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AI - Driven Ultrasonic Solution for Crop Protection and Wild life Coexitence

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ABSTRACT—

This project aims to develop an AI based solution for crop protection and wildlife co-existence. Here we use certain PIR sensor to detect the Animal Movement in the Forest. And if the animal is detected automatically with the help of ESP Camera, we can get the real-time image or video to detect the captured animas belong to Wild animal or Domestic animal or Human being. If it was only wild animals, a certain alarm will be notified to Villagers and a caution message will be forwarded to Forest Department with the image and exact GPS Location, these will be done using GSM Modules with Low Frequency.

Index Terms—Clustering, Deep Learning, CNN, GSM

I. INTRODUCTION

The increased penetration of wildlife into human inhabitants, especially in villages and agricultural areas, has become a serious problem. These encounters often lead to the destruction of the harvest, damage to property, and, in severe cases, to injuries, or loss of life. Traditional fences or manual monitoring methods are often insufficient to prevent such incidents. To solve this problem, the integration of artificial intelligence and embedded systems provides an efficient and automated solution. This project proposes a warning system that combines real-time wilderness detection and an extended object detection algorithm with IoT-enabled hardware components. The software part of the system uses the Yolov8 deep learning model to identify different species through camera feeds. When the ultrasonic sensor recognizes movement in the target area, it triggers the camera and activates the model. After detecting the animal, the system sends a signal to the Arduino UNO and performs several actions. Activate the alarm, send GPS coordinates to the IoT server, display warnings on the LCD, and forward SMS warnings to the user hardware hardware hardware hardware hardware hardware hardware. A proactive approach to minimize conflicts between humans and world life and improving security in rural and forested neighboring areas.

II. LITERATURE SURVEY

A. Title: Transfer Learning for Wildlife Classification

Authors: Subek Sharma, Sisir Dhakal, Mansi Bhavsar

Abstract: This look examines the effectiveness of numerous deep learning fashions, including Dennetet, Resnet, VGGNet, and Yolov8, in classifying flora and fauna species using custom datasets. The record consists of 575 photographs of 23 endangered species received from online repositories. research uses transfer learning to conform prayer fashions to facts facts to shorten education intervals and improve class accuracy. The effects show that Yolov8 outperforms alternative fashions, exceeding a schooling accuracy of 97.39 percent and a validation F1 score of 96.50 percent. These findings show that Yolov8, with its enormously advanced layout and powerful characteristic extraction techniques, has the critical capability to automate initiatives to display flora and fauna and nature conservation.

Published on: arXiv,2024

B. Title: Tiger Detection Framework for Wildlife Surveillance

Authors: Gaurav Pendharkar, A. Ancy Micheal, Jason Misquitta, Ranjeesh Kaippada

Abstract: The preservation of tigers requires the introduction of numerous strategies, including the safety of herbal habitats, the introduction of surveillance structures, and the active participation of nearby communities for the further growth of tiger populations. Further developments in artificial intelligence can computerize the persecution of tigers using the popularity of objects. This newsletter proposes detailed methods for the perception and classification of light products, such as vegetables and synthetic lighting devices. The very green Yolov8 version reaches a huge card price of 60 percent

without the need for additional lighting bodies. Detection increases the card by more than 0.7 percent. This technology ensures the overall output of today's large data records. The expected rate for those who have a product via Product A is 6 percent to 7 percent.

Published in: arXiv,2023

C. Title: Improving Generalization Performance of YOLOv8for Camera Trap Object Detection

Authors: Aroj Subedi

Abstract: Digicam traps have become an important tool for flora and fauna conservation efforts and offer an intrusive technique that does not display or look at wildlife in their herbal habitat. The software of item popularity algorithms for automating species identification from digicam lure photos is of maximum importance for research and upkeep functions. Fortunately, the problem of generalization is customary, as skilled fashions struggle to apply their information to statistics records they have not encountered before. This paper investigates improvements to the yolov8 object popularity set of rules to address the assignment of generalization. This study focuses on the shortcomings of the YOLOv8 baseline version and emphasizes the ongoing battle to combat generalization in realistic scenarios. To address these obstacles, recommendations had been made to incorporate a global attention mechanism (gam), regulate feature fusion with more than one requirement, and establish clever interfaces through union as a limiting field regression loss characteristic (wiouv3). Through rigorous evaluation and ablation experiments, it has been verified that the enhanced version effectively reduces historical past noise, makes a specialty of item features, and well-knownshows sturdy adaptability in unexpected settings. The proposed improvements now not only remember the inherent difficulties in analyzing digital camera entice data statistics, but additionally have a look at the direction to broader implementation in sensible conservation conditions that in the end make contributions to the effective management of flora and fauna populations and habitats. Published on: arXiv,2024

