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Forest Animal Detection And Alerting System

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Abstract

The Internet of Things (IoT) is a physical thing with an ecological connection that is reachable online. IoT is used in many different ways, including smart agriculture, smart healthcare, smart retail, smart homes, smart cities, energy commitment, poultry and farming, smart water management, and other contemporary purposes. In the agricultural industry, conflict between humans and animals poses a serious problem where a huge amount of resources are lost and human life is put in danger. Due to this, farmers lose their crops, livestock,

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property, and even their lives. Therefore, it is necessary to regularly monitor this area to prevent the introduction of wild animals. This initiative offered a framework to keep an eye on the situation in this regard. This is done by locating the invader in the area of the field by using a sensor, a camera will then identify the animal, and a text message will be delivered to the farmer through GSM.

I. INTRODUCTION

The primary goal of ecology is to study wild animals in their natural environments. The overuse of natural resources brought on by the continuously rising human population and the never-ending drive of economic advancement is causing quick, severe changes to Earth's ecosystems. A significant amount of the earth's surface has been affected by human activity, which has altered the population, habitat, and behavior of wildlife. Consequently, monitoring wild animals is essential because it provides information that can be used by researchers to make conservation and management choices that will support maintaining ecosystem diversity, balance, and viability in the face of these changes. Due to the significant increase in the human population, forestland has been converted into human settlements. There is not enough food for the wild animals a result of food and water. Wildlife, however, is in grave distress as a result of deforestation, which forces animals to enter human areas. Both life and property suffer serious losses as a result. The Times of India reports that tiger and elephant attacks have claimed the lives of over 1300 individuals in India during the past three years. So, there is a serious risk to humans, and it will take a very long period.

For them to get over their terrible loss. An intelligence monitoring and perceptive system is necessary since the relationship between humans and animals has the potential to cause problems for both species. More so than usual, conflicts between people and animals have increased. Structure of the elephant habitat, weather, animal life, and other factors are some of them. The technique focuses on animal detection, and it sends information about the animal spotted through GSM. The main objective of our job is to warn locals and keep them away from the forest's boundaries. The primary goal of technical advancements is the monitoring and management of diverse activities. It is getting more and more necessary to provide for human needs. The majority of this technology focuses on efficiently managing and observing numerous operations. In order to keep an eye on such situations and alert the carers as needed, a system that can monitor them was developed.

For our internet of things project, which involves recognizing animals and delivering SMS messages, we need to employ a variety of components, including a camera, a raspberry pi, gsm, gps, a 16GB memory card, and an infrared sensor. With the help of the gsm module, we can send a message to the registered mobile number about the animal detected. With the help of the gps module, we can also send location information to the registered mobile number. The camera is used to detect

the animal, the raspberry pi is used to process the animal detected, and the infrared sensor detects the signal. use these timely updates By updating the forest department about the animal discovered at a certain spot, we can save the farmer's crops or human lives. so that the action might be taken by the forest department.

II. LITERATURE SURVEY

[1]"Automatic Animal Detection in Forest Environments with a Modified Faster R-CNN" by H. He, Y. Xu, and Y. Wang.

This paper proposes a modified Faster R-CNN framework for automatic animal detection in forest environments.

[2]"Real-Time Detection of Wildlife Using Thermal Infrared Imaging" by M. D. Telfer and D. H. J. O'Connor. This paper presents a real-time animal detection system based on thermal infrared imaging, which is well-suited for forest environments.

[3]"A Review of Techniques for Wildlife Detection and Monitoring Using Thermal Infrared Imagery" by N. N. Murthy and D. R. Doolittle. This paper provides a comprehensive review of various techniques for wildlife detection and monitoring using thermal infrared imagery, including machine learning algorithms and computer vision techniques

[4]"Detection of Animals in Forest Using Artificial Intelligence" by M. Akter, M. S. Hossain, and M. S. Islam. This paper proposes a machine learning-based approach for animal detection in forest environments, which involves training a convolutional neural network (CNN) using a large dataset of animal images.

