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Animal Detection in Fields Using Image Processing

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ABSTRACT

One of the primary requirements for sustaining a livelihood isagriculture. Low productivity of crops is one of the issues faced by the growers in our country. Crops destroyed by wild creatures is a major issue in low productivity. The agrarian fields must be defended from any undesirable interruption from creatures. In traditional styles, growers use crackers, electrical walls, direct observation etc., to keep creatures down from their fields but it's a threat factor that harms both humans and creatures. Our proposed system detects the presence of creatures using Image Processing and Machine Learning. Every time, crop damaged by wild creatures is dramatically adding in India. It frequently poses pitfalls to humans and creatures. Since further and further wild creatures are causing damage to their civilization; humans couldn't tolerate it. thus, they bear an effective medium to overcome this situation. With that background, the ideal of this study is to descry wild creatures before entering into the crop fields and enforcing applicable dread- down mechanisms in real- time. This paper presents an overview of the methodologies employed in this prototype model , including image segmentation, point birth, and bracket ways. Overall, this study highlights the significance of image processing technologies in advancing our understanding of this model and promoting sustainable relations between humans and wildlife.

Keywords: Smart Farming, Machine Learning, Computer Vision Technique, User Alert and Animal Detection.

INTRODUCTION

Due to deforestation many wild animals have lost their home, hence they attack humans for food. Because more and more cases of animals found in cities are rising. Therefore, it is very essential to trace them in order to make humans secure. There is no such system available yet to locate the wild animals. Because we cannot install any type of tracker on animals. There is no suitable method to inform the people and forest officers. There is no such system for Night Vision. Electric Fence becomes risky at times as it may harm the wild animal. Computer vision can be used in a wide range of areas such as medical nfield, robotics, remote sensing, machine vision, content-based image retrieval. Computer vision resolves numerous problems in various areas. Computer vision also used in the security area to conduct automatic monitoring and access control and attendance management. The computer vision can be used in agriculture sector in various ways such as disease detection of a plant by checking leaves or flowers or fruits and quality control of agri-products. The computer vision techniques can be used in order to give security from wild animals in agriculture. In agriculture fields near to forest areas have a severe threat from wild animals, which attacks regularly on farms. These attacks causing huge damage to agricultural crops subsequently causes significant financial losses to

farmers. Additionally, the prevention system which farmers employed is extremely costly to deploy as well as dangerous to animals and human life, but farmers tend to kill animals in order to save their crops and life. In order to resolve the issue, the system was created that can identify wild animals entering the crop fields through deploying proper scare-away mechanisms in real-time. It will be achieved by informing farmers via a mobile app of the occurrence of wild animals in their fields. The system will minimize human-animal conflict in crop fields to a great extent. In short, this system has been created to reduce damages in the crop field, loss of human life, and destruction of animals. The scare-away mechanism minimizes the injury and death of animals in an environmentally friendly way.

Literature Review

[1]. N. M. Siva Mangai1 proposed a methodology “implementation of elephant recognition in infrared images to reduce the computational time”, c Springer-Verlag GmbH Germany, part of Springer Nature 2018.Object recognition is a challenging task in image processing and computer vision. This paper proposes a clustering-based image segmentation approach for elephant recognition. An appreciable recognition rate was achieved by κ-means clustering technique followed by feature extraction and K nearest neighbor (K-NN) classifier. The κ-means clustering algorithm employs the concept of fitness and belongingness to provide a more adaptive and better clustering process as compared to several conventional algorithms by

[2]. Shuqiang Jiang, Senior Member, IEEE, Class Agnostic Image Common Object Detection”, Int. J. Comput. Vis., vol. 80, no. 3, pp. 300–316, 2008.Learning image similarity is crucial in computer vision with many applications. Traditional methods focus on global feature distance, local feature matching, and image concept comparison. However, detecting class-agnostic common objects between two images, which captures similarities at a region

level, has not been explored. This paper introduces an end-to-end Image Common Object Detection Network (CODN) for this purpose. CODN has two main modules: a locating module that generates candidate proposals for each image.