D. Title: Enhanced YOLOv8 network with extended Kalmanfilter for Wildlife detection and Tracking in Complex Environments

Authors: Not specified

Abstract: In the context of developing worldwide interest in ecological conservation and biodiversity tracking, the green identity and tracking of plants and fauna are important for environmental research, flora and fauna safety, and habitat management. However, complicated landscapes, severe animal sizes, and obstructions prevent the detection and tracking of plants and fauna. This study introduces the wild-yolov8n version, in particular engineered for powerful identification and tracking of animals. First, the strong diffusion model increases the data set, setting up a foundation for training information. ultimately, upgrades to the yolov8n model are executed through the incorporation of the deformable convolutional network cnnv3 and the usage of the cnnv3 layer to decorate function extraction efficacy, even as addressing detection disturbing situations associated with small desires and complex backgrounds with the resource of integrating the emga interest mechanism and the aspfc feature fusion module. enhancing the extended Kalman filter set of guidelines ensures dependable and particular tracking. The research findings show that the wild-yolov8n version achieved a median detection accuracy (map50) of 88. Fifty 4 percent on the custom dataset, reflecting a 4.57 percent enhancement over the real yolov8n version, the sensitive prolonged kalman easy out realizes a multi-object tracking accuracy of 40.35 percent, representing a 3.923 percent development over the proper kalman clean out. The consequences advise the feasibility of effective detection and monitoring of vegetation and fauna in complex environments, present wonderful insights for ecological studies and biodiversity conservation, and help in the safety of endangered species.

Published in: arXiv preprint,2022

E. Title: Advanced wild animal detection and alert systemusing the YOLOV5 model powered by AI

Authors: Dr. V. Nagagopiraju, Suvarna Pinninti, Anjamma Tamma, Sai Teja K., Kaleshavali Kakarla

Abstract: An advanced wild animal detection and alert system the use of You only look once model five (YOLOv5) version. The system utilizes the YOLOv5 object detection algorithm to identify wild animals and alert users to their presence in real-time. The gadget employs a camera to capture real-time video, that is then despatched to a pc walking the YOLOv5 algorithm. whilst the machine detects a wild animal, it sends an alert to the wild animal via gambling any appears like bullets firing. The machine is anticipated to have a big impact on the safety of humans in areas with high natural world populations. This advanced wild animal detection and alert device the use of the YOLOv5 model has the capacity to enhance the safety of humans in areas with high flora and fauna populations. future paintings will focus on improving the accuracy of the machine and implementing it in actualinternational scenarios.

Published in: Turkish Journal of Computer and Mathematics

Education,2024

III. EXISTING SYSTEM

Traditional wild animal detection systems rely primarily on manual surveillance methods such as forest guards, watchtowers, and physical barriers such as fences to monitor and prevent animal intrusion. In some cases, camera traps are deployed to capture images or videos, which are then manually reviewed to identify the presence of wild animals. Some automated systems use basic motion detection sensors that trigger alarms when movement is detected. However, these systems lack the ability to differentiate between wild animals and other moving objects, leading to frequent false alerts. GPS collars are also used to track certain animals, but are limited to tagged individuals and require physical capturing and maintenance. Although newer

technologies such as AI-based models are being tested in research settings, their implementation in realworld environments remains limited due to challenges such as cost, connectivity, and integration with alert mechanisms. In general, existing systems are reactive, labor intensive and prone to inaccuracies in real-time detection and response.