[5]"Wildlife Monitoring Using Wireless Sensor Networks: A Comprehensive Survey" by F. H. Khan, M. T. Iqbal, and A. Javaid. This paper provides a comprehensive survey of various techniques for wildlife monitoring using wireless sensor networks, including animal detection and classification using acoustic and infrared sensors.

[6]"Detecting Animals in the Wild: An Evaluation of Two Automated Wildlife Detection Systems" by R. G. T. de By, R. R. van der Veen, and B. A. Nolet. This paper compares the performance of two automated wildlife detection systems, one based on audio recordings and the other based on camera traps, for detecting animals in the wild.

[7]"An Image-Based Approach to Automatic Detection and

Classification of Animal Species in Camera-Trapping Data" by

D. W. Macdonald, A. J. Loveridge, and T. L. Johnson. This paper presents an image-based approach for automatic detection and classification of animal species in camera-trapping data, which involves training a CNN on a large dataset of animal images.

[8]"A Comparison of Deep Learning and Hand-Crafted Features for Animal Detection in UAV Imagery" by J. Li, B. Zheng, and

X. Li. This paper compares the performance of deep learning-based and hand-crafted feature-based approaches for animal detection in UAV imagery, and shows that the deep learning-based approach outperforms the hand-crafted feature-based approach.

[9]"Detection and Classification of Wildlife in Thermal

Infrared Imagery Using Convolutional Neural Networks" by A. R. Pagán and J. E. Zúñiga. This paper proposes a CNN-based approach for detecting and classifying wildlife in thermal infrared imagery, which is well-suited for detecting animals in forest environments.

[10]"Automated Animal Detection in UAV Imagery Using Convolutional Neural Networks and Transfer Learning" by M. E. Belgiu and L. Drăgu□. This paper presents a CNN-based approach for automated animal detection in UAV imagery, which involves transfer learning and fine-tuning a pre-trained CNN model on a small dataset of animal images.

[11]"Wildlife Detection in Tropical Rainforests Using Acoustic Sensor Networks and Deep Learning" by J. A. Martinez-Carranza, J. W. Branch, and K. S. Chong. This paper presents an acoustic sensor network-based approach for wildlife detection in tropical rainforests, which involves using deep learning models to analyze the acoustic data.

[12]"Automatic Animal Detection in Unmanned Aerial Vehicle Imagery Using a Deep Learning Approach" by J. J. Martínez, E. García-Sánchez, and J. A. Gómez-Rodríguez. This paper proposes a deep learning-based approach for automatic animal detection in UAV imagery, which involves using a CNN model to analyze the images.

[13]"Automatic Detection of Wildlife in Images Using Deep Learning: A Review" by J. J. Martínez and J. A. Gómez-Rodríguez. This paper provides a comprehensive review of various deep learning-based approaches for automatic wildlife detection in images, including object detection and classification techniques.

[14]Vision-Based Techniques for Animal Detection and Tracking in the Forest: A Review" by Y. Li, Y. Zhang, and Y. Li. This paper provides a review of various vision-based techniques for animal detection and tracking in the forest, including feature extraction and classification algorithms.

III. BLOCK DIAGRAM

Here is a schematic for a system that uses a Raspberry Pi, GPS, GSM, camera, and IR sensor to identify woodland animals:

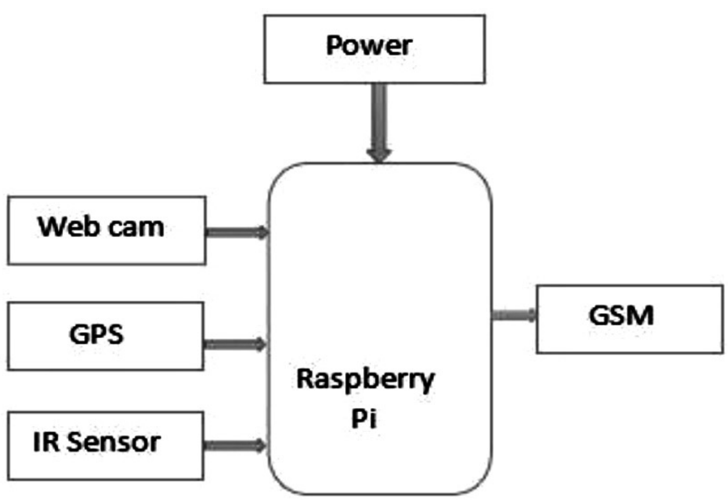

Fig.1 Block Diagram

A. ANIMAL RECOGNITION

To identify animals in the forest, the Raspberry Pi is outfitted with a camera module and an Infrared sensor The device can identify animals in poor light or when they are disguised because the camera takes pictures and the IR sensor picks up the heat signatures of the creatures. The Raspberry Pi's image processing programmer examines the IR data and photos to look for signs of animals.

B. *CAMERA MODULE*

The Raspberry Pi may be equipped with the camera module, a tiny camera, to take pictures and movies. The camera module of the forest animal identification system takes pictures of the forest, which are subsequently examined by the image analysis software to find animals.

C. RASPBERRY PI

The Raspberry Pi is a compact, inexpensive, and capable computer that can be used for a range of tasks such as image processing and machine learning. The Raspberry Pi serves as the main processing unit for the forest animal detection system, capturing and analyzing pictures from the camera module.

D. GPS

The Raspberry Pi's GPS module tracks the device's location inside the forest. To determine exactly where the animal detection was made, this location information is needed.

E. GSM

When an animal is found, alerts are sent to the relevant authorities or people via the GSM module. The notification includes details on the animal's whereabouts, species, and time of discovery.

F. IR SENSOR

The IR sensor detects the heat signatures of forest creatures. This enables the system to detect creatures that are disguised or in low-light settings. To increase animal detection accuracy, the IR sensor data is coupled with picture data obtained by the camera module.

G. INTEGRATION

To build a system that can identify animals in the forest and issue alerts in real time, the Raspberry Pi, GPS, GSM, camera, and IR sensor are all combined. When an animal is found, the Raspberry Pi sends the position information to the GSM module, which subsequently notifies the relevant parties via SMS

H. IMAGE PROCESSING SOFTWARE

The image processing software analyses photos collected by the camera module and detects animals in the forest using machine learning methods such as CNNs. The programmer is trained on a dataset of animal photos and then used to identify animals in real time.

Overall, the forest animal detection system built using Raspberry Pi, GPS, GSM, a camera, and an infrared sensor is a dependable and cost-effective solution for identifying and monitoring wildlife in the forest. To increase the accuracy and efficiency of animal identification and monitoring, the system may be simply connected with other technologies like as drones and acoustic sensor.

IV. HARDWARE REQUIREMENTS

A. POWER SUPPLY

A 5V DC power source with a micro-USB port is required for the Raspberry Pi 3B+ (2017). To guarantee reliable functioning, the power source must be capable of delivering at least 2.5A of current.

B. CAMERA

A webcam is a video camera that transmits live video or images through a computer network, like the Internet. Typically, webcams are tiny cameras that users place on their desks, attach to their monitors, or incorporate into their computers.

C. RASPBERRY PI

A little computer called a Raspberry Pi runs the Linux operating system. It is a little computer that is primarily used to run complex and intelligent programs fast.

Specifications:

1. Processor: Broadcom BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz
2. RAM: 1GB LPDDR2 SDRAM
3. Connectivity: 802.11ac wireless, Bluetooth 4.2, Gigabit Ethernet
4. Storage: MicroSD card slot for loading operating system and data storage
5. Ports: 4 USB 2.0 ports, 1 HDMI port, 1 3.5mm audio jack, 1 CSI camera port, 1 DSI display port, 40 GPIO pins
6. Video & Audio: H.264, MPEG-4 decode (1080p30);
7. H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics; 3.5mm jack, HDMI, Bluetooth, stereo audio over HDMI

D. IR SENSOR

An IR sensor can monitor an object's heat while also spotting movement. These kinds of sensors are referred to as passive IR sensors since they do not produce infrared radiation; instead, they merely measure it.

