Wildlife Conservation Using Image Recognition with Artificial Intelligence

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ABSTRACT- The sustainable development goal provided by United Nation says about 17 major development points and one of which contains to improve safety of wildlife animals and resources for the future. As there is development in human community there is rise in wildlife damage and also the surge in extinction of Unique wildlife animals. The united nation also acknowledges that problem through its development goals (SDG 13, SDG 15) to end theft of wildlife resources and maintain its biodiversity. Along with this image recognition with AI (SDG 9), there are lots of ways to enhance the current technology can do hours of works in milliseconds. moreover, adding AI algorithms can detect animals and human much precisely. Firstly, the camera traps capture an image and with AI algorithm, any object or species can be identifying and with IOT devices, authority can directly gather information on that particular problem. AI plays a crucial role in predicting future condition of an area using deep learning algorithms, that can help in preserving forest biodiversity. On the basis of several studies and analysis, this paper consists of several suggestions on various development and future scopes that can increase safety of wildlife ecosystem. This paper has depicted the advancement of the technology that are being used in many areas for monitoring by provided informative data from IOT devices. Additionally, image recognition algorithms perform a promising role in research with greater accuracy and real time conservation of that data into statical reports.

KEYWORDS-Artificial Intelligence (AI), Internet of Things (IOT), Wildlife Conservation, Species monitoring, Image recognition, Sensors, Neural Networks, Machine Learning (ML), AI Algorithms.

I. INTRODUCTION

The United Nations has prepared a structure based on 17 Sustainable Development Goals (SDGs) and AI-powered technology, which includes AI algorithms and new technology landscape [1]. The UN predicts a population growth of 9.6-9.8 billion people by 2050, and the organization is reviewing guidelines to enable IoT wildlife ecosystems [2]. Advanced image recognition technology is a roadmap to solve complex global problems and compete with SDGs. AI integrated image recognition can be transformative for wildlife conservation, preserving endangered species, biodiversity, and threats to habitats. AI algorithms can efficiently analyse large amounts of data, enabling accurate species identification and population tracking without manual work [3]. AI can also assist in detecting and responding to illegal activities like poaching, by analysing surveillance footage and alerting authorities in real time. AI-powered software can also help citizen scientists contribute to wildlife monitoring by providing instant details about species or habitat loss [4]. This technology can provide valuable insights into wildlife behaviour, population dynamics, and ecosystem health, and encourage active conservation actions to preserve biodiversity for future generations [5].

The contribution of study includes-

- This paper discusses brief about AI image recognition system with automated object recognition, monitoring of wildlife, natural habitats with real time data transmission.
- The technology used here can identify and report about the abnormal activity that may be threat to the forest biodiversity.
- The systematic use of AI algorithms – CNN, ANN are used to identify and to predict future with the help of previous data are being discussed here.

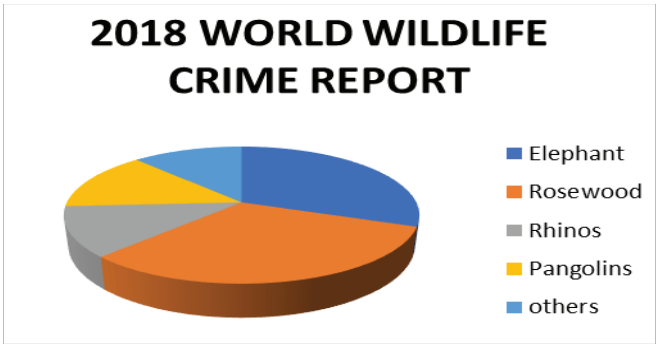

Fig. 1. Crime Report of Wildlife across the world in 2018

II. OVERVIEW

There are increasing case of wildlife crime as shown in fig 1. AI-enabled camera traps are increasingly being used in wildlife conservation, particularly in sanctuary, parks, and protected areas. These traps use AI algorithms like SMART Parks, WILD Eye, Earth Ranger, and Mbaza to identify and detect different plant and animal species [6]. The data collected helps researchers and authorities take action efficiently, identifying and detecting wildlife trafficking.