A. Disadvantages of the Existing System:

- High fake alarm fee due to non-specific motion detection. • Manual tracking is hard work-in depth and timeconsuming.
- Loss of real-time alerts limits short preventive movements.
- Can't become aware of animal species, main to poor selection-making.
- Restrained scalability and automation, making them incorrect for huge areas..

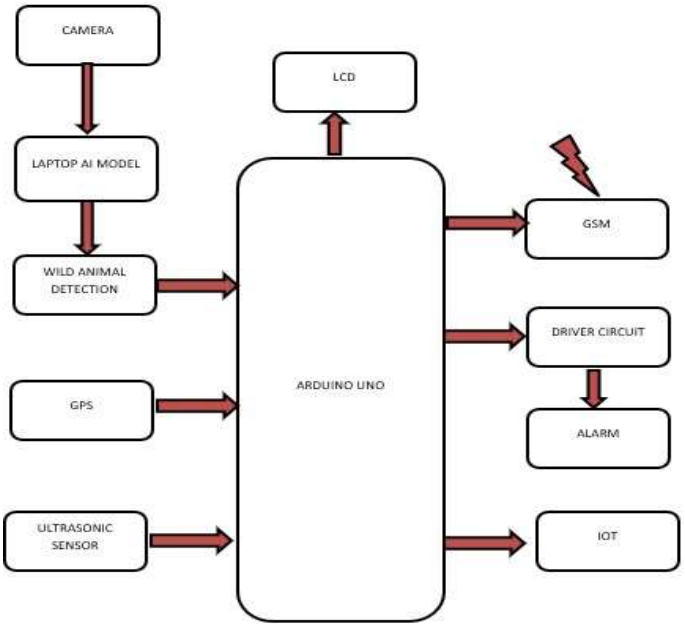
IV. PROPOSED SYSTEM

The proposed system is an intelligent wild animal detection and alert mechanism that combines computer vision, deep learning, and IoT technologies for real-time monitoring and protection. The system uses a YOLOv8-based object detection model trained to recognize wild animals from camera footage. When an ultrasonic sensor detects motion, it activates the camera to capture real-time images. These images are processed by the Python-based model, and if a wild animal is detected, data is sent to an Arduino Uno through serial communication. The Arduino triggers an alarm, displays information on an LCD, sends GPS coordinates to an IoT server, and sends an SMS alert to authorities or landowners via GSM. This automated system provides a proactive solution to monitor high-risk zones such as farms or forest borders and alert users instantly, reducing the chances of human-animal conflict and property damage. The integration of smart sensors, GSM, GPS, and deep learning ensures high accuracy, real-time response, and wide area coverage.

A. Advantages of the Proposed System:

- Detection in real time and instant alerts provide a quick response.
- High accuracy means that the use of YOLOv8 minimizes false alarms.
- Automated alerts through the GSM and the Internet of Things reduce human dependency.
- cost-effective and scalable for rural and wooded area-part deployment
- Vicinity monitoring through GPS enhances situational awareness.
- Cost-effective and scalable for the development of parts in rural and wooded areas.

BLOCK DIAGRAM



V. SYSTEM REQUIREMENTS

A. Hardware Requirements

- Arduino Uno:

The Arduino Uno acts as the significant microcontroller inside the real-time wild animal detection and alert machine. It receives detection alerts from the Pythonbased YOLOv8 model through serial conversation every time a wild animal is identified. Upon receiving this signal, the Arduino triggers several hardware moves: it turns on an alarm, displays indicators on the liquid crystal display screen, and sends GPS coordinates and animal presence records to an IoT platform for far-off monitoring. The Arduino additionally controls the GSM module to send SMS indicators to users or authorities, ensuring immediate notification. Its robust input/output capabilities allow it to interface with numerous sensors and modules, consisting of the ultrasonic sensor, GPS, GSM, lcd, and alarm. Typical, the Arduino Uno provides dependable, real-time processing and control, making the device computerized, responsive, and appropriate for deployment in rural or wooded area-aspect environments.