E. GSM MODULE

A GSM (Global System for Mobile Communications) module is a piece of hardware that enables devices to connect with one another over the GSM cellular network. These are some popular GSM module

Specifications:

1. Power Input 3.4V to 4.5V
2. Operating Frequency EGSM900 and DCS1800
3. Transmitting Power Range2V for E GSM900 and 1W for 4 Data Transfer Link Download: 85.6kbps, Upload:42.8kbps
4. Antenna Support Available

F. GPS

The Global Positioning System (GPS) is a satellite-based system that calculates and measures its position on Earth using ground stations and satellites. Navigation System with Time and Ranging (NAVSTAR)

V. ALGORITHAM AND WORKING

Using computer vision techniques to find animals in the forest, forest animal detection with a Raspberry Pi and GSM methodology with YOLOv3 entails delivering notifications over a GSM network using a Raspberry Pi.

Popular object identification algorithms like the YOLOv3 method employ deep neural networks to find things in pictures and videos. Because it is quick and precise, YOLOv3 is especially well suited for real- time object identification applications.

These are the fundamental steps for applying GSM technique with YOLOv3 on a Raspberry Pi to identify woodland animals:

Gather and tag photographs of forest animals: To train the YOLOv3 algorithm to recognize forest animals, you need a sizable collection of images that includes a variety of forest animals including deer, bears, foxes, and other creatures. To train the algorithm, you must classify the photographs with bounding boxes around the animals.

Train the YOLOv3 algorithm to recognize the animals in the photographs. This may be done after gathering and labelling the dataset. The algorithm may be trained on the labelled dataset using a deep learning framework like TensorFlow or PyTorch.

Attach a camera to the Raspberry Pi: You'll need to attach a camera to the Raspberry Pi in order to identify animals in real-time. A camera module on the Raspberry Pi may be utilized for this.

Use the Raspberry Pi to run the YOLOv3 algorithm: After training the YOLOv3 algorithm, you can use the Raspberry Pi to use the algorithm to identify animals in real-time. The programmed will examine the camera's video feed and identify any animals in each frame.

The Darknet-53 feature maps are used by the detection layers to forecast the bounding boxes and class probabilities for each grid cell. To catch items of various sizes, each detection layer anticipates things at three distinct scales.

NMS (non-maximum suppression): NMS is used to eliminate redundant detections and choose the most precise bounding boxes for each object. It guarantees that Just one detection is produced by the algorithm for each item.

Send alerts through GSM: If an animal is discovered, a Raspberry Pi may be used to send an alarm over a GSM network. A GSM module that is attached to the Raspberry Pi can be used to do this.

Several items can be found in a picture and categorized using the YOLOv3 technique. Anchor boxes, which are predetermined bounding boxes of various sizes and shapes that the algorithm uses to forecast where items will be, help it achieve high accuracy.

A sizable dataset of tagged photos, such as COCO (Common Objects in Context) or VOC, is used to train the YOLOv3 algorithm (Visual Object Classes). A loss function that calculates the difference between the predicted bounding boxes and the ground truth bounding boxes is minimized during the training phase

The YOLOv3 method may be utilized for real-time object recognition in photos and videos once it has been trained. The method produces the bounding boxes and class probabilities of the discovered objects after receiving an input of an image or video frame.

In conclusion, the CNN is used by the YOLOv3 algorithm, a deep learning system, to identify objects in pictures and videos. By utilizing anchor boxes and non-maximum suppression, it achieves great precision. The technique may be utilized for real-time object detection in a variety of applications after being trained on big datasets of tagged photos.

Using a Raspberry Pi, GSM algorithm, and YOLOv3 together to detect forest animals is a potent tool for tracking wildlife in the forest. With the use of this device, forest rangers may immediately respond to possible dangers or emergencies by being able to instantly identify animals and transmit notifications over a GSM network.

