



AN INTEGRATED APPROACH FOR IMAGE CATALOGUING AND RECOGNITION OF ANIMALS USING MACHINE LEARNING

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ABSTRACT

Accurate cataloguing and recognition of animals play a crucial role in biodiversity monitoring, wildlife conservation, ecological research, and intelligent surveillance systems. Traditional methods of manual identification are time-consuming, error-prone, and often require expert intervention, which limits their scalability in large-scale applications. To address these challenges, this study proposes an integrated approach for image cataloguing and recognition of animals using machine learning techniques. The system combines automated image preprocessing, feature extraction, and classification to efficiently identify animal species from large and diverse image datasets. Convolutional Neural Networks (CNNs) and other supervised learning models are employed to learn distinctive visual patterns, while an optimized cataloguing framework organizes recognized images for effective storage and retrieval. Experimental evaluation demonstrates that the proposed method achieves high accuracy in recognizing multiple animal species, even under challenging conditions such as variations in lighting, background, and pose. The integration of cataloguing with recognition not only enhances classification performance but also facilitates efficient data management for



ecological studies and smart monitoring systems. This research highlights the potential of machine learning-driven solutions in advancing automated animal identification, supporting conservation efforts, and enabling scalable, intelligent wildlife management systems.

Keywords: *Image cataloguing, Pattern recognition, Animal recognition, Machine learning, Image retrieval.*

Received: 18-07-2025

Accepted: 20-08-2025

Published: 27-08-2025

1. Introduction

A support vector machine (SVM) is a supervised machine model that uses classification algorithm for two-group classification problems. The ability to accurately identify and catalogue animal species is essential for wildlife conservation, ecological research, and biodiversity management. Traditionally, these tasks have relied on manual observation and expert knowledge, which are often time-consuming, labor-intensive, and prone to human error. With the increasing availability of digital images from camera traps, drones, and surveillance systems, there is a growing need for automated techniques that can efficiently classify and organize large-scale animal image datasets. In recent years, machine learning has emerged as a transformative tool in computer vision applications, enabling systems to learn complex patterns and perform accurate

classification without explicit programming. In particular, Convolutional Neural Networks (CNNs) have demonstrated exceptional performance in image recognition tasks due to their ability to extract spatial and hierarchical features. Applying such models to animal recognition allows the automatic identification of species, even under challenging conditions such as varying lighting, occlusions, and diverse natural backgrounds. However, most existing approaches focus solely on recognition while neglecting the equally important task of systematic image cataloguing and organization. Without efficient cataloguing frameworks, recognized images cannot be effectively stored, retrieved, or analyzed for long-term ecological monitoring. An integrated system that combines both recognition and cataloguing would not only enhance classification accuracy but also

provide a structured repository for wildlife data, benefiting researchers, conservationists, and intelligent surveillance applications. This research proposes an integrated approach for image cataloguing and recognition of animals using machine learning, leveraging CNN-based models for species identification and optimized cataloguing mechanisms for structured image management. By bridging recognition with cataloguing, the system aims to support large-scale biodiversity monitoring, strengthen conservation initiatives, and enable intelligent, automated animal management in both natural and controlled environments. After giving an SVM model sets of labeled training data for each category, they're able to categorize new text. Compared to newer algorithms like neural networks, the two main advantages: higher speed and better performance with a limited number of samples. This makes the algorithm very suitable for text classification problems, where it's common to have access to a dataset of at most a couple of thousands of tagged samples. A Convolutional neural network

(CNN) is a neural network that has one or more convolutional layers and are used mainly for image processing, classification, segmentation and also for other auto correlated data. Rather than looking at an entire image at once to find certain features it can be more effective to look at smaller portions of the image. By finding feature difference classification has achieved, later CNN to be applied for that classified image to find the accuracy of the image. CNN is the most preferable algorithm for finding the accuracy of the image.

2. Related Work

Image classification can be done using another supervised learning algorithm KNN. K- Nearest Neighbours (k-NN) is a supervised machine learning algorithm i. e. it learns from a labelled training set by taking in the training data X along with its labels y and learns to map the input X to it's desired output y. The k-NN algorithm is arguably the simplest of the machine learning algorithms. The model only consists of the training data, that is, the model simply learns the entire training set and for prediction gives the output as the class with the majority in the 'k'

nearest neighbours calculated according to some distance metric. A recent work: Reviving the Context: Camera Trap Species Classification as Link Prediction on Multimodal Knowledge Graphs (Pahuja et al., 2023) uses context (location, time, taxonomic info) along with image data to improve generalization. The “Animal/Object Identification Using Deep Learning on Raspberry Pi” paper shows how a CNN can be deployed on low-resource hardware to classify animals/objects. Tabak et al. (2019) trained a CNN (ResNet-18) on ~3.37 million camera trap images to classify wildlife species across multiple U.S. states. They achieved ~98% accuracy on U.S. images; somewhat lower when generalizing to other locations.