Camera trap images have an accuracy of 90%, according to classification reports. AI for biodiversity conservation is increasingly used in forest management and wildlife monetary detection [7]. The combination of AI, IoT networks, and high-tech devices like sensors, UAVs, high-resolution cameras, and satellite technologies has led to an increase in research in AI applications in biodiversity conservation and forest ecosystems. Neural networks like CNN, DSS, ANN, and other computer vision are also widely used in the field of wildlife as shown in Table 2 [8]. AI algorithms enable accurate surveillance of wildlife and respond to threats like poaching. The development of drones, AI, and thermal sensing systems improves wildlife researchers' ability to survey large areas and identify wildlife animals in precise areas. AI also maintains effective growth in wildlife habitat conservation and ensures the prevention of natural resources for future generations [9].

III. Role Of Technology

AI technologies are increasingly being utilized in wildlife habitat conservation through various software and algorithms. Satellite image analysis allows for easy habitat monitoring and conservation strategies, while predictive modelling helps prevent habitat uncertainty and aids active wildlife conservation [10]. Camera traps and unnamed aerial vehicles (UAVs) like drones are used for species monitoring, providing data on distribution and behaviour. These systems can recognize wildlife animals and help operators define species and wildlife biodiversity [11]. Machine learning (ML) and Deep Learning (DL) are essential tools in scientific applications, such as data mining and algorithm classification. ML has the potential to revert methods used in the past to manage wildlife in a rapidly changing world and resolve current crises as shown in Table 1. Deep Learning, which includes species classification, counting, and segmentation of aquatic life, is used in wildlife monitoring, including fish habitat monitoring. The YOLO v3 automation technology uses deep learning opensource packages for counting animals from images [12]. Convolutional neural networks (CNN) are preferred for animal tracking and monitoring, with models like SSMBD and R-CNN providing accurate detection speeds of 95-98% and efficiency of 96.5%. Convolutional neural networks are also used for detecting dynamic objects, as the image processing reduces illumination effects [13]. Artificial neural networks (ANN) are another neural network used in wildlife conservation, working similarly to the human brain by resembling processing units. ANN can predict future environmental conditions based on previous graphs, statistics, and data. It can also be helpful in species detection modelling, remote sensor analysis, and climate change impact assessment to protect biodiversity and ecosystems [14].

TABLE I. Role Of Sensors And Their Description

Reference	Sensors	Description
[15]	Monitoring sensor	It can detect objects in real time and send the information to centralized management system.
[16]	Visual sensor	3D image results gathered with photographic Structure from Motion method.
[17]	Image sensor	localize animal species within camera trap images
[18]	GPS	To get the fix success rate and accuracy of location
[19]	Thermal sensor	to check the thermal data of animals

AI plays a crucial role in monitoring wildlife ecosystems, enabling the detection of species and real-time information for conservation and response to land problems. Wildlife monitoring is essential for species detection, preventing rare animal extinction, and environmental assessment [20]. Traditional and current technology, including advanced algorithms and network models, have proven effective in managing and controlling the environment [21]. Accuracy of conservation models depends on theory fulfilment, initial conditions, weather, vegetation, and economic factors. Tools like cameras, GPS, thermal sensors, and unmanned aerial vehicles (UAVs) are used to gather peak data, making it easier for research to gather quality information [22].

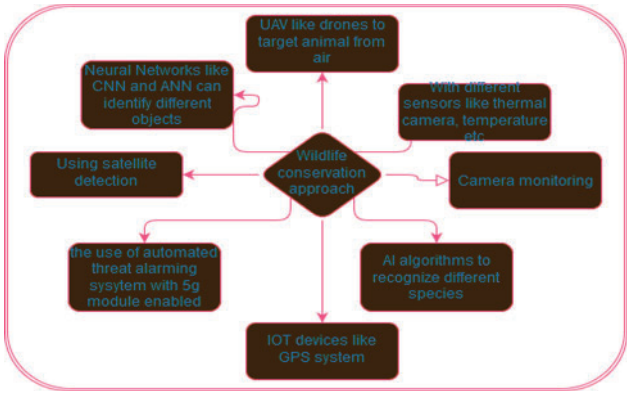

Fig. 2. Various method to conserve Wildlife biodiversity.