[3]. Balch T, Dellaert F, “multi-robot systems research will accelerate our understanding of social animal behavior”, Proc IEEE 94:1445–1463 Our understanding of social insect behavior has significantly influenced artificial intelligence (AI) and multi-robot systems’ research (e.g., ant algorithms and swarm robotics). In this work, however, we focus on the opposite question: How can multirobot systems research contribute to the understanding of social animal behavior? [As we show, we can contribute at several levels. First, using algorithms that originated in the robotics community, we can track animals under observation to provide essential quantitative data for animal behavior research. Second, by developing and applying algorithms originating in speech recognition and computer vision, we can automatically label the behavior of animals under observation.

[4]. Xiaoyu Zhang1 “Complex image recognition algorithm based on immune random forest model”, Springer-Verlag GmbH Germany, part of Springer Nature 2020Y.Advancements in technology have made social networks a key part of daily life, with a surge in image sharing through mobile platforms. This shift is replacing text-based communication with images. In modern warfare, systems like air defense rely on computers to quickly process image data and classify targets. This paper introduces an image recognition algorithm using an immune random forest model, showing high efficiency and robustness.

[5]. Willi, M. et al. (2019) ‘Identifying animal species in camera trap images using deep learning and citizen science’, Methods in Ecology and Evolution, 10(1), pp. 80–91. doi: 10.1111/2041210X.13099. Ecologists use camera traps to study wildlife, generating large datasets that are hard to analyze manually. To address this, they enlist citizen scientists to help classify images. However, as the number of studies grows, it's challenging to find enough volunteers. Advances in deep learning, like convolutional neural networks (CNNs), enable automatic image classification, reducing human effort. This study assessed the accuracy of CNNs in classifying animal images, especially with smaller datasets, and applied these models to an online citizen science project. Using CNNs and transfer learning improved accuracy and reduced manual work by 43%, speeding up the data processing for large studies.

AUTHOR & YEAR	**PROPSED WORK**	**ANIMAL DETECTED**	**METHODOLOGY USED**	**FEATURES &ACCURACY**
N. M. Siva Mangai1& 2018	implementation of elephant recognition in infrared images to reduce the computational time	Elephant	clustering-based image segmentation – ‘k means’	98%
Shuqiang Jiang & 2008	Class Agnostic Image Common Object Detection	Horse	CODN (Common Object Detection Network)	80%
Balch T & 2015	multi-robot systems research	Social insect like ant	social insect behavior has significantly influenced artificial intelligence (AI) and multi-robot systems research	95%
Xiaoyu Zhang1 & 2020	Complex image recognition algorithm based on immune random forest model	Giraffe	image recognition algorithm using an immune random forest model, showing high efficiency and robustness	97%
Willi, M & 2019	Identifying animal species in camera trap images using deep learning and citizen science	Cow	convolutional neural networks (CNNs), enable automatic image classification, reducing human effort	86%

2. METHODOLOGY

2.1. Image Acquisition:

The first step is capturing images or videos from a camera or other imaging devices. The quality of the input image affects the accuracy of the detection. Install multiple cameras at strategic locations around the farm to capture images of various animals in different environments (e.g., farms,barns). Use high-resolution cameras for better image clarity.

Capture images across different times of the day and varying weather conditions to ensure diverse data. This will help the model generalize better with changes in lighting and background.

Figure 1. Bear and sheep image representation.

Preprocessing:

Resizing: Images may be resized to a consistent resolution to reduce computational load.

2.1.1. Image capturing:

Camera: Various cameras are used during the study such as DSLRs, trail cameras, and drones as per the requirements of the field and the nature of animal activities.

Sensors: Infrared or thermal cameras might be used for night active animals' detection or at low light.

Deployment: Fixed vs. Moving: Cameras can be fixed (located at pre-arranged locations) or on moving platforms such as drones to capture larger areas.