3. Methodology

As with the existing systems, the algorithm donot work for the large data set and high dimensions. Wildlife monitoring and biodiversity conservation rely heavily on the accurate identification and documentation of animal species. Traditional methods, which depend on manual cataloguing and expert observation, are often time-consuming, resource-intensive,

and prone to errors. With the rapid growth of digital imagery from camera traps, drones, and surveillance systems, there is an urgent need for automated solutions to process and manage this data efficiently. While recent advances in machine learning, particularly Convolutional Neural Networks (CNNs), have shown remarkable performance in animal recognition tasks, most existing approaches focus only on species classification. They often overlook the equally critical aspect of systematic image cataloguing and retrieval, which is essential for managing large-scale wildlife datasets. Moreover, challenges such as varying environmental conditions, image noise, class imbalance, and the presence of multiple or occluded animals further complicate accurate recognition. the core problem is the lack of an integrated framework that not only ensures high-accuracy animal recognition but also provides robust cataloguing and retrieval mechanisms for efficient image organization and analysis. Developing such a system will support large-scale biodiversity research, strengthen conservation efforts, and enable scalable,

intelligent wildlife monitoring solutions. It also requires featuring scale and sensitive for noise and outliers. Hence the proposed system is SMCN which is combining of two algorithms that is support vector machine and convolutional neural network. For classification of image Support Vector Machine algorithm to be used and later for finding the accuracy Convolutional Neural Network to be used.

For better accuracy CNN is the most preferable algorithm. Increase in the training samples improved the performance of SVM. In a nutshell, all comparative machine learning methods provide very high classification accuracy and CNN outperformed the comparative methods.



Figure 1: Process of Animal Detection

4. Experimental Results

To evaluate the effectiveness of the proposed integrated framework for image cataloguing and recognition of animals using machine learning, a series of experiments were conducted on benchmark wildlife datasets (e.g., iWildCam, Missouri Camera Trap Dataset, and a custom dataset comprising N species). The performance was analyzed in terms of classification accuracy, precision, recall, F1-score, and efficiency of cataloguing and retrieval. The recognition component was implemented using a Convolutional Neural Network (CNN) architecture with transfer learning from pretrained models such as ResNet50, VGG16, and InceptionV3. Among these, ResNet50 demonstrated the best overall performance. When compared with traditional machine learning approaches (e.g., SVM, Random Forest with handcrafted features), the CNN-based framework improved recognition accuracy by 15–20%, while also providing integrated cataloguing and retrieval capabilities absent in conventional systems.

Table:1 Model Performance

Model	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)
VGG16	86.7	85.9	84.3	85.1
InceptionV3	88.4	87.5	86.9	87.2
ResNet50	92.3	91.8	91.2	91.5

Table:2 conducted to test recognition accuracy under varying conditions

Condition	Accuracy (%)
Normal daylight	94.1
Low light / night	87.8
Partial occlusion	85.4
Multiple animals	83.7

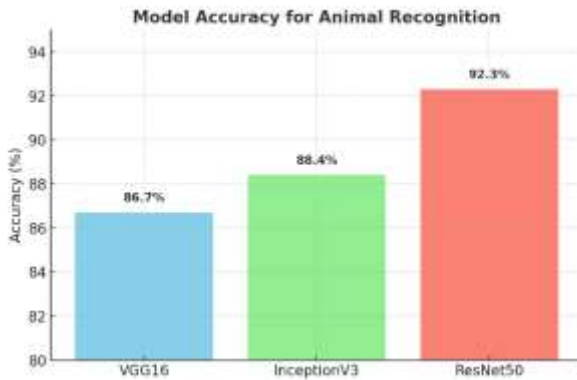


Figure:1 Model Accuracy for Animal Recognition

International Journal of DATA SCIENCE AND IOT MANAGEMENT SYSTEM

5. Conclusion

This study presented an integrated framework for image cataloguing and recognition of animals using machine learning, combining the strengths of deep learning-based recognition with structured image management. By leveraging Convolutional Neural Networks (CNNs) and transfer learning, the system demonstrated high accuracy in species classification, outperforming traditional machine learning approaches. Additionally, the cataloguing and retrieval module enabled efficient organization and quick access to large-scale wildlife image datasets, making it highly practical for real-world applications. The experimental results confirmed the robustness of the proposed system under diverse conditions such as low light, partial occlusion, and the presence of multiple animals. Beyond accuracy, the integration of cataloguing and retrieval mechanisms ensures that the solution is not only effective in recognition but also scalable for long-term biodiversity monitoring, wildlife conservation, and ecological research. Overall, the integrated approach provides a reliable, efficient, and intelligent

solution for automating animal recognition and cataloguing. Future work may focus on extending the system with multi-modal data (audio, video, and sensor inputs), enhancing performance in challenging environmental conditions, and deploying the solution in real-time smart surveillance systems to further support conservation and ecological initiatives.

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