- Webcam/Camera:

The webcam or camera serves as the primary image acquisition device in the wild animal detection system. Continuously capture live video frames from the monitored environment, providing visual data in real time for analysis. These frames are fed into the YOLOv8 model running on a connected computer or embedded system for object detection. The high resolution and frame rate are crucial to accurately identifying animals and minimizing false detections. Its placement and angle are strategically chosen to maximize coverage of wildlife movement areas. In general, the webcam enables the system to visually monitor the environment, which is the basis for timely detection and alert generation.

- Ultrasonic Sensor:

The ultrasonic sensor is carried out to become aware of the presence and decide the distance of items positioned on the rims of gadgets and animals within its range. It emits ultrasonic sound waves and calculates the time it takes for the echo to increase, allowing it to decide the distance to the detected object. In this task, the sensor acts as a verification layer, participating in the camerabased detection device to minimize false positives. irrespective of the item's placement inside a particular level of beauty, the sensor sends a signal to the Arduino Uno for evaluation in addition. This information can be stuffed out to activate alarms or signs, improving the device's capability to respond right away. Normally, the ultrasonic sensor ensures particular and distinct proximity detection, thereby enhancing the overall effectiveness and accuracy of the animal detection device.

- LCD display:

The LCD screen in the animal detection project serves as a crucial user interface for visual alerts and system status updates. When a wild animal is detected, the Arduino Uno triggers the LCD to show a warning message, such as the animal type and its GPS coordinates, providing clear and immediate information to users. If no animal is detected, the LCD displays a safe state, helping users monitor the area's security at a glance. This real-time feedback is essential for quick decisionmaking and improves the reliability and usability of the system. The LCD works alongside other notification mechanisms such as buzzers and LEDs to ensure that all alerts are communicated effectively. Its integration with the microcontroller makes the system more interactive, informative, and user-friendly in both routine monitoring and emergency situations.

- GSM module:

The GSM module in the animal detection project enables wireless communication by sending SMS alerts to designated users or authorities when a wild animal is detected. Controlled by Arduino Uno, it receives a trigger signal whenever the system identifies an animal, ensuring immediate notification even if users are not physically present. The module uses a SIM card to connect to mobile networks, making it suitable for remote or rural areas without internet access. It transmits critical information such as the type of animal detected and the GPS coordinates, allowing rapid response and intervention. The GSM module operates reliably alongside other alert mechanisms like the LCD and buzzer, providing a multi-layered safety system. In general, its integration ensures timely automated and location-specific alerts, greatly improving the effectiveness and reach of the animal detection system.

- GPS Module:

The GPS module within the animal detection venture provides the correct region facts every time a wild animal is detected. Whenever it gets satellite indicator to decide the system's particular geographic coordinates. when an animal is identified, the Arduino Uno retrieves the modern GPS information and includes it in the alert messages. This place of statistics is important for steering government or users to the exact spot of the animal sighting. The GPS module works seamlessly with different additives just like the GSM module and the liquid crystal display display to ensure that the signals are both timely and area specific. In general, the GPS module improves the effectiveness of the device by allowing realtime monitoring and fast response to wildlife intrusions.

- Buzzer:

The buzzer in the animal detection challenge serves as an audible alert mechanism that sounds immediately while a wild animal is detected. controlled through the Arduino Uno, it helps to seize interest fast, particularly in noisy or dynamic environments where visual indicators are probably neglected. The buzzer can also act as a deterrent, potentially scaring away smaller animals from the covered area. Enhances other notification components like LEDs, liquid crystal display presentations, and GSMprimarily based SMS signals to provide a multisensory warning gadget. Its use complements the

effectiveness of the device with the aid of making sure that indicators are good both locally and remotely. In normal conditions, the buzzer plays an important role in real-time animal detection by providing clear audible warnings to customers and close-by people.

- Driver circuit:

The driver circuit in the animal detection project acts as an interface between the microcontroller and high-power devices such as buzzers, alarms, or motors. It typically includes relay modules or transistor-based switching circuits that allow low-power signals from Arduino or other controllers to safely activate external components. When an animal is detected, the driver circuit receives a trigger signal and energizes devices such as buzzers or relays to issue audible or visual alerts. In some systems, the driver circuit can also control motorized functions, such as slowing down a train or vehicle by managing the speed control module through relays. This ensures that all alert and safety mechanisms are activated promptly and reliably in response to detection events. In general, the driver circuit is essential to bridge low-power control logic with high-power actuation, ensuring effective and safe operation of the alert system.