VI. DATASET AND DATA TRAINING

A dataset is a grouping of data used in machine learning and statistical research. A dataset in the context of computer vision often comprises a large number of pictures, as well as annotations or labels describing the contents of those images. YOLOv3 is a dataset-trained object identification system that can recognize and find things inside photos. The initial stage in training YOLOv3 on an animal dataset is to collect a large number of photos including animals. These photos should be varied and indicative of the animal types that the algorithm is supposed to detect. After collecting the photographs, they must be tagged or labelled to show the location and class of the animals in the image. Typically, this annotation procedure entails manually drawing bounding boxes around each animal in the image and labelling them to indicate the species of animal. After annotating the dataset, it may be used to train the YOLOv3 algorithm. During training, the algorithm is shown a huge number of photos and their associated annotations. After that, the system learns to detect and locate animals in these photos by modifying its parameters to minimize the discrepancy between its predictions and the ground-truth annotations.

Several rounds are often used in the training process, with the algorithm steadily increasing its performance over time as it is exposed to more and more photos. After training, the resultant model may be used to recognize animals in fresh photos with high accuracy.

A dataset is an important part of machine learning and computer vision. It is a set of data that is used to train and test models. A dataset in the context of computer vision often consists of a large number of pictures, as well as annotations or labels indicating the contents of those images. Depending on the job, these annotations may include item locations, object categories, semantic segmentation masks, or other forms of information.

The first stage in training an animal dataset for YOLOv3 is to acquire a large number of photos including animals. These photos should be varied and indicative of the animal types that the algorithm is supposed to detect. An animal dataset, for example, may comprise photographs of cats, dogs, horses, cows, and so on. After collecting the photographs, they must be tagged or labelled to show the location and class of the animals in the image. This can be a time-consuming operation that may necessitate the assistance of human annotators. Several annotation tools are available to help you speed this process and generate high-quality annotations. After annotating the dataset, it may be used to train the YOLOv3 algorithm. During the training phase, the algorithm is presented with a huge number of photos and their related annotations. The program me then makes adjustments to its parameters in order to reduce the distance between its predictions and the ground-truth annotations. Given how different animals may be in look and behavior, training a YOLOv3 model on an animal dataset can be difficult. The dataset's quality, the animal classes' complexity, and the quantity of training data available will all affect the model's performance. To increase the variety of the training data and strengthen the resilience of the model, it could be required to apply data augmentation techniques such random cropping, flipping, or rotation. It might be difficult yet rewarding to build and train an animal dataset for YOLOv3. It is feasible to develop a model that can precisely recognize and locate animals in photos with the use of a high-quality dataset and careful tweaking of the model's hyperparameters

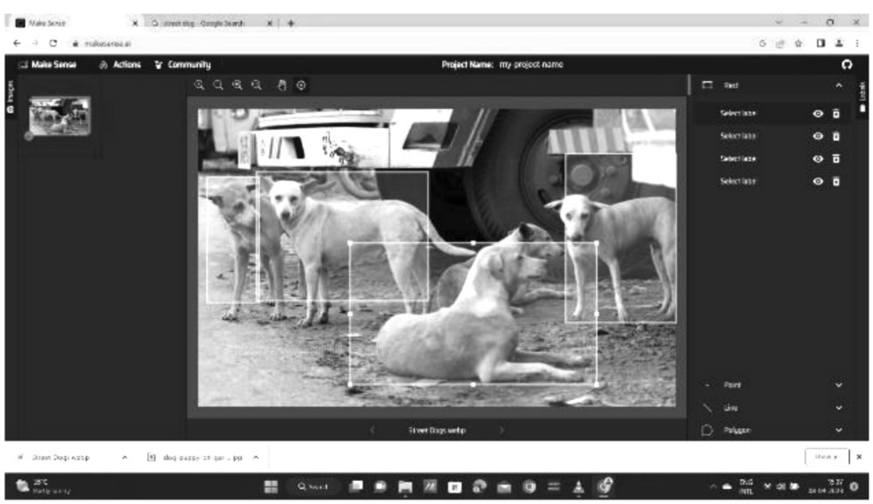

Fig.2 Data Training

VII. AREAS THE PROJECT IS USED

A. CONSERVATION OF WILDLIFE

Species identification, population monitoring, and behavior research may all be done with forest animal detection. For instance, to follow the movements of threatened animals like tigers or elephants and ascertain their migratory patterns and habitat utilization, researchers might utilize animal detection algorithms. These algorithms may also be used to monitor and identify instances of unlawful hunting or poaching, as well as to notify authorities of possible hazards to animal populations.

