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AUTOMATIC IDENTIFICATION OF FLYING BIRD SPECIES USING COMPUTER VISION TECHNIQUE FOR ECOLOGICAL DATA ANALYSIS

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ABSTRACT

The aim of this study is to propose a bird detection algorithm. Bird detection is useful for the counting and dynamics of bird study. Neural networks are used for bird detection and the first step is to learn to classify bird species based on previous experiments. We further develop a proof of concept for the meta-data fusion which indicates that the fusion of elevation data can be used to increase the accuracy of the model, and to decrease its coverage error, in particular.

KEYWORDS: bird detection, automatic, computer vision

1. Introduction

An area of interest in environmental studies is monitoring animal populations to better understand their behaviour, to determine population dynamics [1-3]. Birds can be automatically recognized and/or classified using the latest computer vision technologies. The aim of this study is to propose a bird detection algorithm, created for bird recognition. Bird detection is useful in bird dynamics and counting. Neural networks are used for bird detection and the first step is to learn to classify bird species based on previous experiments [4]. Several fields need birds' detection.

Bird species are an important biodiversity indicator able to describe changes in sensitive ecosystems and, therefore, counting bird populations and their behaviour analysis are a quantifiable method to determine levels of changes. Birds can be monitored by ecologists to determine population fluctuations and to assess biodiversity.

A large number of technical challenges emerge in the visual analysis technologies in natural environments. These include challenges concerning light variation, variation of distance to the objects to be detected, robust object detection, tracking objects in crowded environments. Also, there are many challenges in tracking articulated bodies, such as in the case of birds with the aim of birds' detection [5]. Artificial intelligence algorithms combining computer vision technologies generate reliable results, though errors cannot still be eliminated.

The object classification has been a major interest of research in the computer vision and machine learning communities during the last years, and a lot of progress has been made in developing algorithms and techniques [6-8]. The concern in the topic of detection of objects, a variety of techniques have been issued and many datasets are available for use as training for artificial intelligence techniques. These techniques include feature encoding methods, such as the Fisher vectors (FV) and the Histogram Encoding through to the more recent developments of deep learning algorithm [9-10].

Authors used the motion detection though these methods may however require important computational resources, but simpler methods, such as the background subtraction is working even on low computational power, such as the embedded system and the Raspbery Pi is preferred to others. One of the traditional motion detection algorithms used for tracking objects has been the Kalman Filter.

In many studies the main goal was to be able to track birds and count it. For our case, tracking the bird is necessary for further analyse trajectory. In our case, we store the past information and calculations concerning the speed and trajectory, when new image frames come in from the video footage [10-11].

The aim of this study is to propose a bird detection algorithm. We further develop a proof of the concept for the meta-data fusion, which indicates that fusion of elevation data can be used to increase the accuracy of the model, and decrease its coverage error, in particular.

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2. Experimental procedure

The field experiment was carried out in Galati, near the Danube River, where there is an important amount of bird species. For monitoring bird activities, a spot towards the Danube was chosen with the elevation of 30 degrees of camera point of view towards the sky, where bird's activities were relatively high. Videos were recorded at 1080p as the birds were relatively small and generally far away from the cameras. Two GoPro Hero 4 cameras were installed at the four corners of the field. Videos were recorded at 30 frames per second during the morning hours from 7:00 am to 9:00. The experiments were conducted between September 20 and 25 in the year of 2019. The conceptual steps for application are described in Fig. 1.

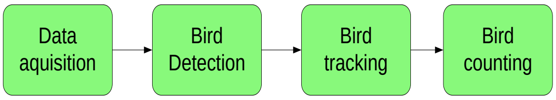

Fig. 1. *Steps for the application*

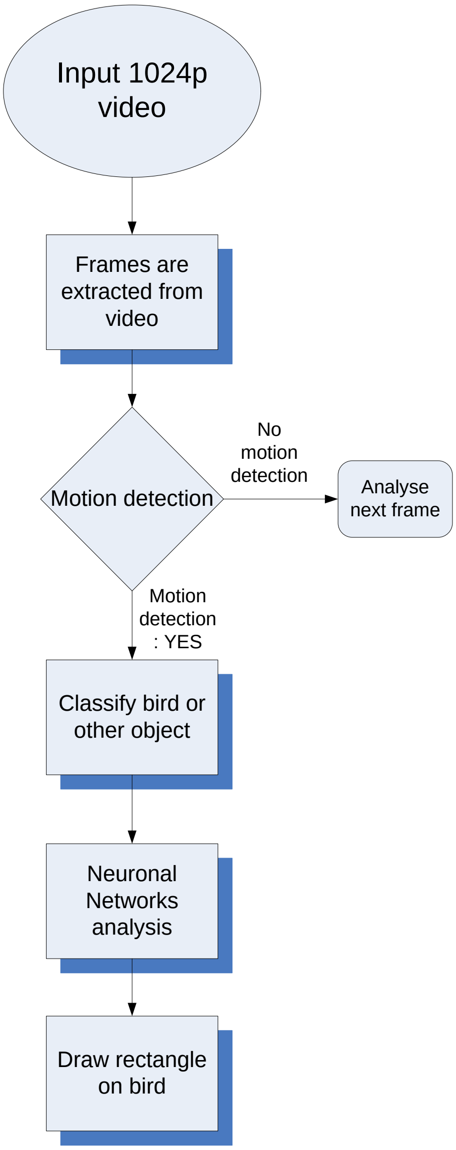

Fig. 2. *Algorithm for bird recognition*

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The data acquisition is the first step, followed by bird detection, which is the topic of the present paper. The bird tracking and counting are used to produce the data for ecology purposes. We used as online processing a laptop with i3-8145U processor, 8 GB RAM. As development environment we used Visual Studio along with OpenCV library.

The neural library we used is Keras. The algorithm for bird recognition is taking into account motion detection in order to detect object in the scene to be analysed (Fig. 2). Not all of the moving objects in the sky are birds. Airplanes or even clouds happened to be detected as moving objects.

The neuronal networks analysis is able to classify the objects and exclude those that are not birds. The birds are marked with a rectangle (Fig. 4 and 6), regardless of the wing positions.

Fig. 3. *Cameras Field of View*

Fig. 4. *Detection of bird*

Fig. 5. *Detection of bird*

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3. Results and discussions

To be able to store shape, for a later study concerning bird species detection, we store shape for several frames, until the bird is out of the focus of camera. Many improvements could be made in motion concerning the mathematical morphology analysis, taking into account the wings dimensions and the motion to be done on the binary images. The neuronal networks have been trained using morphology operators in order to compensate imperfections to the potential “blobs” that represent moving objects. The morphology operators are taking into account bird position in flight. These positions were generated using real images of bird flying.

This approach also might better result as it allows for birds to be detected as separate birds and avoid the situations when multiple regions of the bird moving are detected as bird.

Results showed that the detection rate is up to 97% and false positive are very low, under 4%, in case of scene depicting random objects. We also need to note that the experiments were conducted during clear sky during morning.

We further develop a proof of the concept for the meta-data fusion, which indicates that fusion of elevation data can be used to increase the accuracy of the model and decrease its coverage error, in particular.

4. Conclusions

Neuronal networks along with computer vision allows development of reliable results for bird detection. Possible ways forward are to tune the hyper parameters of the neural networking information concerning the weather status (rain, air pressure, humidity, position of the sun).

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