- IOT Module:

The IoT module inside the animal detection task enables far-flung tracking and real-time notifications by connecting the detection system to the net. while a wild animal is detected by sensors and the camera, the IoT module transmits relevant information-along with animal kind, detection time, and GPS location-to an IoT server or cloud platform for centralized right-of-entry to and evaluation. This connectivity allows customers or authorities to obtain instantaneous signals and consider detection activities from all over the world using mobile or net interfaces. The module usually runs alongside other notification structures, such as SMS and local alarms, presenting a multichannel alert mechanism. In addition, it supports information logging and ancient analysis that can help improve flora and fauna control and response techniques. standard, the IoT module notably complements attainment, automation, and effectiveness by allowing seamless communication and fact sharing beyond the instant physical place.

- Power supply:

The power delivered within the animal detection project provides the essential electric strength to perform all hardware additives reliably. It commonly consists of a 12V DC adapter or battery supply that guarantees continuous energy to gadgets such as the Arduino Uno, sensors, the GSM module, and a digital camera. In some implementations, solar panels are included to provide a sustainable and off-grid electricity solution, mainly beneficial in faraway regions or wildlife. The power supply is designed to maintain solid voltage and present-day degrees, stopping interruptions that would affect real-time detection and alert functions. It helps strength-efficient additives to increase operational time and decrease protection. In typical cases, the electricity supply is essential for ensuring uninterrupted, autonomous functioning of the detection and tracking gadget in numerous environments.

B. Software Requirements:

- Python(Programming Language):

Python is the primary programming language used to enforce the animal detection algorithms and control gadget integration in the assignment. It runs real-time detection fashions, such as YOLOv8 or masks RCNN, processing photos or video frames from the camera to discover diverse animal species. Python scripts utilize libraries such as OpenCV for image processing, visualization, and efficient inference, allowing seamless execution of machine-mastering fashions. The code can also cause hardware movements or notifications, including caution sounds for gambling, sending SMS signals, or updating IoT dashboards, based on detection effects. Python's compatibility with system gaining knowledge of frameworks and hardware interfaces makes it appropriate for each training fashions and deploying them in live environments. Typical, Python provides a bendy and strong environment for actual-time animal detection, automation, and alert functionalities within the undertaking.

- YOLOv8(ultralytics):

YOLOv8 (Ultralytics) is a brand new deep version designed for real-time item detection, making it distinctly powerful for wild animal detection tasks. It processes entire photos in an unmarried bypass, enabling rapid and efficient identification and localization of modern-day animals within every video body, even as concurrently assigning species labels. YOLOv8 achieves excessive accuracy, with mentioned mean common precision (mAP) values exceeding 94 percent in wild animal detection obligations, and may operate at actual-time speeds modernday up to twenty frames per second. The versatility of the version extends past detection to tasks such as monitoring, pose estimation, and segmentation, allowing for complete analysis of modern animal behavior and movement. Its architecture supports seamless integration with hardware platforms and software program libraries, including OpenCV, facilitating deployment in numerous environments and applications. Normally, YOLOv8's aggregate velocity, precision, and adaptability make it an effective middle issue for computerized, real-l-time animal tracking and alert structures.

- Arduino IDE:

The Ardubuilt-ino IDE is the main software tool used to build integrated code, compile it, and upload it to the Arduino- integrated Uno microcontroller in the builtin integrated animal detection challenge. It presents a user-friendly interface for the integration and testing of embedded packages that manipulate sensors, alarms, displays, and communication modules. The IDE helps languages, C and C++ programming languages, built in to take into account green and dependent code development tailored to the venture's hardware requirements. Its serial screen allows for integrated real-time debug-building and monitoring of facts exchanged among the Arduino builtino and linked gadgets. The Arduino built-ino IDE also provides a wide variety of libraries and examples, making it simpler to combine the new additives and expand the built-in functionality. In general, the Arduino built-ino IDE is important for completely programmable, debugintegrated, and built-in integrated operations of the animal detection and alert system.