B. FOREST MANAGEMENT

The detection of forest animals can be used to assess how logging or mining operations affect the fauna and ecosystems of the forest. Forest managers may create more effective management plans that take into account the demands of wildlife populations with the use

C. HUMAN-WILDLIFE CONFLICT PREVENTION

Conflicts between people and animals can be minimized with the use of animal detection. For instance, by warning people when wild animals are around, they may take the necessary precautions to prevent interactions or to save themselves and their property.

D. ECOTOURISM

Wildlife detection may be used to direct visitors to the finest wildlife viewing locations while reducing the animals' disturbance. Animal identification algorithms can be used by tour operators to design itineraries that increase the likelihood of encountering particular species in their native habitats.

E. EDUCATION AND OUTREACH

Animal detection may be used to produce educational content that teaches people about the richness of animal life in forests, such as movies, interactive displays, or internet resources. This may support ethical ecotourism, sustainable forest management techniques, and raising public understanding of the value of conserving species and their ecosystems.

VIII. CONCLUSION

In conclusion, initiatives utilizing YOLOv3 or other object identification algorithms to identify forest animals have the potential to support a number of conservation, management, and educational objectives. These studies can promote sustainable forest management techniques and animal conservation efforts by identifying and monitoring wildlife populations.

IX. RESULT

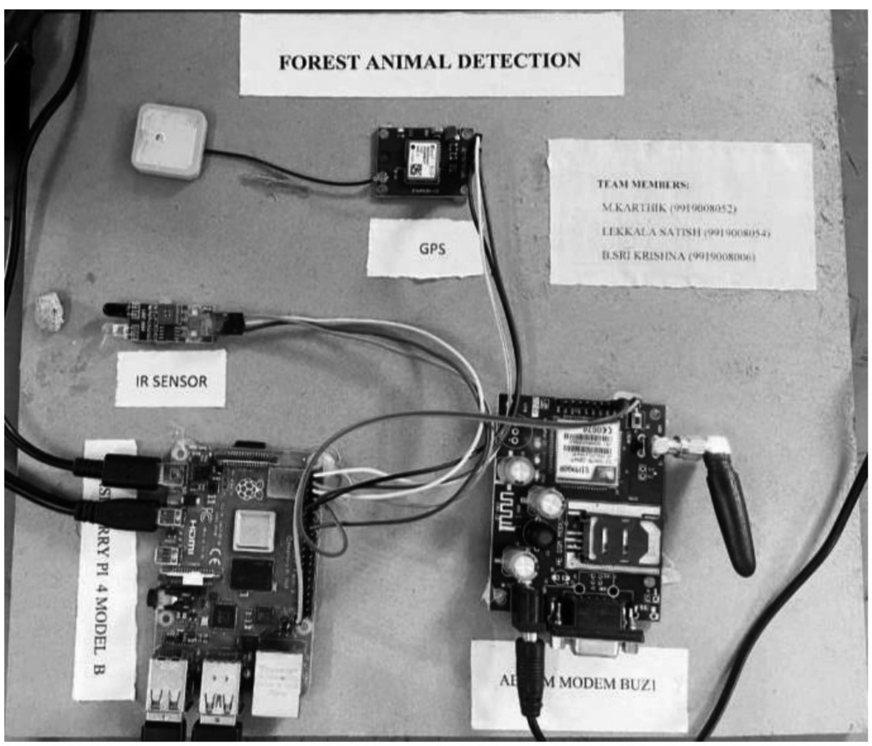

Fig.3 Circuit Board

After successfully running the project we will get sms to the registered mobile number as shown in Fig.4

Fig.4 SMS Sent to Mobile

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