Timing and Triggering: An automatic system may obtain an image based on motion detection, a time interval, or even changes in lighting.

Environmental Considerations:

Lighting: The arrangement thoughtfully considers the different natural light conditions that can occur throughout the day, thereby ensuring that the image quality remains at its best possible level.

Cameras must be weatherproofed or placed in a way that minimizes exposure to less-than-optimal weather conditions such as the rain or direct sunlight.

Data Collection and Recording:

The continuous process of capturing images or videos makes it possible to thoroughly and effectively observe most wildlife activities. They prefer very high-resolution images to work with to get better details in the subsequent analysis.

The processes involved in Storage and Transfer: The captured images can be stored on memory cards. They are portable storage devices, or they can be transmitted to a remote server that has been especially designated for processing purposes. In doing so, the images are easily accessible for subsequent analysis and evaluation**.**

2.1.2 Preprocessing:

Reduction of Noise

Filtering: A variety of methods, such as Gaussian and median filters, are utilized to minimize the inherent noise existing in images. This process enhances image clarity and diminishes artifacts that could interfere with precise detection.

Image Enhancement:

Contrast Enhancement: Various techniques are employed to enhance the contrast within images, effectively making animals identifiable and distinct from their surroundings. Brightness Correction: Adjustments are typically made to ensure images are sufficiently bright, particularly in low-light situations where capturing clear images can be challenging.

Normalization: Uniform Scaling: Images may be resized uniformly, ensuring that all images throughout the dataset maintain a consistent size. This consistency is crucial as it lays the groundwork for effective and precise subsequent processing.

Color Space Transformation

Images are often converted to different color spaces, such as grayscale or HSV, depending on the type of analysis or processing needed. This transformation facilitates both segmentation and feature extraction.

Geometric Translations

Rotation and Scaling: It may be necessary to rotate or scale images for proper alignment. This step is vital for ensuring that images are correctly positioned and considers aspect ratios, which is critical for accurately representing animal features.

Background Removal: The techniques applied focus on isolating animals from their backgrounds. This separation aids in simplifying segmentation and analysis methods. It is essential for ensuring a clearer distinction between animals and their surrounding environments.

2.1.3 Object detection:

This phase is vital for distinguishing animals from their surroundings by employing methods like thresholding, edge detection, or techniques centered on regions. The aim is to accentuate the shapes of animals distinctly so that each one can be swiftly recognized in the images.

Machine Learning Models:

Classification Algorithms: Convolutional Neural Networks, known as CNNs, are developed using annotated datasets that feature various animal species to effectively identify and differentiate between them. During this training, these complex models learn to recognize identities and discern intricate patterns and traits distinct to individual species.

Object Detection Frameworks: Sophisticated object detection systems like YOLO (You Only Look Once) and Faster R-CNN are utilized to simultaneously identify an object and categorize it in real-time.

Definition of the Bounding Box:

Detected animals are typically enclosed by bounding boxes that accurately show their exact position within the examined image. This visual representation assists in recognizing the existence of animals and measuring both their numbers and distribution in the environment.

In sequences of video frames, various behaviors have been recognized, tracking animals with remarkable precision across multiple frames to analyze their movement patterns and behavioral inclinations. To effectively monitor these animals during video analysis, advanced approaches such as Kalman filters or methods based on optical flow are typically employed.

Output Visualization: The analysis results are often showcased visually with bounding boxes and associated labels overlaid directly on the original images. This provides a clear visual presentation of each distinct animal detected within those images.

2.1.4 Feature Extraction:

To identify animals, the system gathers essential attributes from images, focusing on aspects like shape and color. The shape characteristics, found through contour detection methods, assist in recognizing the distinct contours of various animals, while the color attributes come into play when animals show unique color patterns. The features collected are utilized to train machine learning models that can accurately classify and identify different species. By utilizing these attributes, the system improves its detection precision, increasing its effectiveness in recognizing and reacting to animals in real-time, which minimizes false positives and guarantees proper responses are implemented.

