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An ai-based aggressive behavior detection method for pig monitoring system (#85)

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Introduction

In Taiwan, the average annual meat consumption per person is 78 Kg where pork accounts for approximately 48%. Since the proportion of imported pork is less than 10%, domestic pig farms play an important role in pork supply. Along with the declining birthrate and changes in industrial structure, workers engaging the livestock industry have experienced significantly negative growth and aging trend. Additionally, the pandemic of swine flu has caused many unpredictable losses in recent years. As the statistic shows, it is an important and inevitable trend to use smart technology to assist farmers to secure birthrate of pig and reduce losses.

Recently, we construct an IoT (internet of thing) system to monitor the pig farm. The main goal of the system is to reduce the necessary farming manpower and provide a better living environment for pigs with the current IoT techniques. Fig. 1(a) shows the basic architecture of our pig monitoring system. Multiple sensors are installed to monitor the air quality (hydrogen sulfide, biogas, ammonia, PM2.5, carbon dioxide concentration, temperature and humidity) of pig sheds and record the feeding and drinking frequency of pigs. A camera and a microphone are embedded in the roof to catch images and sounds for observing. Finally, an edge computer is used to process all data (sensors' signals, sounds and images) and to communicate with the remote server. The whole system was set up in a real pig farm two months ago and the picture of practical layout is as shown in Fig. 1(b).

In a pig farm, a pig with aggressive behavior should be isolated to protect other pigs. Since pig aggressive behavior is one of the most important concerns for a pig farmer, we adopt image processing and Artificial Intelligence (AI) techniques, and propose a pig aggressive behavior detection method in this paper. The experiments show that we can achieve good detection results without human involved. Currently, other sensing data in our experimental field is under processing andanalyzing. With the help of AI techniques, hopefully we can complete the whole control strategy to maintain the healthy environment for pig nursing in the near future.

Methods

To detect aggressive behavior of pigs, we adopt an AI-basedimage processing technique in the system. Since the height of each shed is limited, it is not suitable to use a normal lens to capture the whole group of pigs in the shed. Therefore, a five mega pixels camera with 2.8 mm wide-angle lens is installed at 2 meters high from the ground, which is used to capture 3 m^2 full size of the shed area. However, images captured by wide-angle lens suffer from barrel distortion (or fisheye effect) . It means that the outer regions of the image are compressed more than the inner one. First, a proper image processing method is realized to correct barrel distortion, then an AI-based method is used to detect the aggressive behaviorin the current image.

Training and Detecting are the two important processes in AI applications. We adopt Tensorflow Object Detection API, an AI tool provided by Google, in our detection system. Here, we label the pigs, heads, and tails in the image for AI training. The faster R-CNN ResNet-101 is implemented as the training and detecting model. First, the model will resize the images and go through the Convolutional Neural Network (CNN) layers to obtain the feature maps. Next, the Region Proposal Networks (RPN) divides several anchor points on the feature maps and uses each box of different proportions and sizes to score each anchor point. After that, the most likely bounding boxes and a score of the object will be generated. The Region Of Interest (ROI) pooling will map the coordinates obtained in the feature maps and then divide them into a number of sections for the max pooling process in order to obtain the same size feature maps. Finally, the Fully Connected layer (FCL) integrates the abstracted features that have been convolved and normalized, then outputs theprobability of aggressive behavior in the current image.

Results

In the experiments, we use 217 images containing 637 pigs, 414 heads and 516 tails to train the detection model. To evaluate the accuracy, 71 images containing 172 pigs, 171 heads and 84 tails are used for the detection. The average accuracy rate of pigs, heads and tails detection is around 93%, 84% and 86%, respectively. As shown in Fig. 3, there are 3 pigs in the shed and our system can detect them effectively. Specifically, the green box indicates the pig is detected, pink box represents head and yellow box is tail.

Conclusion

The result shows that we achieve a favorable detection result in the experiments. In other words, our system can monitor the behavior of pigs without human involving. Currently, other sensing data in our experimental field is under processing and analyzing . With the help of AI techniques, hopefully we can complete the whole control strategy to maintain the healthy environment for pig nursing in the near future. The goal of our design is not only to reduce the cost of labors but also to improve the growing conditions of pigs in the livestock industry.

Notes

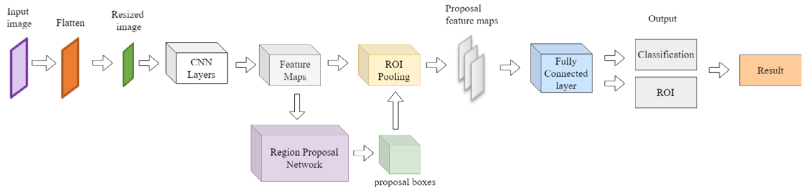

Fig. 2. The detection process of AI

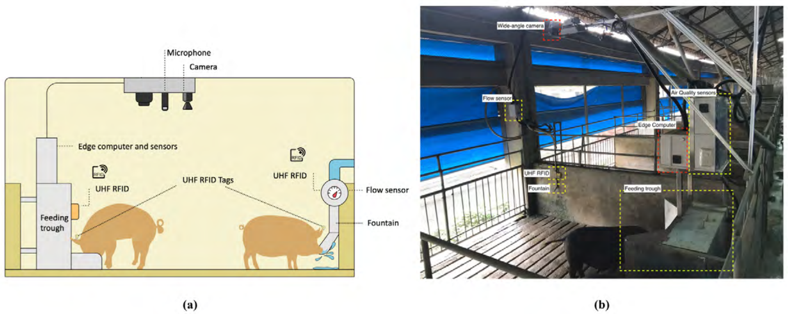

Fig. 1. (a)The system architecture of pigs monitoring; (b)The actual experimental environment The actual experimental field located at Livestock Research Institute (Ping Tung, Taiwan)

Fig. 3. The detection results of pigs, head and tail

Notes