USE OF ARTIFICIAL INTELLIGENCE (AI) TO IDENTIFY NEW SPECIES IN ZOOLOGY

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Abstract
In order to improve our understanding of biodiversity and direct conservation efforts, zoologists still rely heavily on the identification and classification of new species. Mostly relying on expert knowledge and morphological evaluation, traditional taxonomies are demanding and perhaps limited by subjective biases. Artificial intelligence (AI) has the potential to improve and expedite species identification processes, hence revolutionizing them. This study looks at the approaches, challenges, and possible applications of AI in zoology for the categorization and identification of new species. In order to automatically identify species, we emphasize machine learning, computer vision, and deep learning techniques that make use of morphological, genetic, and ecological traits. Combining AI with traditional taxonomic techniques allows zoologists to increase efficiency and accuracy while also discovering new facts of biodiversity. This is especially important in view of the rapid changes in the environment.
Keywords: *Artificial Intelligence (AI), Zoology, Biodiversity, New Species.*

Introduction

Biodiversity is essential to the viability of life on Earth, human welfare, and environmental stability. According to Mora et al. (2011), despite enormous efforts, many species remain unknown, especially in poorly characterized ecosystems including deep waters, dense forests, and underground regions. Despite the importance of traditional taxonomy, which is based on physical characteristics and genetic analysis, it usually takes a great deal of time and specialized knowledge. Because environmental changes threaten the survival of species, quick and scalable identification methods are needed (Hobern et al., 2019). Machine learning (ML), deep learning (DL), and computer vision are all components of artificial intelligence (AI), which has emerged as a powerful tool to automate, support, and enhance species discovery. The acoustic categorization of Australian frogs using improved features and machine learning methods has been covered by Xie et al. (2016).AI systems enable the faster and more accurate identification of new species by analysing large datasets, identifying trends, and detecting tiny morphological traits that humans cannot (Schneider et al., 2019). The methods, uses, difficulties, and opportunities of AI's revolution in zoological species discovery are examined in this review article.

AI Methodologies in Species Identification:

Machine Learning and Data-Driven Classification

The machine learning algorithms categorize unidentified points of data by recognizing trends in datasets with labels. Support vector machines (SVM), random forests, and neural networks are examples of approved machine learning (ML) models used in zoology that have been trained using ecological data, genetic sequences, or morphological measures in order to differentiate between species. The process of proposing an identification to a genetic identification of any species can be accelerated by computer vision (Derkarabetian et al., 2022). ML classifiers trained on morphological characteristics, for instance, are able to distinguish minute differences that may be signs of new species.

Computer vision and Deep Learning

The quick recognition of species from images has been transformed by deep learning, especially convolutional neural networks (CNNs). Artificial intelligence, biosensors, optical sensors, physical sensors, and other technologies are utilized in smart aquaculture systems to gather data in real time. Automation and automated decision-making also play a part (Sharma et al., 2020). In order to accurately identify species from photos or videos, CNNs automatically extract hierarchical characteristics from pictures. This feature is particularly useful for field research, where large visual datasets are produced via camera traps and drone photography.

Genomic Data Analysis

AI techniques are increasingly applied to genetic data, such as DNA barcodes and whole-genome sequences, to delineate species boundaries. Clustering algorithms and neural networks can detect genetic divergence indicative of speciation events. AI-based clustering approach suggests that endemic species (i.e. fish) conservation should focus on alleviation of low fows, control of species introduction, limiting generalist expansion, and enhancing the hydrological connectivity fragmented by dams (Cheng et al., 2018). Integrating morphological and genetic data through AI models enhances reliability in discovering cryptic fish species.

AI Applications in the Search for New Species: Automated Image Identification in Surveys of Biodiversity

Rapid analysis of photos taken by drones, camera traps, or field photography is made possible by AI-powered image identification systems. In order to identify bird species from photos, Schneider et al. (2019) created a CNN-based approach that was successful in identifying morphological variations that were previously unknown but suggested the existence of new species. And lastly, five machine learning algorithms—K-nearest neighbor, support vector machines, random forest, artificial neural networks, and linear discriminant analysis—are used to compare various augmented visual representations of features. The findings of the experiment indicate that, when compared to alternative approaches, our suggested visual representation of features might produce superior classification performance for twenty-four frog species (Xie et al., 2016).

Species Delimitation and Genetic Information

The discovery of species boundaries has been rendered easier by AI algorithms applied to genomic databases. By using machine learning techniques to examine genetic divergence between fish populations, Sharma et al. (2021) were able to uncover cryptic species that are not discernible by morphology alone. These genetic AI technologies speed up the process of validating novel species, particularly in morphologically related groupings.

Integration of Environmental DNA (eDNA) with AI

Genetic material in environmental samples can be used to determine the existence of species through environmental DNA sampling. Even for uncommon or elusive species, AI algorithms may detect species signatures by analyzing massive eDNA datasets. In distant settings, this method has resulted in the discovery of novel aquatic species.

Automated Acoustic Monitoring

A further method for finding new species is bioacoustics, which records animal noises and cries. In order to differentiate between species based on vocalizations, AI systems examine acoustic data. By identifying distinct call patterns, for instance, models based on machine learning and deep learning have discovered new frog species (Xie et al., 2016)

Challenges And Limitations:

Despite promising advances, applying AI for new species discovery faces several challenges:

Data Quantity and Quality: For the development of precise AI models, high-quality, annotated datasets are necessary. Model creation for uncommon or cryptic species is hampered by a lack of data.

The ability to apply the predictions of AI models to new species may be diminished due to bias and overfitting to training data.

Taxonomic Validation: Expert validation is necessary for AI predictions, and differences between AI and conventional taxonomy may spark discussions on species status.

Issues of Ethics and Conservation: Rapid AI-driven identification has been combined with conservation tactics to avoid environmental degradation or illicit use.

Future Perspectives

Combining AI with other technologies has the potential to improve species discovery even more:

Multimodal Data Integration: By integrating ecological, morphological, genetic, and auditory data into AI platforms, identification of species precision can be increased.

AI and Citizen Science: By combining AI analysis with public participation in data collecting, biodiversity monitoring initiatives may be expanded.

Automated Taxonomy: While human monitoring is still essential, the development of AI systems that can provide taxonomic categorization suggestions on their own might speed up the discovery process.

Global Biodiversity Monitoring: Real-time monitoring of biodiversity hotspots can be facilitated by AI- enabled systems, which can help with the quick identification of new species and modifications to the environment.

Conclusion

Zoological taxonomy and biodiversity discoveries might be revolutionized by artificial intelligence. AI speeds up the discovery of new species, particularly in poorly understood or inaccessible areas, using sophisticated picture recognition, genetic analysis, auditory monitoring, and environmental DNA interpretation. Even though there are still issues with data quality, validation, and ethics, further technical advancements and multidisciplinary partnerships should make artificial intelligence (AI) a vital tool in zoology. In the face of fast environmental change, utilizing AI's potential can result in a more thorough knowledge and protection of Earth's biodiversity.

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