The metrics of color histograms and moments are meticulously calculated to define the color distribution found within the animal. This methodical approach proves helpful in distinguishing various species, particularly those that exhibit specific and unique coloration patterns, aiding in their differentiation from one another.

Texture Features:

Methods for analyzing texture, such as Local Binary Patterns and Gabor filters, play a significant role in measuring and examining surface textures. This quantification is crucial because certain animals might share similar color shades but have vastly different fur or skin textures.

Spatial Features:

Conversely, various features are assessed spatially to grasp the context of the animal's habitat and its surroundings. Some elements examined include how close the animal is to others nearby and the types of vegetation that may be found in its locality among other factors.

Dimensionality Reduction: Techniques like PCA, or Principal Component Analysis, can also be applied to effectively minimize the dimensionality of the feature space. This process ensures that the most significant features are retained, ultimately leading to quicker processing times and enhancing the accuracy of the results generated from classification processes.

2.1.5 Classification:

Following the identification of features, the system categorizes objects within the image to ascertain if they are wildlife, utilizing machine learning techniques to specify the kind of animal. This classification phase guarantees that the system not only recognizes animals but also differentiates among various species. The integration of feature identification and machine learning amplifies the system's capability to initiate suitable reactions, such as activating deterrents, significantly improving its efficacy in reducing human-wildlife encounters.

Feature Representation:

Upon deriving the important features from images, such as shape, color, and texture, these characteristics are then formatted for analysis. Typically, this is done by converting them into numerical vectors that can be examined and further processed.

Training Dataset:

For a machine learning model to be trained successfully, there is a necessity for a well-annotated dataset comprising a variety of images featuring multiple animal species. Each image in this dataset carries a specific species label, serving as essential examples for the model to understand and recognize while learning. Some of these include algorithms for machine learning.

Traditional Methods: Classification can be performed using techniques like Support Vector Machines, Decision Trees, and k-Nearest Neighbors, all of which rely on features extracted from the data. Deep Learning: Among contemporary and advanced approaches, Convolutional Neural Networks, commonly referred to as CNNs, stand out. These networks possess the capacity to learn raw hierarchical representations of features directly from unprocessed image data. This innovative learning approach ultimately enhances classification precision and boosts performance across various applications.

2.1.6 Post processing:

Result Filtering**:** IP systems have the capability to identify animals that may endanger agricultural plants, allowing farmers to take specific actions to safeguard their harvests. This innovation minimizes reliance on chemical repellents, encouraging eco-friendly methods.

Noise reduction: All false positives and irrelevant detections are filtered out by applying some criteria, such as evaluating the confidence scores or specific thresholds of size. It therefore postulates that the outcome will contain only valid detections left, thus improving the general accuracy and reliability of the results.

Refine Bounding Box:Well, the bounding boxes that surround the animals that have already been detected can surely be adjusted so that these bounding boxes meet the requirements and even encapsulate the whole animal. Such an improvement not only makes for better visualization of the animals but also contributes a lot to better data analysis in general.

