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Abstract:

The bird population is rapidly changing these days for a variety of reasons, including deforestation, forest fires, climate change, human interference, and global warming. Counting birds and tracking their behavior is now feasible thanks to machine learning algorithms that automatically identify different types of birds. This work develops an automatic bird identification system that does not involve physical intervention, as manual identification of many bird species requires a great deal of time and effort. Convolutional neural networks are employed in place of more conventional classifiers like SVM, Random Forest, and SMACPY to accomplish this goal. The main objective is to identify the species of birds by using the dataset that includes the various birds' vocalizations.

Keywords:

Convolutional neural networks, machine learning algorithms, ecological exploration, Light Weight CNN, Artificial Neural Network (ANN), Animal Species Recognition System

1. Introduction:

In the realm of ecological exploration, we embark on a fascinating endeavor: automating bird species identification through the fusion of audio signal processing and neural networks. Birds, with their diverse calls, paint a sonic tapestry that holds the key to unlocking their identities. This study seeks to bridge the gap between nature and technology, employing sophisticated algorithms and machine learning to create a seamless system capable of recognizing and categorizing bird species based on their unique vocal signatures.

By leveraging the capabilities of neural networks, we aim to transform birdwatching and ecological monitoring. Imagine a world where the songs of birds not only enchant our senses but also provide valuable insights into biodiversity. This research endeavors to bring us closer to that vision, offering a simplified yet powerful solution for automating the identification of bird species through the magic of audio signal processing and the intelligence of neural networks.

2. Literature survey:

- Many crowd counting algorithms have been created for events, crisis management, and workplace safety throughout the past 20 years. Although neural networks are very accurate, the suggested Light Weight CNN (LW-CNN) architecture addresses the infrequent occurrence of uncertainty by including a point estimate for crowd size. The framework is able to classify partial head counts more accurately than pre-trained models after being trained on a variety of scenarios, including those with full and partial head vision. Because of this, headcount estimation accuracy for public spaces during COVID-19 is improved, and processing time is shortened, highlighting its efficiency.
- Extreme Learning Machine (ELM) techniques are used to address the sluggish computation time and enhanced gain of the feed-forward neural network. By randomly enhancing network components, ELM outperforms traditional approaches in terms of accuracy. This paper introduces a unique feed-forward technique to optimize neural network performance and explains ELM versions for various applications. ELM integration guarantees quicker learning rates, shorter calculation times, and less human involvement. The study presents a basic classification approach, sheds light on the true nature of ELM, and explores potential future developments for a range of function approximation applications.
- In this article, a two-stage automated bird species identification system is introduced. To

create spectrograms, the initial step is building the perfect dataset and using wise pre-processing methods. A Convolutional Neural Network (CNN) classifies the spectrograms in real time for the purpose of identifying bird species in the second stage.

- The Animal Species Recognition System proposed in this study uses an Artificial Neural Network (ANN) in Matlab to identify bird sounds. To identify bird species based on auditory input, a graphical user interface (GUI) must be created, the ANN must be trained for species identification, and power spectral density data for each type of bird must be obtained. A tool for researching and addressing the effects of climate change and endangered animal populations is made available by the successful deployment.
- In order to identify bird sounds, the research presents an Automated Bird Detection (ABD) system that uses the Gaussian Mixture Model (GMM) for classification and Dual-tree M-band Wavelet transform (DMWT) for feature extraction. Three phases make up the proposed system: DMWT feature extraction to extract audio signal content, GMM-based classification modeling of bird sounds, and preprocessing using explosion and pre-emphasis filters. The paper analyzes a number of current techniques for classifying bird sounds, such as neural networks, support vector machines, and extreme learning machines.
- The goal of the research is to address challenges to bird populations and to facilitate bird species identification automatically by utilizing neural networks and sound processing. With CNN (AlexNet) and transfer learning, pre-emphasis is used in this work to obtain 91% accuracy in real-time bird species categorization. A Graphical User Interface (GUI) that is easy to use improves practical applicability.
- The literature review investigates the use of neural networks and signal processing for automated bird species identification. While other research include a variety of methodologies, such as deep convolutional neural networks, audio-visual classification, and feature learning algorithms, illustrating the constantly developing landscape of bird species identification techniques, the main paper obtained 80% accuracy on 138 bird species.
- The research highlights the advantages of machine learning in streamlining the classification process and focuses on employing Convolutional Neural Networks (CNNs) for bird species identification. With an accuracy range of 87%–92%, the research makes recommendations for future developments, such as a mobile application for real-time monitoring, and suggests uses in wildlife monitoring.

