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COMPREHENSIVE SURVEY ON ANIMAL DETECTION BASED ON MACHINE LEARNING

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Abstract : Researching how to spot animals holds value in many practical scenarios. Techniques for detecting animals can help in studying how selected animals move. It also aids in halting the unwelcomed visits of risk-bearing animals in residential zones. Many sub-areas of study tie themselves to animal detection. The primary goal of this research is to investigate various image and object detection approaches used for identifying and addressing object detection challenges. This paper goes into detail about the various object detection algorithms used in diverse contexts. Finally, comparisons are presented between several object detection methods employed in various picture settings.

INTRODUCTION

Living harmoniously with animals is a key to sustaining nature's balance but it is difficult especially in places where people and wildlife habitats overlap. When people and wild animals cross their paths, it could be hazardous for both. Humans have created numerous algorithms and approaches to gain a deeper understanding of animal's behaviour. Lately, evolution in tech-tools, mainly focused on image processing and sensor networks, has introduced promising solutions to lessen the issues. Systems for spotting animals, paired with alert functions that work in real-time, are now seen as hopeful tools. They help with noticing and managing interactions between humans and wildlife early on. The rest of this paper is arranged this way: Section 2 talks about the different ways we can detect wildlife in different situations. Section 3 presents the comparison of the techniques in literature. Section 4 wraps up what we found in this review.

LITERATURE SURVEY

Zhi Zhang., et al.[1] tackles animal detection and segmentation in wildlife camera-trap videos. It leverages a new technique that factors in both an animal's movement and its spatiotemporal context. The method utilizes cross-frame verification for accurate background distinction, and boosts classification performance by combining handcrafted and deep learning features. Notably, they built a large camera-trap image dataset to train effective object detection algorithms for crowded natural environments, achieving significantly better results than existing methods at 80 percent and 90 percent coverage rates. N. Banupriya., et al.

[2] explores the potential for automated, accurate, and inexpensive data collection that could turn many biological, ecological, and zoological disciplines into "big data" sciences. The Convolutional Neural Network technique is used in this study to identify wild animals. Using the 3.2 million picture Snapshot Serengeti dataset, they train deep convolutional neural networks to recognize, quantify, and characterize the behaviours of 48 different species. This deep neural network detects animals with over 93.8 percent accuracy. The dataset is a collection of image data with a variety of animal images in it which is divided 75:25 into training and testing portions. Yunfei Fanga., et al.

[3] introduces a system utilizing global pixel motion patterns to detect moving animals against a background. It employs optical flow methods to estimate motion vectors for each pixel in video datasets featuring animals in motion. Using a pixel velocity threshold, the system performs coarse segmentation to eliminate background elements, further refining results by applying criteria to filter out potential background noise. By focusing on distinguishing motion patterns between animals and the backdrop, this approach effectively detects animals, as demonstrated in wild animal tracking scenarios. The study underscores the efficacy of motion features in accurate animal detection and tracking. Matuska, S., et al.

[4] introduced a new approach for object recognition by using hybrid local descriptors. This method, which comprises of two sections, combined a few techniques (SIFT, or scale-invariant feature transform, and SURF, or speeded up robust features). A few photographs from the dataset were used to illustrate how the hybrid methodologies that were given could be used. The dataset classes depict large creatures found in Slovak territory, including deer, wolves, foxes, brown bears, and wild boar. Jason Parham., et al.

[5] proposes a five-component detection pipeline that can be applied to an animal recognition system that uses computer vision: whole image classification to select the images that actually show the species or species of interest; bounding-box localization to form the annotations; annotation classification to determine the species and viewpoint; coarse annotation segmentation to narrow the pixel-level focus of the identification algorithm and a classifier to choose what defined as "annotations of interest" in each image. It provides a new detection dataset, named WILD, together with detection pipeline. The overall image classifier accuracy is 64.77 percent, while the mean AUC for all species is 98.27 percent. Wenling Xue., et al.

