Research on Application Technology of 5G Internet of Things and Big Data in Dairy Farm

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***Abstract*—For the past few years, the 5G + Internet of Things (IoT) technology and big data mining and analysis applications have gradually entered various areas of people's lives.. The rapid expansion of 5G + IoT and automation technology is the basis for the formation and construction of the smart dairy cattle pasture production. Big data and artificial intelligence have greatly improved the management level and economic benefits of dairy farms. The practical application of Blockchain + 5G IoT and big data in the production of dairy products can ensure the quality and safety of milk, and is expected to bring greater social and ecological benefits. The smart dairy farm is proposed to effectively improve the production and economic benefits of the pasture. This article aims to propose an intelligent way of identifying individual cattle and precise feeding of dairy cows based on 5G IoT technology. Within the frame of smart pasture management, the cow image identification makes feasible the timely identification of abnormal individuals in order to take suitable treatment for a different situation. The application of 5G image processing technology could save labor and promote efficient management. The combination of this technology and intelligence can effectively improve the economic benefits and production efficiency of the cattle farm through image recognition technology.**

***Index Terms*—Internet of things; 5G; Dairy farm; Precision feeding**

I. Introduction

With the application of the Internet of Things (IoT) technology in various fields of society, artificial intelligence and the resulting big data have penetrated into people's lives. According to statistics, in 2020, about 50 billion objects will be connected to the Internet, and the Internet of things (IoT) has been widely used in precision agriculture, product supply chain management, environmental monitoring, cloud computing, etc [1]. In recent years, the technology of Blockchain +5G IoT [2]and the new generation of big data mining and apply technology to solve the problem of information island have gradually attracted public attention [3]. Dias et al. discussed how accurate dairy farming system data could bring economic benefits to farm [4]. The Euro-Tier 2018 in Hannover of Germany made it clear that precision farming technology with digitization and IoT as the core business has occupied a remarkable position in the whole animal husbandry and breeding [5]. The Blockchain +5G IoT technology in dairy cattle production is mainly applied in cattle individual identification, precision feeding etc.,[6,7] and the big data generated can be used to improve farm management and ensure milk quality and safety [8]. The basis of intelligent management of a dairy farm is accurate and effective individual identification. The cow individual recognition technologies recognized by the international committee for animal recording (ICAR) include visual ear tag recognition [9], radio frequency identification (RFID) [10], image biometric identification [11],etc. Visual ear tag recognition is a relatively traditional cattle individual identification method. RFID identification is the most widely used wireless communication technology [12]. Image biometrics identification is the latest technology of cattle individual recognition [13]. TMR is widely used to feed dairy cows in farm [14].More accurately, TMR feeding techniques [15] were used to match a more rational diet for dairy cows.TMR

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intelligent management system is gradually applied in the pasture [16].Due to the TMR feeding technique have the advantages of increasing milk production, improving milk quality, reducing the incidence of disease and saving feed cost.

At present, one of the main tasks of dairy cattle breeding is to improve the accuracy of dairy cattle breeding and the economic benefits of pastures. In order to improve the efficiency of pastures, this article aims to study an effective method to improve the effective feeding of dairy cows and the identification of individual dairy cows. Through the combination of pasture and 5G + IoT Technology [17], the combination of sensors and drones can effectively obtain relevant information, such as pictures and videos. Upload collected data to the server, and use image recognition technology to processing the acquired information to obtain diagnostic results. The combination of sensors and drones can effectively obtain relevant information, such as pictures, videos, etc. The collected data are uploaded to the server, and image processing technology is used to process the acquired information to obtain diagnostic results.

II. Scene Description

The intelligent breeding of dairy cows requires the perception of individual dairy cow information and analysis of behavior, so individual identification is the prerequisite and basis for automatic information collection and processing. The establishment of individual archives, the collection of information, and the traceability of livestock products in dairy farming all require rapid and accurate identification of dairy cows. To increase the economic efficiency of the dairy farm and reduce the input of labor costs, this paper simulates a specific breeding scenario of a dairy farm. In this scenario, the individual identification of cows is achieved through image recognition. Figure 1 shows the scene of sensor network diagram of smart dairy farm.