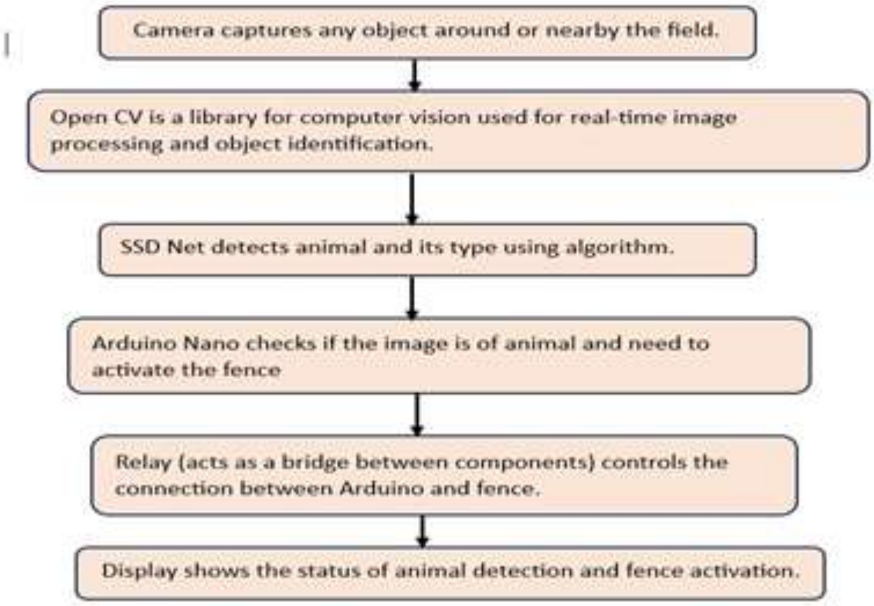
Monitoring: In video stream contexts, where detection is believed to occur, different algorithms including Kalman filters are used to successfully track animals as they change frames. These allow for the continuous observation and analysis of their movement patterns and behavioral traits over time.

Temporal Analysis: For collections of pictures or moving images, time-related patterns can be examined to understand animal actions, movement patterns, and relationships throughout a period.

Data Aggregation:Detections can be accumulated so that statistic sums could be calculated with respect to animal counts, species diversity, and habitat use, thereby providing information for ecological studies and conservation planning.

Visualization: The initial pictures or charts may be enhanced with intricate classifications of animals identified, creating visually striking and vibrant depictions that are highly beneficial to scientists and others engaged in the research.

Reporting: Findings can be meticulously compiled into thorough reports or engaging dashboards. This aids in the summarization of varied outcomes while delivering crucial insights into the dynamics and behavior of animal populations. Such information can also assist in additional analysis or more informed choices.



Flowchart 1. Representation of the project

3. Objectives:

1.Species Identification and Classification:

To accurately identify and classify different species in images or videos, enabling researchers to track biodiversity and study specific species or groups of animals.

2. Preventing Human-Animal Conflict:

To detect and track animals (e.g., large predators or crop-raiding animals) near human settlements or farms, providing real-time alerts to prevent conflicts and damage.

3.Data Collection for Ecological Studies:

To collect large-scale, high-quality data on animal populations, behavior, and habitat use, providing valuable information for ecological and conservation studies.

4.Automated wildlife monitoring: This approach leverages various technologies to collect large amounts of data in real-time, allowing for better conservation efforts, species protection, and understanding of wildlife behavior and ecology providing the theoretical framework and empirical evidence necessary for the development of new technologies and solutions to real-world problems. From ground-breaking discoveries in medicine and engineering to insights into human behavior and social dynamics, research papers continue to shape the trajectory of human progress and knowledge.

4. Results:

The Python programming languageis utilized for identifying wild animals. We have implemented the TensorFlow library for detection and also incorporated the Google Vision library. This system employs a camera as a security measure to capture photographs when an object is identified, which will assist in the processes of object detection and recognition. The experimental arrangement encompasses a farm equipped with an LED fence linked to an Arduino. The system proficiently identifies animals from the series of images taken by field cameras. It effectively categorizes animals into varied species through the use of image processing techniques and machine learning approaches.

Enhanced Prevention of Human-Wildlife Conflicts: Findings indicate that the system aids in reducing conflicts by recognizing animals close to agricultural areas and providing prompt notifications to farmers or relevant authorities .

The Electric Fence averts potential crop loss: The Electric Fence delivers mild electric shocks to animals in order to deter them from the fields.

