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AI-Based Wild Animal Tracking System using IoT and Deep Learning

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Abstract: *Wildlife monitoring is essential for conservation and reducing human–animal conflict. Traditional tracking systems primarily rely on GPS collars, which provide location data but lack intelligence in identifying animals or detecting their presence in real time. This paper presents an AI-based wild animal tracking system that integrates Internet of Things (IoT), image processing, and deep learning techniques. The system uses a PIR sensor to detect motion and trigger a camera module, reducing unnecessary power consumption. Captured images are processed using Convolutional Neural Networks (CNN) to identify animals, specifically focusing on leopards. A GPS module provides real-time location, and data is transmitted to the cloud for monitoring via web or mobile applications. The proposed system enhances automation, accuracy, and efficiency in wildlife tracking while minimizing human intervention*

Keywords: Wildlife Tracking, IoT, CNN, Image Processing, GPS, Smart Monitoring

I. INTRODUCTION

Wildlife conservation has become increasingly important due to habitat destruction, poaching, and human–wildlife conflicts. Animals such as leopards often enter human settlements, creating dangerous situations. Traditional tracking methods like GPS collars and manual monitoring are limited in efficiency and do not provide real-time intelligence or animal identification.

With advancements in Artificial Intelligence (AI) and IoT, it is now possible to build smart systems capable of automated monitoring. Deep learning models such as CNNs enable accurate animal recognition based on unique patterns, while IoT devices allow real-time data transmission.

This project proposes an intelligent wildlife tracking system that detects motion, captures images, identifies animals using AI, and provides real-time tracking and alerts.

II. LITERATURE SURVEY

Previous studies show that GPS-based tracking systems provide only location data and cannot identify animals. Camera trap systems capture images but require manual analysis, making them time-consuming.

Research in deep learning has shown that CNN models can accurately identify animals based on visual features. IoT-based systems enable real-time monitoring and data transmission. However, most existing systems do not combine detection, identification, and tracking into a single automated solution.

III. METHODOLOGY

System Architecture : The proposed system follows a multi-layer architecture that integrates hardware and software components:

Working Process:

Motion Detection using PIR Sensor

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The PIR (Passive Infrared) sensor continuously monitors the environment for changes in infrared radiation. When a warm object such as an animal enters the detection range, the sensor detects the change and sends a signal to the controller. This ensures that the system remains energy-efficient by activating only when necessary.

Image Capture

Once motion is detected, the camera module is activated automatically. The system captures an image or short video of the detected object. This selective capturing mechanism reduces unnecessary storage usage and improves processing efficiency.

Image Pre-processing

The captured image is processed using OpenCV techniques such as resizing, noise reduction, and normalization. This step improves the quality of the image and prepares it for accurate analysis by the AI model.

Animal Detection and Identification (AI Model)

A Convolutional Neural Network (CNN) model is used to analyze the processed image. The model is trained on a dataset of animal images and can classify whether the detected object is a leopard or another species. The system can be further extended to support multiple animal classes.

Location Tracking using GPS

The GPS module retrieves real-time geographic coordinates (latitude and longitude) of the detected animal. This data helps in tracking movement patterns and identifying high-risk zones.

Data Transmission (IoT Integration)

The collected data, including image, animal type, location, and timestamp, is transmitted to a cloud server using communication protocols such as MQTT or HTTP. This ensures real-time data availability and remote monitoring.

Cloud Storage and Processing

The cloud platform stores the incoming data and can perform additional analysis if required. It also manages alerts and notifications based on predefined conditions.

User Interface and Alerts

The processed data is displayed on a mobile or web application. Users can view animal activity, track movement, and receive instant alerts when animals enter restricted or human-populated areas.

IV. MODELLING ANALYSIS

The proposed system was tested under controlled and semi-real environments to evaluate its performance. The results demonstrate that the system effectively detects motion, captures relevant images, identifies animals, and provides real-time tracking.

The PIR sensor successfully detected movement with minimal false triggers. The motion-based activation of the camera significantly reduced power consumption and unnecessary data capture. The CNN model was able to identify animals with good accuracy, depending on the quality and diversity of the training dataset.

The GPS module provided accurate location data, which was successfully transmitted to the cloud. The IoT communication system ensured real-time data updates, and the user interface displayed information clearly and effectively.

Overall, the system showed improved efficiency compared to traditional methods. It reduced manual effort, provided faster response times, and enabled better monitoring of wildlife activity.

V. CONCLUSION

The AI-based wild animal tracking system presents an intelligent and automated approach to wildlife monitoring. By integrating technologies such as AI, IoT, GPS, and motion detection, the system addresses the limitations of traditional tracking methods and provides a comprehensive solution.

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The system enables real-time detection, identification, and tracking of animals, reducing the need for manual intervention and minimizing risks for forest officials. It also helps in preventing human–wildlife conflicts by providing timely alerts and accurate data.

Furthermore, the system is scalable and can be deployed across large forest areas. With future enhancements such as multi-species detection, predictive analytics, and edge computing, the system can become even more powerful and efficient.

In conclusion, this project contributes significantly to wildlife conservation by providing a smart, reliable, and cost-effective monitoring solution that supports data-driven decision-making and sustainable ecosystem management.

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