier is trained through traincascade, and then an xml file is obtained, which is the trained model. Below, you can identify the pigs in the pigsty through the cascade.

2.4.2. Pig Face Recognition Based on YOLO Algorithm

The YOLO paper was published by Joseph Raymond in CVPR2016 as a single stage model[6]. Similar to OpenCV, the first thing to do is to capture the pig's image from the video, and then perform clipping processing to generate a reliable dataset. The YOLO-9000 algorithm is introduced here. By running raw_ data/image_ Process.py to cut the image into a square. After that, run raw_ data/get_ data_ Txt.py, this step is to divide the data into 50 storage files and store them in TXT files for easy distributed reading of large data. Next, run raw_ data/create_ h5_ Dataset.h5, which converts the data into an h5 file. Here, the Bilinearcnn algorithm is used for model training. Here, it is divided into pre training and full network training. First, through pre training for 50 times, the optimal model is introduced into the full network training for 200 times, and then the optimal model is saved. After later parameter adjustment, the most accurate model can be obtained, and finally, predict can be run_ Resvgg.py prediction results.

3. Eliminate Pig Face Recognition Errors Caused by Too Short Growth Cycles

In practical applications, when we train a pig's facial recognition model in its infancy[7]. Due to the short growth cycle of a pig, its facial image information changes greatly. The recognition accuracy of the model is greatly reduced.

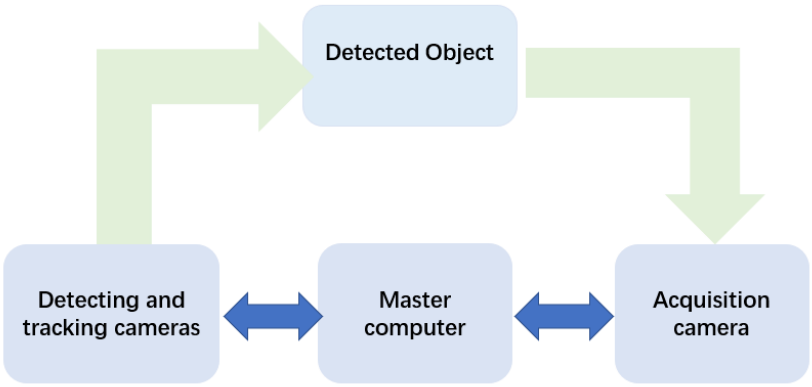

Figure 3: The system Closed loop correction diagram.

To solve this problem, we designed a method. Firstly, the camera responsible for monitoring the pig farm is hung above the pig farm, which is responsible for monitoring and tracking the behavior information of the pigs in real-time 24 hours throughout the entire pig farm and recording it. At the same time, a camera is installed at the place where pigs must pass every day, such as in front of the sink where pigs drink water, or in front of the pig's feeding trough. This camera is responsible for collecting facial image information of pigs every day and transmitting it back to the server. The server compares and analyzes the returned data with the monitoring and tracking data. Once errors

occur, they can be corrected in a timely manner, and the recognition model is retrained, forming a closed-loop control. Not only ensures the accuracy of tracking data, but also eliminates the pig face recognition error caused by the too short growth cycle of the pig. The system flowchart is shown in Figure3.

4. Conclusions

Pig face recognition is an essential step in achieving intelligent pig farming, and it is the "eye" of intelligent pig farming monitoring systems. In traditional farming, when the breeder pours the feed from the same herd of pigs into the same trough, 10 to 15 pigs flock to grab the feed for food, ultimately resulting in uneven growth when the same herd of pigs is released, with the smallest being only 70 kilograms and the largest being 130 kilograms.

Unlike traditional pig feeding models, intelligent farm models are much more fair and efficient. They can distinguish the weight and race of pigs through an automatic monitoring system based on pig face recognition, and calculate the optimal amount of food consumed and the quality of nutrients that should be supplemented. Then the feed that this pig should eat is automatically fed, and the amount of feed fed is controlled to an accuracy of even grams. Within the planned guidance amount, it can also support interactive meal sharing, truly enabling pigs to eat whenever they want. This precise feeding can reduce the weight difference of the same herd of pigs when they are released to within 5%, and can also save feed costs.

Traditional pig farming mostly adopts extensive farming methods, and pig health monitoring technology is limited, which consumes a lot of manpower and material resources. The mortality rate of piglets remains high, and it is difficult to increase production, cost, and profitability. The intelligent monitoring system for pig breeding can continuously monitor the health signs of organisms on line and in real time 24 hours a day. When the system captures abnormal data such as the amount of exercise, food intake, body temperature, and feces of the pig, it retrieves the past body temperature, food intake records, and exercise amount of the pig in the database for comparative analysis. The possible risk of illness in this pig can be determined at an early stage. The staff can detect the pathogen at the first time, immunize in advance, effectively control and quickly eradicate the plague from the source.

It is estimated that after adopting "pig face recognition", the labor cost of the farm will be reduced by 30% - 50%, the amount of feed used will be reduced by 8% - 10%, and the average time to market will be shortened by 5-8 days. Pig face recognition is an essential step in the data processing process. In the future, automated pig farms should be able to achieve intelligent feeding, monitoring and early warning, data collection, and other functions. Staff only need to perform specific tasks based on data reminders. With the popularization of artificial intelligence, intelligent pig breeding will gradually become a focus in the pig industry. Intelligent pig breeding brings higher efficiency, more accurate management, and less labor costs. This will make the meat on your table cheaper and healthier.

Therefore, pig face recognition will be popularized in the near future.

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