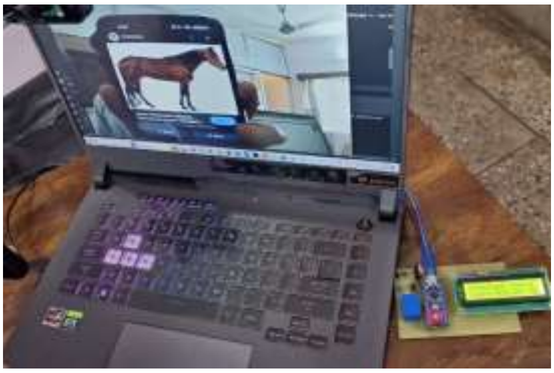


Fig. Horse detected

Fig. Message displayed

Fig. Cow detected

5. Discussion:

Animal identification through image processing holds significant promise across different sectors, but it also brings about challenges and factors worth considering.

1. **Progress in Technology**

Recent developments in machine learning, particularly with convolutional neural networks, have significantly improved the precision of systems designed for animal detection. These networks are exceptionally skilled at recognizing patterns and features in images, facilitating accurate real-time species identification. Additionally, having extensive datasets for training enhances these models' capabilities, increasing their dependability for detection in diverse environments.

2. Applications and Benefits:

The applications of IP in animal detection are wide-ranging:

- **Wildlife Conservation**: Automated monitoring systems help track endangered species and gather data on their behaviours and habitats without human interference. This data is crucial for developing effective conservation strategies.
- **AgricultureIP:** Systems have the capability to identify animals that may endanger agricultural plants, allowing farmers to take specific actions to safeguard their harvests. This innovation minimizes reliance on chemical repellents, encouraging eco-friendly methods..

- **Urban Planning**: Understanding animal movement patterns in urban areas helps planners design infrastructure that minimizes human-wildlife conflicts, contributing to more sustainable urban environments.

3. Challenges and Limitations

Despite its advantages, there are challenges in deploying IP for animal detection:

- **Environmental Variability**: Variations in lighting, weather conditions, and habitat types can affect image quality and detection accuracy. Developing robust models that can adapt to these changes remains a challenge.
- **Species Diversity**: Different species exhibit diverse behaviours, sizes, and appearances, complicating detection. Fine-tuning models for specific species or groups often requires significant effort and data.
- **False Positives and Negatives**: Ensuring high precision and recall is essential, as false detections can lead to misinterpretation of data, while missed detections can undermine conservation efforts.

4. Ethical Considerations

The use of IP in wildlife monitoring raises ethical questions, particularly regarding privacy and the impact of surveillance on animal behaviour. Continuous monitoring can alter natural behaviours, leading to potential stress for the animals involved.

6. Conclusion:

The problem of yield destroying by wildlife has become a serious social problem in the present era. It needs urgent attention and a strong setup. Therefore this project carries an immense social value because it intends to solve this problem. Detection of animals in the field based on image processing is a serious development in wildlife monitoring, wildlife conservation and ecological studies. Through the use of current technologies like AI, machine learning, and computer vision, this method automates and improves upon the capabilities to detect, identify, and follow animals in their natural habitats. It cuts down on the amount of manual observation required, offers real-time surveillance, and allows for large-scale data collection on animal behavior, population patterns, and ecosystems health. As technology advances, it will play a more important role in safeguarding endangered species , avoiding human-wildlife conflicts, and enhancing our knowledge of wildlife. The potential of the project to integrate with image processing, real-time tracking prevents any crop loss in the farms and also safeguards livestock. Global conservation activities make it an essential tool for future ecological and conservation projects. We have introduced an intelligent farmland system for wild animal detection and recognition. Accurate and efficient object detection has been a significant area of focus in the development of computer vision systems. With the introduction of deep learning methods, precision for object as well as animal detection has grown exponentially.

The project focuses on incorporating advance methods for animal detection and alerting for crop protection with an aim of attaining high accuracy in a real-time performance. Apart from overcoming the limitations of the conventional system this computer vision-based system will offer additional efficiency. The resulting system is quick and accurate, thereby supporting all those applications that need animal detection.