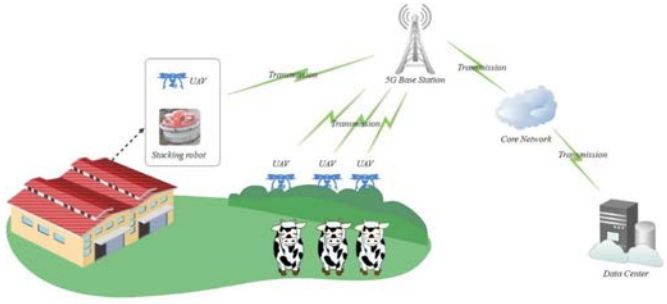

Fig. 1. The Scenario of Smart Agricultural Applications.

In this scene, there is now a dairy farm, and there are currently 1,000 dairy cows in the farm. In order to solve the input problem of feed cost and labor cost when feeding cows in the pasture. It is necessary to allocate a certain number of drones in the pasture, and uses drones to monitor the cows in real time. The drone can obtain individual pictures of cows and pictures of the remaining amount of cow feed. The UAV is mainly used to obtain the required pictures, upload the obtained pictures to the server, classify and filter the obtained pictures, and analyze the remaining amount of rations, and distribute the cows on demand according to the results.

III. Image Processing

The process of converting a color image into a gray scale image is the gray scale [18]processing of the image. The color of each pixel in a color image is determined by the three components of R, G, and B, while a gray scale image is a special color image with the same three components of R, G, and B.RGB represents the color of the red, green and blue channels and is one of the most widely used color systems. In digital image processing, images in various formats are generally converted to gray scale images to reduce the amount of calculation for subsequent images. Image gray-scale processing can be used as a preprocessing step of image processing to prepare for subsequent image processing operations such as image segmentation, image recognition, and image analysis. Figure 2 and Figure 3 show the original image of the cow picture and the resulting image after gray-scale processing.

Fig. 2. Original image.

Fig. 3. Cow picture after gray scale processing.

After the image is grayed, the information expressed by the histogram is the number of pixels of each brightness. The histogram uses a small amount of data to express the gray statistical characteristics of the image. The gray histogram [19]

of the image can only reflect the gray level of the image. The distribution situation reflects the relationship between each gray level in a digital image and its appearance frequency, but it can describe the general picture of the image. Perform gray scale processing on the pictures acquired by the drone, calculate the histogram of the image, compare and get the result. Figure 4 shows the comparison results between different two dairy cows, and figure 5 shows the comparison results of pictures of the same two dairy cows. Through the comparison results shown in the following two pictures, the results show that the above data processing methods can compare the gray histograms of different dairy cows. This method can effectively improve the efficiency of individual recognition of dairy cows.

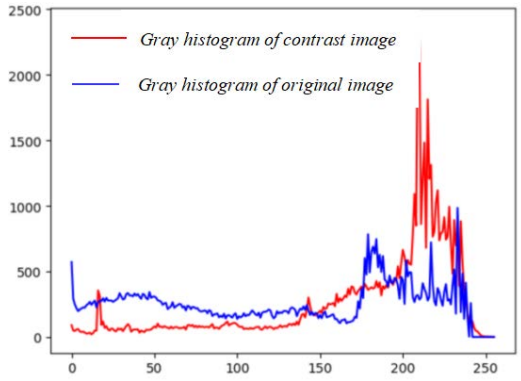

Fig. 4. Comparison of gray histogram among different dairy cows.

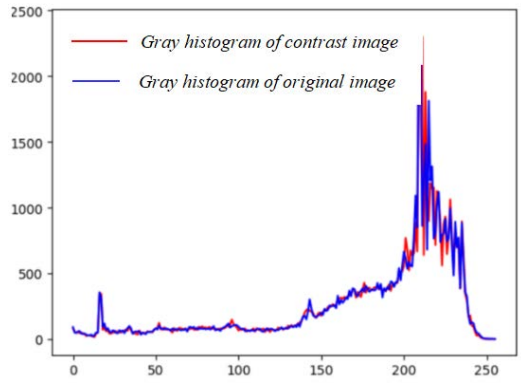

Fig. 5. Comparison of gray histogram among the same dairy cows.

IV. Summary

In the smart pasture, by combining 5G +IOT technology, intelligent recognition technology and unmanned aerial vehicle, the intelligence of precise feeding of individual cattle and dairy cows is realized. After processing and analyzing the image information obtained by the drone, corresponding measures can be implemented according to the results. This method can effectively enhance work efficiency and reduce the input of labor cost, and can effectively promote the development of smart ranch. However, this research also needs to improve the accuracy of recognition. The integration of IoT technology and animal husbandry is getting closer. In future smart farms, 5G IoT technology will also play a significant part in facilitating smart advancement.

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