Application of artificial intelligence bird recognition technology in airport bird strike prevention safety management

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Abstract. Bird strike prevention is an important part of airport safety production management. For bird identification technology in airport bird strike prevention business, this paper summarizes various research results of using artificial intelligence for bird recognition, and analyses the pros and cons of different types of application of the technology in the actual airport bird control business. Also, the bird identification technology in the current airport bird prevention and control technology is prospected.

1. Introduction
Bird strike refers to a flight safety accident that occurs when an aircraft is hit by wild animals such as birds during takeoff, flight, or landing. The problem of bird strike aircraft is a difficult problem in the safety management of the world aviation industry today. The traditional airport bird controlling process mostly uses artificial bird repelling and uses hardware equipment such as sound waves and lasers. With the development of information technology, airport technicians from various countries have proposed corresponding technical optimization methods and equipment by means of the Internet of Things and artificial intelligence for bird recognition, bird driving, bird information collection and analysis, which can reduce the inefficiency and errors caused by manual control in the traditional bird driving business. This paper focuses on the application of artificial intelligence technology in the bird identification phase of the current airport bird control process, and presents the existing technical means, technical processes and difficulties of intelligent bird prevention in the airport.

2. Overview of airport bird control
The contents of bird strike prevention at the airport mainly include steps such as bird information monitoring and identification, bird strike risk assessment, and expulsion and removal of birds, which is the "discovery-assessment-treatment" mode. Among these steps, bird condition monitoring is to monitor the bird activities in the airport and its surroundings, and to grasp its position, speed, number, volume, flight trends and other information. This is a prerequisite for the development of airport bird control systems.

The traditional bird condition monitoring mainly relies on manual observation and sound discrimination. However, when the visual conditions are relatively poor at dawn, dusk, and night, or in...
rainy and snowy weather, the efficiency of manual observation is very low, and errors are prone to occur. At the same time, due to the huge noise of the aircraft engine on the airport, the interference of the bird sound discriminating is very large, so the traditional manual method for monitoring bird conditions is not effective. After the development of technology in recent years, the modern bird strike prevention work can be roughly disassembled into three important processes: detecting birds, identifying birds and driving birds. After bird detection radar detects birds, the photoelectric recognition system identifies birds, then the bird control equipment automatically drives birds, and realizes the integration of detection, recognition and drive of birds. Among them, as the most priority and one of the main steps of bird prevention business, bird recognition technology, under the existing technical conditions, especially under the application of neural network and artificial intelligence technology, the recognition speed and accuracy have been greatly improved. Under the premise of a more comprehensive data set, it can achieve more accurate bird identification and provide help for subsequent bird driving process.

Based on this point, the bird identification technology in airports will be analyzed and presented, and the application and role of artificial intelligence technology will be introduced.

3. Artificial intelligence bird recognition technology
The artificial intelligence recognition of birds mainly includes two characteristics, including the recognition of bird chirps and bird body features. The process of the two types of recognition technology is: after data preprocessing, a large number of bird training data will be input into the neural network to perform feature training and automatic feature recognition, and design feature extractor and classifier based on the extracted feature information. The research status and technical analysis of the two bird feature recognition technologies will be conducted below.

3.1. Bird feature recognition based on bird chirping
Bird chirping is one of the unique characteristics of birds, and the chirping of different birds is quite different. It is a commonly used bird feature recognition method in existing research.

For the feature recognition based on bird chirping, in the existing research, Wang Enze proposed a bird chirping recognition method based on MFCC and dual GMM model, and separately distinguish the feature of bird chirping and singing voice, which improves recognition rate[1]. Xie Jiangjian et al. proposed a bird feature recognition method based on deep learning and multi-feature fusion. The method uses three kinds of speech samples calculated by short-time Fourier transform, Mel cepstrum transform and Chirplet transform. They train models through sample sets and achieve multi-feature fusion[2].

3.2. Bird feature recognition based on bird body

3.2.1. Image pre-processing.
The preprocessing process of the image data on which the bird recognition algorithm for bird body is based is to enhance the image resolution and obtain more accurate recognition results. In the actual data processing process, after extracting the birds from the image, it is necessary to improve the resolution through image segmentation, binarization, interpolation processing, multi-picture stitching, and resampling. In the pre-processing process, a large number of bird image data is used for recognition training before the application of the algorithm and during the real-time application.

In the pre-processing of bird detection algorithms, some scholars use Fisher image segmentation algorithm, and use corrosion, dilation and combination methods to remove small noise and holes and other interference. Ensure that through the preprocessing step, the image segmentation block can meet the needs of subsequent algorithm processing, and maximize the clarity and resolution of the image to improve the recognition performance.
3.2.2. Establishment of recognition model.
Based on the bird image data in the airport, combined with the deep neural network theory, the bird population classification network framework is designed and the model is trained, and finally a bird recognition algorithm based on the convolutional neural network is generated. During the training process, the bird data is classified and the bird characteristics are identified according to the training algorithm, thereby generating the final classification model and algorithm. The process is shown in Figure 1.

![Figure 1. Bird recognition process.](image)

The feature extraction for bird recognition will include various geometric features, spectral features, grayscale features and other features. In the training process, for local bird features, some scholars combined the RCNN object positioning framework, key point group detection algorithm or image segmentation model to extract local bird features, and superimposed through vector machines or classification layers. The merged classification will construct a reasonable bird recognition model and integrate with the global bird characteristics.

For recognition based on bird body features, in existing research, Lin Han et al. proposed a bird feature extraction method based on wavelet transform and KL transform, and used BP neural network classifier for bird recognition[3].

4. The application of bird identification technology in airport bird controlling
The main purpose of the existing airport bird identification technology is to realize the identification of birds in the airport, and to record and analyze the bird population, so as to provide help for subsequent targeted bird driving[4]. In the actual application process, due to its relatively empty geographical environment and the actual internal environment in the airport where only low lawns exist, most of the birds appear to fly in the air and land for food, and bird song is less likely to appear. And because of the high requirements for the speed of bird identification in the airport, especially near the airport runway, it is often necessary to identify and drive birds immediately once they appear in the restricted area. Bird identification based on bird song identification will be difficult to achieve the required recognition speed.

Therefore, of the two types of bird recognition techniques analyzed in the previous section, only bird recognition techniques based on bird body are more suitable for airport bird recognition techniques that use bird driving as a follow-up purpose. In fact, in the existing research, some scholars have put forward related research topics. Ye Mingshu proposed a recognition method based on optical images to track and recognize the outline of birds in airports, but it is only limited to the recognition of bird outlines and cannot realize bird species identification[5]. Tian Jie et al. proposed a bird feature recognition system based on bird shape, texture and color features, but this system is only suitable for the prevention of bird damage in substations[6]. Shao Zhendh proposed an airport bird detection algorithm based on machine vision, but the algorithm focuses on the dynamic distinction between aircraft and birds, without further analysis of bird species[7].

5. Summary
The existing bird recognition technology is mainly divided into two types: bird chirping recognition and bird body recognition. Due to the high security requirements in the airport and more restrictions on various types of machinery and equipment, image recognition and artificial intelligence for bird
body recognition is more suitable for the current bird identification requirements for bird control in the airport. This paper analyzes the bird identification methods based on artificial intelligence technology under the existing technical conditions and research status. The technical basis and feasibility of the bird identification methods are studied, so as to analyze and discuss the bird identification in the intelligent airport bird control technology.

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