Over the past decade, advancements in machine learning (ML), deep learning (DL), and computer tools have led to a growing interest in wildlife conservation. The main focus has been on developing lightweight neural network algorithms, particularly in R-CNN, which are crucial for image recognition and object detection. These techniques help enhance research for future studies and maintain records of previous studies.

Unmanned aircraft systems (UAV) have made it easier to capture visual representations of areas, but they still struggle to detect animals accurately due to human limitations [23]. However, advancements in algorithms and deep learning techniques have improved animal detection accuracy and time efficiency. Fast regional convolutional neural networks (RCNN) have become more accurate, with the ability to achieve descent output and overcome traditional issues. The architecture model of Faster Region Convolutional Neural Network (FRCN) uses images obtained from camera traps to generate regional data using Regional Proportional Network (RPN). Each region is then reshaped with the effect of the region of interest (ROI) to remove object loss and recreate the required area. Convolutional neural networks (CNN) are preferred for animal tracking and monitoring, with models like SSMBD and Fast Region-Based R-CNN being used for their accuracy and efficiency. Artificial neural networks (ANN) can also be used in wildlife conservation by predicting future areas based on previous graphs, statistics, and data. ANNs can also be helpful in species detection modelling, remote sensor analysis, and climate change impact assessment to protect biodiversity and ecosystems [24]. Hence all methods should be applied to conserve wildlife biodiversity as shown in Fig 2.

TABLE II. REVIEW OF LITERATURE

Year	Ref	Technology used	Purpose	Limitation
2021	[18]	IOT	To differentiate and detect species of animals using vision system by camera images.	This is only for bird species detection which may not depict land animals
	[21]	AI	**III.** RECOGNITION OF SPECIES THROUGH CAMERA AND IMAGE OF ANIMALS USING AI IN FOREST OF NORTH EAST AREA	The deep learning model requires high computing. this may rise a challenge on devices
2022	[22]	AI	**IV.** IDENTIFICATION OF WILDLIFE SPECIES AND DATA ABOUT THEIR HABITAT USING AI	Attaching device to the animal may cause disturbance in their natural habitat
	[13]	IOT	Technique used detect animal species and classification.	It lacks some technology such as GPS tracking, thermal seasoning.
2023	[25]	IOT	Wildlife monitoring in real time and transferring data in automation.	Limited GPS tracking coverage.
	[26]	AI	Animal detection using UAV and CNN	Using arial technology may rise a challenge to detect animals in dense forest

IV. RECOMMENDATION AND FUTURE SCOPES

- The AI algorithms that are being used till now for wildlife image recognition can be improved, so it can detect more precisely and small animals even in worst conditions. Moreover, IOT can also need development to track species accurately and transfer its data, this can gradually increase monitoring of animal and their habitat.
- AI algorithms can be improved to detect and help researchers about future problems that can impact forest resources or threat detection such as natural or manmade destructions. It can also help in reviving old forest where there is hope of new trees and ecosystem. Using optimized systems that can works with AI can be useful in many terms.
- Combine use of satellite, UAV like drones and camera can effectively create dataset for analyzing and making decisions regarding problems in forest. Then combining the data gathers from different technology can furthermore be used in studies to update our future generations, AI model can gather crucial information from this information.
- Creating a user-friendly device for researchers who work near or in remotely areas, this may create a good community for researches and use of light weights ai models for small area gives advantages in remote area. This could encourage more researches by influence of devices that are easy to use and can be accessible in any area.

V. CONCLUSION

Presenting this review demonstrates that there is already a promising work done with maximizing approaches that are beneficiary. Due to increase in wildlife trafficking and crimes like killing animals for their goods cause animal and plant species extinction, to oppose this, use of AI and camera traps become requirement to conserve wildlife resources, also with IOT technology, it enhances the approach of conservation. This paper has depicted the advancement of the technology that are being used in many areas for monitoring by provided informative data from IOT devices. Additionally, image recognition algorithm performs a promising role in research with greater accuracy and real time conservation of that data into statical reports. The continuous upgrading in these technologies can revolutionarily makes it essential for sustainable growth and slowly preserving forest heritage for future generations.

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