- In the study, a two-stage automated method for identifying bird species is introduced. It uses Convolutional Neural Networks (CNN) and reports real-time accuracy of 91%. Although offering benefits including increased scalability and efficiency, drawbacks include inconsistent accuracy rates, dataset restrictions, noise sensitivity, and difficulties managing variability in bird vocalization.
- In order to increase efficiency and scalability, the research article suggests a two-stage method for automated bird species identification utilizing convolutional neural networks (CNNs) and acoustic signal processing. Although the study acknowledges several limits, such as accuracy issues and susceptibility to environmental noise, it highlights the importance of automated systems for ecological research and conservation initiatives.
- With benefits over conventional techniques, the research focuses on employing Convolutional Neural Networks (CNNs) to quickly identify bird species through sound analysis. The automated systems have many uses in environmental study, conservation, and birdwatching despite obstacles such background noise, demonstrating the rapid and flexible application of technology in bird species identification.

Papers	Title	Authors	Year Of Publication	Proposed System	Gaps
(1)	Speedy Image Crowd Counting by Lightweigh t Convolutio na l Neural Network	Vivekanand a m, B.	2021	Integration of Lightweight CNN (LWCNN) for crowd counting, emphasizing accuracy and efficiency. Trained on various scenes, it categorizes partial head vision, providing higher accuracy during COVID-19.	LWCNN's drawback is sensitivity to diverse crowd conditions, affecting robustness. Optimization is required for consistent performance across dynamic scenarios.

(2)	Study of Variants of Extreme Learning Machine (ELM) Brands and Its Performance Measure on Classification Algorithm	Manoharan, J. Samuel	2021	Investigates variants of ELM for improved neural network performance. Addresses challenges in feed-forward neural networks, proposing ELM algorithms for faster learning and reduced computation time. Future extensions for various applications are discussed.	ELM's drawbacks include sensitivity to parameter tuning, requiring careful optimization, and potential challenges in handling complex data distributions, limiting its applicability in diverse classification tasks.
(3)	Automated Bird Species Identification Using Audio	Chandu B, A. M	2020	Two-stage process involving dataset creation and sound preprocessing. Utilizes a Convolutional Neural Network (CNN) to classify bird species based on spectrograms. Real-time implementation is executed for practical application.	Drawbacks include challenges in handling diverse bird vocalizations, potential limitations in accuracy due to environmental noise, and the need for extensive and well-curated datasets for robust performance.

(4)	Bird Sound Identification based on Artificial Neural Network optimization	M. M. Sukri, U. Fadlilah, S. Saon, A. K. Mahamad, M. M. Som, and A. Sidek	2020	Proposes bird sound identification using Artificial Neural Network (ANN) and Matlab. Trains ANN on power spectral density data for accurate bird species recognition with a graphical user interface (GUI).	This bird sound identification system using Artificial Neural Network (ANN) may face challenges in real-world noise conditions, limits identification to one species at a time, and relies on a graphical user interface.
(5)	Automated Bird Detection in Audio Recordings by a Signal Processing Perspective	Raja Shekar Kadurka & Harish Kanakalla	2021	Introduces an Automated Bird Detection (ABD) system using Dual-tree M-band Wavelet transform (DMWT) for feature extraction and Gaussian Mixture Model (GMM) for classification. Promising results in automated bird sound detection are demonstrated.	The ABD system, despite its promising results, may encounter challenges in handling diverse bird vocalizations, and the effectiveness could be influenced by environmental noise, potentially impacting classification accuracy.

(6)	Automated Audio Signal Processing for Bird Species Identification Including Neural Networks	Mohammed Sadiq B1, Pooja H M2	2023	Explores automatic bird species identification using sound processing and a convolutional neural network (CNN) called AlexNet. Achieves 91% accuracy in real-time classification with a user-friendly GUI.	Despite achieving an impressive 91% accuracy, the automated bird species identification system using CNN may face challenges in real-time scenarios with environmental noise, necessitating additional training for robust performance.
(7)	Automatic Bird Recognition Using Signal Processing and Neural Networks	Gitanjali Pote1, Ashwini Sase2, Puja Barwal3, Pooja Nandre4, Prof. Neelam Joshi5	2023	Neural network-based system achieves 80% accuracy in bird recognition based on sound signatures. Reviews various studies on audio signal processing and neural networks for bird species identification.	The comprehensive exploration of automatic bird species identification using signal processing and neural networks presents a neural network-based system achieving 80% accuracy, but potential challenges include diverse avian characteristics and varying feature sets affecting identification reliability.
(8)	Automated Bird Species Identification Using Audio Signal Processing and Neural	Avinash Tatar, Bhushan Chavan, Kashyap Bhamare, Snehal Shirode, Abhay	2022	Proposes a two-stage identification approach using audio signal processing and Convolutional Neural Network (CNN),	The automated bird species identification system using audio signal processing and neural networks achieves 91% accuracy in real-time, but faces limitations such as sensitivity to environmental noise, varying accuracy rates, and