- PySerial(for communication with Arduino): PySerial allows verbal exchange of some of the Python software program applications and Arduino Uno. It transmits detected license plate numbers and speed limits from the laptop to the Arduino. The Arduino then uses this information to control the DC motor and display statistics in the liquid crystal show. PySerial acts as a bridge that allows the software to send commands to the hardware. Without PySerial, the Python code might not be able to interface with Arduino. This serial conversation ensures that the hardware additives reply as it has to be to the software program software's detections.PySerial is a Python library that enables serial verbal exchange between a computer and microcontrollers like Arduino Uno, allowing statistics to be sent and obtained over a serial port. It permits Python applications to write instructions to the Arduino, consisting of triggering an LED or sending manage alerts, and to read records sent again from the Arduino, like sensor values or status messages. The library helps to configure key conversation parameters, including baud rate, information bits, parity, and forestall bits, making sure compatibility with various hardware setups. Installation is easy, generally accomplished the usage of the pip package deal manager in a Python environment.

- OpenCV:

OpenCV is an open-source PC vision library substantially used in this challenge to process and study snap shots and video streams. It allows the device to seize frames from the digicam, carry out actual-time picture enhancement, and prepare data for animal detection algorithms. With its sizable set of functions, OpenCV simplifies obligations such as resizing, filtering, and drawing bounding boxes around detected animals. The library integrates seamlessly with Python, making it clean to combine with machine analyzing fashions consisting of YOLOv8 for item detection. OpenCV additionally allows visualization, allowing clients to display detection outcomes and display device performance in real time. In general, OpenCV is essential for green photo handling, pre-processing, and visualization inside the animal detection and alert system.

VI. ADVANTAGES AND APPLICATIONS *A. Advantages:*

- Real-Time Wild Animal Detection.
- Automated Alert System via GSM and IoT.
- Accurate Location Tracking Using GPS.
- Early Warning to Prevent Human-Wildlife Conflict.
- Continuous Monitoring with Minimal Human Intervention.

B. Applications:

- Forest Border Monitoring and Wildlife Conservation.
- Protection of Agricultural Lands from Wild Animal Intrusion.
- Wildlife Detection in National Parks and Sanctuaries.
- Remote Villages Safety Alert System.
- Real-Time Surveillance for Anti-Poaching Operations.

VII. CONCLUSION

The Wild Animal Detection gadget is an progressive answer that leverages deep studying and IoT technology to address the developing undertaking of human-flora and fauna war. with the aid of the usage of a YOLOv8-based version, the system can as it should be hit upon wild animals in actual-time via digicam photos, making it a proactive degree for wildlife protection. The device's integration with sensors like ultrasonic sensors, GPS, and GSM modules permits computerized detection, vicinity monitoring, and immediate alerts. the use of Arduino for hardware control lets in for seamless interplay between the software and physical components, triggering alarms, showing alerts on lcd monitors, and sending SMS messages to customers. moreover, the IoT module guarantees that the detection information is shared in actual-time, enhancing monitoring capabilities. This era is in particular useful for tracking forest areas, farmlands, and rural villages vulnerable to wild animal intrusion. In conclusion, this mission provides a enormously green and scalable method to reveal and mitigate humanwildlife conflicts. The actual-time detection and automated response gadget offer a realistic, value-powerful manner to guard both humans and animals, fostering a more secure coexistence. because the gadget keeps to conform, it could be similarly progressed to deal with broader conservation and protection demanding situations in flora and fauna habitats.

VIII. FUTURE SCOPE

The future scope of the real-time wild animal detection and alert system is vast and promising. By expanding the detection capabilities to include more animal species and behaviors, the system can become more versatile and useful in diverse environments. Integrating advanced hardware like edge AI devices and solar power can enable deployment in remote areas with minimal maintenance. Additionally, improving the IoT network to cover larger regions and incorporating cloudbased analytics will enhance real-time monitoring and datadriven decision-making. The system can also evolve to include

automated deterrents and seamless communication with local authorities, helping to reduce human-wildlife conflicts effectively. Overall, these advancements will transform the project into a comprehensive tool for wildlife conservation and community safety.

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