[6] describes the implementation of intrusion detection using a wireless sensor network based on UWB technology. A convolutional neural network is used to automatically learn the features of Ultra wide band signals by analysis of their characteristics. Finally, humans and animals are classified using the SVM or Softmax classifier. According to experimental data, the method described in this paper can detect animal and human invasion very successfully and increase detection accuracy by around 16 percent when compared to manual extraction methods. Pragya Gupta., et al.

[7] introduces the DFDL framework for wild animal detection, utilizing class-specific dictionaries derived from the DFDL technique to identify images within their respective classes. The dataset comprises medium- to large-sized wild creatures, and evaluation metrics include true positive rate, false positive rate, and accuracy. The DFDL approach achieves a notable true positive rate of approximately 97 percent, demonstrating effectiveness in handling both intra-class similarities and inter-class variation, leading to a 93 percent accuracy rate. Although not yet applied to wild animal detection, its performance stands out with a 2 percent false positive rate, showcasing a high 97 percent true positive rate and promising potential for this application. Shivam M., et al.

[8] investigated three models eXtreme Gradient Boosting (XGBoost), Particle Swarm Optimization, Convolutional Neural Network for animal detection and classification. The major aim of this model was to solve the problem of animal detection with a high accuracy. They use advanced image processing to first design a method for producing animal object region proposals, and then they apply artificial intelligence methods for identifying and categorizing the animal. Among these algorithms, CNN has got highest accuracy. Chun Biao Zhu1., et al.

[9] suggested a two-channelled perceiving residual pyramid network to handle objections to camera trap images. In order to train a network, the depth cue from the original images was retrieved and fed into a two-channelled perception model. Full size detection results were produced by combining all of the data using the three-layer residual blocks. Additionally, utilising the concepts of dataset design, a brand-new, excellent dataset with a complicated wild setting was created. Jaskó, G., et al.

[10] proposed a system capable of detecting different huge sized wild animals from traffic scenes. Visual information was captured by a monocular colour vision camera. The aim of the analysis was to identify any animals that might have caused an accident on the road by correctly classifying the regions of interest found in the traffic scene image. An importance traffic scene image was used to create the map by utilising the features of intensity, colour, and orientation. The key areas on this map were thought to be areas of concern. A database was created by compiling numerous photos of different four-legged wild creatures. From these, pertinent features were taken out and used to train Support Vector Machines classifiers. Lo, N. W., et al.

[11] created an improved method that more successfully detects mating behaviour by tracking the distance between two mating objects. Furthermore, a more thorough explanation of the mating behaviour was provided in relation to the distance patterns in the tails of the two caged mice. A.Gomez., et al.

[12] proposed an automatic species recognition method based on very deep convolutional neural networks. They used 4 dataset partitions from Snapshot Serengeti dataset like unbalanced data, balanced data, objects in background and animals segmented in order to study if a powerful learning algorithm can overcome the four common issues in camera trapping: unbalanced samples, empty frames, incomplete animal images, and objects too far from focal distance. The method reached 88.9 percent of accuracy in Top-1 and 98.1 percent in Top-5 in the evaluation set using a residual network topology ResNet-101.

COMPARISON OF VARIOUS IMAGES AND VIDEOS BASED OBJECT DETECTION TECHNIQUES

An overview of the benefits and drawbacks of various object detection algorithms based on photos and videos in different environments is given in this section.