	Networks	Gaidhani		specifically AlexNet. Reports a 91% accuracy in real-time implementation, emphasizing efficiency and scalability.	challenges in handling bird vocalization variations.
(9)	Bird Species Identification Using Audio Signal Processing and Neural Networks	Dr. Amol Dhakne1, Vaishnav M. Kuduvan2, Aniket Palhade3, Tarun Kanjwani4, Rushikesh Kshirsagar5	2022	Introduces a two-stage identification approach with audio signal processing and CNNs. Highlights challenges, advantages, and limitations in bird species identification. Discusses future scope, including mobile applications and ecological parks.	While proposing an automated bird species identification system using audio signal processing and neural networks, the research acknowledges challenges such as limited accuracy, the need for diverse datasets, sensitivity to environmental noise, and variations in bird vocalizations.
(10)	Automated Bird Species Identification Using Audio Signal Processing and Neural Network	Samruddhi Bhor, Rutuja Ganage, Omkar Domb, Hrushikesh Pathade & Shilpa Khedkar	2022	Utilizes Convolutional Neural Networks (CNNs) for automated bird species identification based on sound analysis. Emphasizes the	Despite the advantages, challenges in automated bird species identification using audio signal processing and CNNs include dealing with background noise and the need for efficient noise removal techniques. Additionally, while the

				superiority of CNNs over older methods. Addresses challenges like background noise and proposes potential applications.	proposed method shows promise, further improvements may be required for real-world applications.
(11)	Bird Species Identification Using Convolutional Neural Network	Dharaniya R a,1, Preetha Mb and Yashmi SC	2023	Focuses on using Convolutional Neural Network (CNN) for bird species identification. Discusses challenges in bird identification and highlights advancements in deep learning. Achieves 87% accuracy and suggests applications in wildlife monitoring.	The paper on bird species identification using CNN highlights its benefits, achieving 87%-92% accuracy, but potential challenges include limited dataset size and applicability, requiring consideration for broader ecological contexts.

3. Existing solution:

The literature survey explores various innovative approaches to automated bird species identification and speedy image crowd counting. For crowd counting, the integration of a Light Weight Convolutional Neural Network (LW-CNN) is proposed. This addresses the limitations of existing methods, emphasizing the need for uncertainty indication in crowd counting estimates. On the other hand, in bird species identification, multiple studies showcase the effectiveness of Convolutional Neural Networks (CNNs) and signal processing techniques. Methods involve constructing ideal datasets, employing neural networks like AlexNet for real-

time classification, and utilizing audio signal processing for accurate bird species recognition. Despite challenges such as environmental noise, these automated systems demonstrate moderate accuracy and potential applications in wildlife monitoring, conservation, and ecological studies. Future directions include mobile applications and continued improvements in accuracy and dataset diversity. Overall, technology, especially CNNs, is significantly advancing bird species identification and crowd counting solutions for various practical purposes.

4. Proposed solution:

In our bird identification system, we're using VGG16, a model originally built for images, to understand bird sounds. We collect a diverse set of bird audio recordings, turn them into pictures called spectrograms, and feed them into a mix of VGG16 and a custom neural network (CNN). This helps us find unique patterns in bird calls. We train our system on various bird sounds, ensuring it can identify different species accurately. By tweaking and fine-tuning the model, we aim to create a simple and effective way to automatically recognize bird species, contributing to the world of bird research and conservation.

VGG16 has some advantages over AlexNet. VGG16's deep architecture with small filters makes it great at capturing detailed features in spectrograms, which is crucial for recognizing complex patterns in bird calls. Additionally, VGG16's prior training on diverse datasets gives it a head start in understanding various visual features. However, it's important to note that VGG16 can be computationally demanding. Overall, VGG16 might be a better choice when dealing with a larger and diverse bird audio dataset, aiming for more detailed feature extraction in automated bird species identification.

5. Conclusion:

In conclusion, our automated bird species identification project, employing the VGG16 model and a customized CNN, stands as a promising venture at the intersection of technology and ornithology. VGG16's prowess in extracting intricate features from spectrograms, coupled with the adaptability of a custom CNN architecture, positions our system to decode the diverse language of bird calls. Through meticulous steps of data collection, preprocessing, and training, we aspire to create an accurate and efficient tool for identifying avian species based on their unique vocalizations. This project not only contributes to the evolving field of bioacoustics but

also holds implications for ecological monitoring and conservation initiatives. As we navigate the complexities of bird songs, the harmonious integration of advanced technology and the natural world fosters a deeper appreciation for avian biodiversity. Our aspiration is that this simplified yet powerful solution will serve as a valuable asset in the ongoing efforts to understand, protect, and coexist with the diverse array of bird species inhabiting our planet.

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