Experiment arrangement includes farms with LED fence on Arduino. The fence is charged, when a wild animal reaches near the fence, the alarm is triggered and photo is taken. For wild animal identification, Python is utilized. We have utilized google vision library.

Acknowledgement

We want to acknowledge my sincere gratitude to everyone who helped and participated in the successful fulfillment of this study on Animal Detection Using Image Processing.

First and foremost, we are deeply thankful to my supervisor, Dr. Amar Kumar Dey, for their constant support, insightful suggestions, and encouragement during this research. Their feedback and expertise were instrumental in determining the direction of the research and improving the analysis.

We would also like to take this opportunity to extend my gratitude to Bhilai Institute of Technology Durg, for granting the requisite facilities and resources that allowed me to conduct this research work. The provision of sophisticated computing resources and support services has played a key role in performing the required experiments and analysis for this study.

Special thanks are given to the local community and farmers who gave us important information and comments on the field-level issues of wild animal detection in farms. Their comments and experiences played a vital role in making sure that this research was tackling real-world problems and making practical contributions.

References

[1]. N. M. Siva Mangai1 · P. Karthigaikumar2 · Shilu Tresa Vinod1 · D. Abraham Chandy1, “implementation of elephant recognition in infrared images to reduce the computational time”, c Springer-Verlag GmbH Germany, part of Springer Nature 2018.

[2]. Chandana H C [1], Amruth [1], Akash P S [1], Shilpa K Allurkar[1] Bharath H P[2] ,“Vision Based Animal Detection and Alerting For Crop Protection”,2International Journal of Scientific Research and Review ISSN No.: 2279-543X, Volume 07, Issue 03, March 2019.

[3]. Balch T, Dellaert F, Feldman A, Guillory A, Isbell C, Khan Z, Pratt S, Stein A, Wilde H “multi-robot systems research will accelerate our understanding of social animal behaviour”, Proc IEEE 94:1445–1463.

4]. Xiaoyu Zhang1 • Wei Huang2 • Xiao Lin2,3 • Linhua Jiang2 • Yan Wu4 • Chunxue Wu2, ‘Complex image recognition algorithm based on immune random forest model”, Springer-Verlag GmbH Germany, part of Springer Nature 2020Y.

[5]. Shuqiang Jiang, Senior Member, IEEE, Sisi Liang, Chengpeng Chen, Yaohui Zhu, Xiangyang Li“Class Agnostic Image Common Object Detection ”, Int. J. Comput. Vis., vol. 80, no. 3, pp. 300–316, 2008.

[6]. S. Gould, J. Rodgers, D. Cohen, G. Elidan, and D. Koller,““Multi-class segmentation with relative location prior”, Int. J. Comput. Vis., vol. 80, no. 3, pp. 300–316, 2008.

[7] Willi, M. et al. (2019) ‘Identifying animal species in camera trap images using deep learning and citizen science’, Methods in Ecology and Evolution, 10(1), pp.

[8]. N. M. Siva Mangai1 · P. Karthigaikumar2 · Shilu Tresa Vinod1 · D. Abraham Chandy1, “implementation of elephant recognition in infrared images to reduce the computational time”, c Springer-Verlag GmbH Germany, part of Springer Nature 2018.

[9]. Balch T, Dellaert F, Feldman A, Guillory A, Isbell C, Khan Z, Pratt S, Stein A, Wilde H “multi-robot systems research will accelerate our understanding of social animal behaviour”, Proc IEEE 94:1445–

[10]. Shuqiang Jiang, Senior Member, IEEE, Sis Liang, Chengpeng Chen, Yaohui Zhu, Xiangyang Li“Class Agnostic Image Common Object Detection ”, Int. J. Comput. Vis., vol. 80, no. 3, pp. 300–316, 2008.

[11]. Willi, M. et al. (2019) ‘Identifying animal species in camera trap images using deep learning and citizen science’, Methods in Ecology and Evolution, 10(1), pp. 80–91. doi: 10.1111/2041210X.13099