Ref no	Title	Attributes	Merits	Demerits	Performance metrics
[1]	Animal Detection from Highly Cluttered Natural Scenes using Spatiotemporal Object Region Proposals and Patch Verification.	Camera-traps	It developed IEC method which achieved high performance on object segmentation and outperformed existing methods by12%.	This technique might require significant computational resources which could limits its real time application.	The average F-score is 83.98%. The average precision is also improved by a large margin from 78.24% to 82.09%
[2]	Animal Detection using Deep learning algorithm	Convolutional Neural Network	It trains deep convolutional neural networks to identify, count and describe the behaviours of 48 species in dataset.	Reliance on large amounts of labelled data for training.	Deep neural networks automatically identify animals with over 93.8% accuracy
[3]	Motion based Animal Detection in Aerial videos	Antelope and Zebra	It demonstrates how effective motion features are tracking	The method does not use more efficient local threshold selection techniques.	Species=antelope False positive=12.50% False negative=11.39%
[4]	Classification of Wild Animals based on SVM and local descriptors.	Wild boar,brown bear,wolf,fox,and deer	Promising results comparable with other key point detectors.	Poor results with success rate of classification around 50% only.	Classification success rate = 86%
[5]	An Animal detection pipeline for identification	Masai Giraffe,Reticulated Giraffe,Sea turtle,Whale fluke,Grevy's Zebra,Plains Zebra	This method gives environmentalists better ecological knowledge	The overall performance of the system could be affected if any of the 5 stages fail to perform optimally.	Achieves Map of 81.67% and an Aoi accuracy of 72.75% across 6 animal species of interest.
[6]	Animal intrusion detection based on convolutional neural network	Null, Human being, and Animal	This paper can detect human and animal invasion very effectively.	These methods might lack interpretability	Improved accuracy of detection by nearly 16% compared to the traditional manual extraction.
[7]	Wild animal detection using discriminative feature-oriented dictionary learning.	Caltech 101 dataset	The system has low false positives and high true positives	The technique has not been used for wild animal detection.	High true positive rate of 97% and low false positive rate of 2%.
[8]	Detection and classification of animals using machine learning and deep learning.	Missouri camera trap images and Oregon wildlife dataset.	High accuracy classifier.		CNN showed an accuracy of 87% and XGBoost showed an accuracy of 86% and PSO showed an accuracy of 60%.
[9]	Towards Automatic Wild Animal Detection in Low quality camera tarp	VWM dataset	Improves the quality of wild animal detection and more robustness	Low F measure value	Mean Absolute Error=0.0722 F-measure = 0.7303

	images using two channeled perceiving residual pyramid networks.				
[10]	Animal detection from traffic scenarios based on monocular color vision	The dataset contains 50% images of deer,25% images of horses and 25% images of moose.	Highly accurate classifier	The static size of region delimiter box	Test number =6 True positive(left facing animal)= 95%
[11]	Caged mice mating behavior detection in surveillance videos	Two mice	Effectively detect the mice mating behavior with high precision rate	This approach does not perform high speed applications.	Precision rate= 96.1%
[12]	Towards Automatic Wild Animal Monitoring: Identification of Animal Species in Camera-Trap images using very deep convolutional neural networks	Snapshot Serengeti dataset	Different situations present in camera trap images that must be overcome to make species identification automatically are described and experiments are done with different architectures.	It acknowledged the need for advancements in incorporating temporal information, dataset enhancement and improving segmentation algorithms.	The method reached 88.9% of accuracy in Top-1 and 98.1% in Top-5 in the evaluation set using a residual network topology ResNet-101

CONCLUSION

In this paper, the detection and classification of the animals using various techniques including the use of all-inclusive context, mobility considerations by monitoring videos, deep convolutional neural networks for identification and detection of animals, motion patterns for recognition, discriminative feature-oriented dictionary learning for the classification of species are discussed. The table compares how image and video-based object recognition algorithms fared in various contexts and with various datasets. From the above table, Wild animal detection using discriminative feature-oriented dictionary learning (DFDL) shows effective high experimental result with 97 percent positive rate has not yet been used for the detection of wild animals. However, the suggested model can only be described as effective if it distinguishes between people and animals and, If it is an animal then its location , species and category. The proposed model uses the SVM or Softmax classifier to classify humans and animals. Experimental results show that, in comparison to manual extraction approaches, the method presented in this study may very successfully detect invasion by humans and animals and boost detection accuracy by around 16 percent. Recommends a cross-frame image verification method for accurate animal background categorization, by using Fisher Vectors and DCNN image features to encode manually created HOG image features, camera trap image classification performance be enhanced. Optical flow techniques are utilised to estimate the motion vector of each pixel in the video footage, and coarse segmentation to remove the background. This deep neural network detects animals with over 93.8 percent accuracy. Thus, we draw the conclusion that the suggested model performs better than the earlier models, displaying excellent accuracy and efficiency outcomes.

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